



University of Hradec Králové  
Faculty of Informatics and Management

# Hradec Economic Days



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proceedings of the international scientific conference  
Hradec Economic Days 2020

April 2–3, 2020

Hradec Králové, Czech Republic



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## Preface

Ladies and gentlemen, dear colleagues,  
the Hradec Economic Days conference has been traditionally and continuously held since 2003. University of Hradec Králové organized the 18th Hradec Economic Days conference in cooperation with the Wrocław University of Economics, the Cracow University of Economics and the Office of Transfer of Technologies at the University of South Bohemia. The conference was held from April 2 to April 3, 2020. It aimed to promote the idea of communication and cooperation of scientists from various fields with practitioners. The conference was in 2020 subtitled "Innovations and upcoming challenges of developed and developing economies". This year conference scopes were to address following fundamental issues of:

- new trends in the economy and its impacts on globalization,
- social, legal and educational challenges of contemporary economics
- economic growth and employment,
- effective methodologies for the integration of physical, informational, and financial flows,
- innovative approaches to the management of operational processes,
- financial innovations and focus on the consumer,
- sectoral and intra-sectoral changes: energy sector, tourism, agribusiness, ICT sector, health economics, social entrepreneurship,
- quantitative methods in economics and management.

Hradec Economic days conference has undergone dynamic development since the first year in both quality and quantity. The program committee also undergone fundamental change as well in favor of a substantial increase in the spectrum of international academicians from the USA, China, Malaysia, Spain, Croatia, Slovakia, Romania, Poland, and the Czech Republic. In 2019 we again cooperated with the MDPI publishing and two of their journals indexed in the Emerging Sources Citation Index (ESCI). The highest quality papers are to be revised for a possible inclusion in the special issue of Sustainability, Economics and Social Sciences open access journal published by MDPI. For the first time we also cooperate with Acta Informatica Pragensia Peer-reviewed journal on social and business aspects of informatics.

All submitted papers undergone careful selection and were reviewed by 2-3 reviewers. We selected the best 101 papers in English that were published in two proceedings volumes. Authors of the conference papers are scientists and practitioners from the Czech Republic, Slovakia, Poland, China, Japan, Malaysia, Croatia, Russia, Ireland, Bulgaria.

I am very pleased we succeeded in indexation of the 2019 proceedings, and I firmly believe that the changes the conference has undergone will contribute to regular indexation also in the future.

Despite the fact that HED2020 conference had to face organizational changes due to a COVID-19 epidemic, we managed to further develop the professional format of outputs. HED2020 articles were assigned DOI and retrospectively were DOI assigned to HED2019 proceedings as well. Except for obvious evolution in database Thomson Reuters, proceedings were assigned ISSN and will be sent to the Scopus database for evaluation.

I want to thank all who participated in organizing the conference: thank you for your high-quality work. My thanks also go to the authors for their trust and support, and I am looking forward to seeing you again at HED2021.

Hradec Kralove, March 22, 2020



Assoc. Prof. Petra Marešová  
General Chairman of Hradec Economic Days  
Faculty of Informatics and Management  
University of Hradec Kralove



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# Impact of Organizational Culture on Project Portfolio Management

Matilda ALEXANDROVA

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**Abstract:** The paper considers an up-to-date issue in project management, namely the impact of organizational culture on the project portfolio management (PPM) effectiveness in contemporary project-oriented organizations. PPM has expanded in the practices of modern project management, however, the role of organizational culture has not been comprehensively explored especially in the transition economies of South Eastern Europe. It is known that PPM success is effectively aligned with the organizational strategy, so the paper provides a short review of the theoretical grounds in respect of the relation between organizational culture and PPM. It is expected that the organizational culture of project-oriented organizations plays a key role for the effectiveness of PPM. The paper also presents a selection of results from a questionnaire survey of PPM practices in over 180 Bulgarian project-oriented organizations where several aspects of PPM effectiveness have been explored in relation with particular dimensions of the organizational culture. Conclusion are derived regarding the establishment of specific organizational culture that is supportive for PPM and its core functions.

**Keywords:** organizational culture; project-oriented organization; project portfolio; project portfolio management

**JEL Classification:** O22; M10

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## 1. Introduction

Project based activities and processes have been growing worldwide along with the expansion of project, program, and portfolio management practices in the last decades. This contemporary managerial approach proved to be effective for enhancing business organizations' competitiveness especially when project-based funding has been extensively utilized by the organizations. Such processes facilitated a sustainable transformation towards project-oriented structures and cultures at these organizations. However, in many organizations even a limited number of projects are difficult to execute due to weak and unfavorable culture for implementing appropriate project methodologies and decision-making style. This way, inefficient resource allocation, lack of project prioritization, and mismatches with corporate strategy have been frequently identified in project portfolio management practices.

The focus of the current study is on the impact of organizational culture on the project portfolio management (PPM) effectiveness. In general, the interrelations between organizational culture and PPM effectiveness/success have been rarely studied empirically. Nonetheless, research interest has been devoted to a variety of issues related to the type of organizational culture that is appropriate for a successful project management (Patanakul and Aronson 2012).

Modern business environment requires project and portfolio managers to demonstrate leadership and managerial competencies supporting the development of strong project-oriented organizational culture that provides a fundament for a successful implementation of PPM practices. These competences are oriented to an optimal and effective utilization of organizational resources, with a priority on human capital and talent management. This way, it is expected from project portfolio managers to be aware of strategy implementation, balancing, and providing synergies by execution of the complex of projects in the organizational portfolio. This cannot be achieved without developing a favorable organizational culture that supports team working, creativity, and innovation.

The aim of this paper is to provide insights on the impact of organizational culture on the effectiveness of project portfolio management. A special focus is put on a long-term perspective as far as PPM effectiveness is indicated by three dimensions of the strategic alignment of project portfolio. The first one relates to the achievement of strategic goals of the organization through selection and realization of targeted projects. The second one is focused on the strategic resource allocation by projects in the portfolio. The third one is measured by the degree of achieving sustainability of financial results from the executed projects. These dimensions reflect the degree of coordination of project selection, evaluation, prioritization, execution, monitoring, and control within an operational system of PPM. Here we assume that the effectiveness of PPM is directly related to a better alignment of projects in the portfolio with the organizational strategy.

The operation of organizations that have adopted the PPM approach depends on the existence of supportive organizational culture, however, it affects PPM processes in a concealed way. In the same time, the specifics of the organizational culture define a unique work environment with a distinct character. Ultimately, the cultural dimension could facilitate or obstruct the effective operation of any organization, and specifically, project-oriented organizations. The paper presents some results from a questionnaire study of PPM effectiveness in 184 Bulgarian project-oriented organizations where several indicators have been experimentally measured. The interrelations between these indicators and a selection of cultural dimensions have been particularly explored.

## **2. Literature Review**

The specialized literature on project management underlines the expanding implementation of PPM approach in organizations that execute a complex of projects and its importance for the achievement of synergies and strategic goals. Along with this, some studies have focused on the influence of organizational culture on project outcomes (Shore 2008). Still, rarely the research findings are supported by empirical arguments considering the interrelation between organizational culture and PPM processes, practices, and success.

PPM as a managerial approach is based on the selection, prioritization, balancing, and control over the execution of multiple projects in a project-based organization. Typically, the goals of the selected projects are aligned with the organizational strategy and reflect the perspectives of organizational development. Within the current study, we adopt a definition of PPM as coordinated management of a portfolio of projects oriented to the achievement of the strategic objectives of the organization (PMI 2017). PPM provides numerous opportunities to the organizational leadership for implementing flexible decision making in a dynamic and turbulent environment. Moreover, it facilitates the organization to become more adaptive to the uncertainty of the ever-changing business environment (Jerbrant and Gustavsson 2013). Many benefits are identified regarding the utilization of PPM, however, still the effective implementation of this approach is a challenge to managers (Patanakul 2015).

PPM outperforms the traditional framework and mechanisms of project management due to the substantial changes required for an effective implementation of portfolio structures leading to complex synergetic effects on organizational performance. It is generally accepted that the aims of PPM are oriented to: (i) finding the right balance within the project portfolio, (ii) aligning the portfolio to the organizational strategy, and (iii) maximization of the overall value of the project portfolio (De Reyck et al. 2005). In a multi-project environment this approach contributes to the enhancement of competitiveness by maximizing the value added by separate projects along with minimizing the costs and risks associated to their execution. This way, PPM has proved to be a source of competitive advantage for the implementing organizations as well as a powerful tool for achievement of strategic goals (Alexandrova 2017).

The issue of resource allocation by simultaneously executed projects, from the practice point of view, is important to be considered within the implementation of PPM, especially, by appropriate scheduling and planning. Some authors recommend a focus on special management policies, e.g. "horse trading, interpretation, and sense making" that suggest a complex approach compared to the traditional project management methods (Engwall and Jerbrant 2003). In this respect, applied

research in project management has identified needs for additional empirical studies devoted to various organizational problems related to PPM implementation (Blomquist and Muller 2006).

Specialized literature reveals a consensus about the significant impact of culture on the organizational performance in two dimensions: effectiveness and financial performance (Booth and Hamer 2009). Some studies discuss the interrelation between strategy, culture, and performance which induce the competitive advantages of companies (Hogan and Coote 2014). Project management by itself is considered as a specific sub-culture in the framework of an established organizational culture. It assumes, among others, particular principles and practices, norms and ethical standards, emphasis on team working, effective communications, transparency, regular reporting, monitoring, and control. In order to support PPM implementation some organizations develop a project management office (PMO) as an organizational unit that provides conditions for successful simultaneous execution of projects in the portfolio aligned to the organizational strategy (Banister-Hazama and Hazama 2014).

Organizational culture can be studied by various standpoints and is defined in different ways. A classical definition of culture is given by G. Hofstede as “the collective programming of the minds” of individuals by which “one group distinguishes itself from other groups” (Hofstede 2003). In respect of the organizational culture some authors emphasize on “enduring beliefs, values and assumptions” that differentiate the members of the organization, and the organization itself from others (Cameron and Ettington 1988). Organizational culture can also be described by the mechanisms through which the “organization does things” on the basis of common norms, beliefs, and shared values. In this respect, it is closely related to the organizational structure and control system which facilitate the compliance with these norms, values, and behavior within the organization (Dess et al. 2007). Having this in mind, it should be noted that the measurement of different dimensions of organizational culture is complicated due to its intangible character, e.g. collective assumptions, shared values, etc.

Associating organizational culture with processes within a project-oriented organization generates an environment that can facilitate the successful execution of the projects as well as achieving significant organizational benefits. A better understanding of this association can reveal options for transformation of the organizational culture towards a more supportive one regarding the effective leadership and project team’s management. The specialized literature on project management mostly emphasizes on the role of organizational culture for the success of projects execution. Indeed, although many organizations expand their project activities, a particular weakness is their cultural deficiency (Palmer 2002). This way, promoting a project-oriented culture appears to be an important task that requires targeted support from the top management.

Some studies consider the organizational culture at project portfolio level focuses on resource allocation, portfolio optimization, and strategic alignment. The simultaneous execution of projects in a portfolio as well as the necessity of coordinating different project teams generate substantial complexities and require a novel project-oriented culture. Organizational culture reflects the strategic focus and orientation, this way leading to increased complexity of PPM (Martinsuo and Killen 2014). Some authors consider the contextual features of the cultural influences on project work as somehow ignored (Hanisch and Wald 2012).

Nevertheless, the study of factors influencing the PPM success has attracted interest recently (Alexandrova 2018). Special attention is put on the organizational culture as integrated into the strategic focus regarding the PPM implementation. This integration is considered in two aspects: internal and external (Unger et al. 2012). Although the existing studies are limited in exploring the range of cultural issues concerning project and portfolio management, some research reveals how the organizational culture – as well as the national culture – induces contextual effects on the way organizations execute the projects in their portfolios (Unger et al. 2014).

### 3. Methodology

#### 3.1. Data Source

The empirical analysis in the current study is based on data collected by a questionnaire survey conducted in the period 2017-2018 among representatives of 184 project-oriented organizations that operate in Bulgaria. Since there is no specific register or other kind of statistical frame to facilitate a random drawing, the respondents have been selected by a purposive sampling scheme. A specific questionnaire has been developed and sent to 200 respondents (project management experts, project managers, project portfolio managers, and representatives of the top management boards). The method of individual self-interview has been applied by participation in online survey or by submitting a filled questionnaire by email. Appropriate respondents have been reached through the channels of professional networks (LinkedIn; Bulgarian Association for Project Management). All respondents have professional duties and competences in the area of project management performed in a multi-project environment. Moreover, some of them have a key role in the management of a project portfolio operated by the respective organization. Due to substantial non-response 16 questionnaires are excluded from data processing and analysis.

#### 3.2. Survey Instrument

In order to provide empirical measurement for the organizational culture and PPM effectiveness the questionnaire instrument suggests formulations of two groups of items. Each item uses an ordinal scale with ranks 1 to 5 for evaluation of the respective feature. The questionnaire instrument has been developed specifically for the goals of the empirical study of PPM practices, factors, and effectiveness.

**Table 1.** Dimensions of organizational culture.

<b>In what extent each of the following element / statement is valid for your organization?</b>	<b>Not at all</b>	<b>Rather No</b>	<b>Neither Yes nor No</b>	<b>Rather Yes</b>	<b>Certainly Yes</b>
Flexible and adaptive managerial style	1	2	3	4	5
Effective project communications	1	2	3	4	5
Team-working and trust between project team members	1	2	3	4	5
Creativity and innovation stimulating atmosphere	1	2	3	4	5
Turnover and low motivation	1	2	3	4	5

**Table 2.** Aspects of PPM effectiveness.

<b>In what extent do you agree with each of the following statements about your organization?</b>	<b>Likert Scale</b>				
	<b>1- Fully disagree</b>				<b>5- Fully agree</b>
Project portfolio is aimed in achieving sustainable financial results	1	2	3	4	5
Projects in the portfolio have goals that fully match the strategic goals of the organization	1	2	3	4	5
Resources allocation by projects is subjected to the strategic priorities of the organization	1	2	3	4	5

The first set of items requires the respondents to evaluate the extent to which a statement is valid regarding particular dimension of the culture at her/his organization (Table 1). The second one invites the respondents to express her/his opinion about the extent to which a particular aspect of PPM effectiveness is achieved at her/his organization (Table 2).

The primary data collected by the questionnaire survey has been processed and analyzed by descriptive statistical methods as well as Spearman rank correlation method.

## 4. Results

### 4.1. Profile of Respondents

A variety of personal attributes, both demographic and professional, were recorded during the survey. The pool of respondents is relatively balanced by gender; however, the age structure shows predominantly middle-aged individuals (over 70% in the range 31-50) and about one fifth with age up to 30. The sectoral structure of employment shows that almost half of them work in organizations operating in sector “IT and communications”. The next more frequently recorded sectors are “Public administration” (22%) and “Construction” (14%).

An important characteristic is the experience of the interviewed – over one third indicated a long period of general work experience (over twenty years) whereas about 11% declared just a recent experience: up to 5 years. The professional experience in project management has been identified by the number of years working in project management (project team member, project office expert, project manager, project portfolio manager). The major share (about 60%) is held by respondents with specific experience 6-15 years, and over 20% indicate professional experience over 16 years (Table 3).

Table 3. Experience of the interviewed.

Professional experience	General experience					Total
	Up to 5	6-10	11-15	16-20	Over 20	
Up to 5	100.0%	48.1%	2.9%	5.9%		19.6%
6-10		51.9%	48.6%	14.7%	8.8%	22.8%
11-15			48.6%	67.6%	39.7%	36.4%
16-20				11.8%	42.6%	17.9%
Over 20					8.8%	3.3%

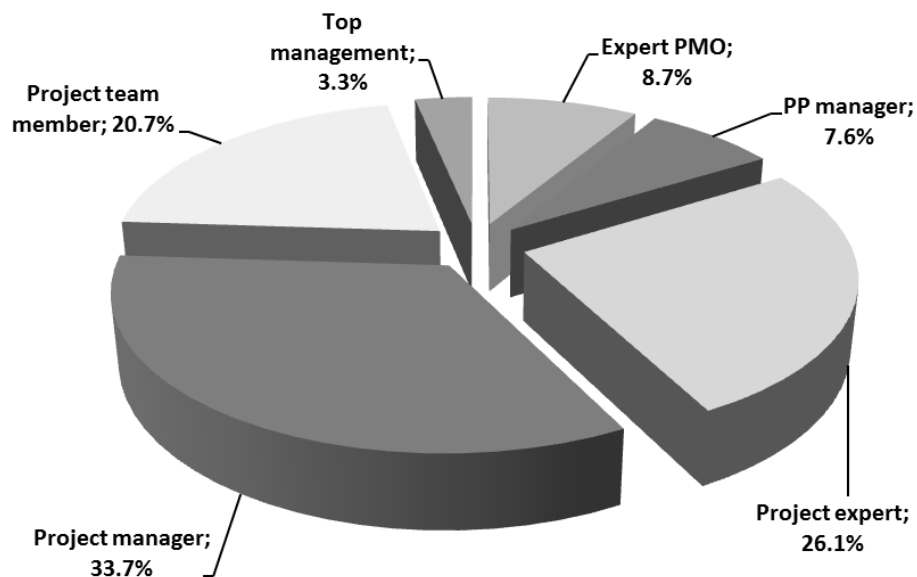


Figure 1. Distribution of respondents by position held at the organization.

Additional to the experience, the survey provides information on the positions held at the moment of filling the questionnaire. About one third of respondents act as project managers at their organization – a position which holds the largest share in the sample (Figure 1). About a quarter of the interviewed occupy various positions of project experts, followed by members of project teams (21%) and project office experts (9%). The position of “project portfolio manager” is rarely met, but still, about 8% of respondents indicate such occupation. Albeit rarely, representatives of top management of project-oriented organizations have also participated in the survey.



#### 4.2. Impact of Organizational Culture on PPM Effectiveness

The available data provides opportunities for measuring the degree of correlation between variables representing the selected dimensions of organizational culture and the variables reflecting the PPM effectiveness. Figure 2 presents the diagram of the links between the two sets of variables where dashed line represents a negative correlation between the respective variables.

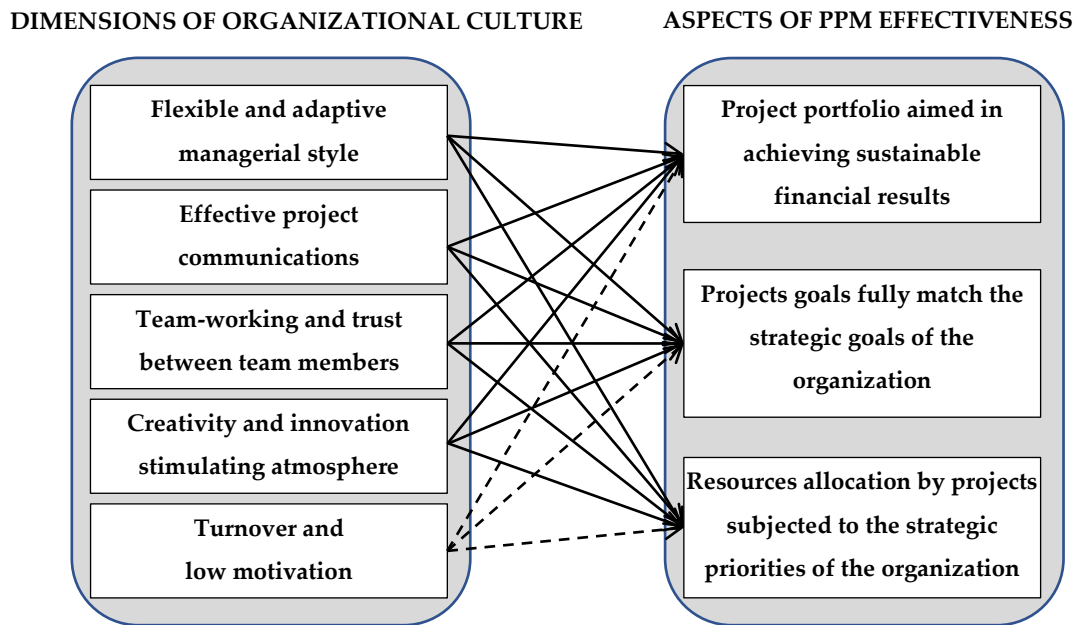


Figure 2. Impact of organizational culture dimensions on PPM effectiveness.

Table 4. Rank correlations between dimensions of organizational culture and PPM effectiveness.

Dimensions of organizational culture	Project portfolio is aimed in achieving sustainable financial results	Projects in the portfolio have goals that fully match the strategic goals of the organization	Resources allocation by projects is subjected to the strategic priorities of the organization
Flexible and adaptive managerial style	0.745	0.729	0.663
Effective project communications	0.574	0.638	0.390
Team-working and trust between project team members	0.427	0.455	0.505
Creativity and innovation stimulating atmosphere	0.388	0.356	0.303
Turnover and low motivation	-0.340	-0.302	-0.282

Table 4 presents the Spearman rank correlation coefficients estimated for each pair of variables – between each of the organizational culture dimension variable and each PPM effectiveness variable. All coefficients are significant at 0.01 or lower level (number of valid cases: minimum 179). The highest coefficients have been obtained for the dimension reflecting “Flexible and adaptive managerial style” where strong correlations are estimated with each measure of PPM effectiveness. The highest result (0.745) is obtained for the correlation with the variable representing “Project portfolio aimed in achieving sustainable financial results”. Obviously, in most cases when such managerial style has been clearly identified, the focus of project portfolio on sustainable financial results is typically achieved, and vice versa.

High coefficients are observed also for the dimension revealing “Effective project communications” where moderate correlations are estimated with the measures of PPM effectiveness. The highest result (0.638) is obtained for the correlation with the variable characterizing “Projects

goals fully match the strategic goals of the organization". This provides evidence that practicing effective communications in project-oriented organizations systematically leads to better results concerning the achievement of strategic goals through targeted project activities, and vice versa.

Relatively lower correlations, but showing the expected positive signs, are obtained for the dimensions "Team-working and trust between project team members" and "Creativity and innovation stimulating atmosphere" – moderate correlation coefficients varying in the range 0.3-0.5. These results reveal the positive impact of these two dimensions on each of the three aspects of PPM effectiveness, according to the survey data for Bulgarian project-oriented organizations.

Moderate to weak correlations are found regarding the fifth dimension of organizational culture reflecting the eventual existence of "Turnover and low motivation" in the organizations. These results are indicative for a supposition that a lack of policies for keeping high motivation and loyalty as well as for reducing turnover rates inevitably leads to worsening the results on the chosen aspects of PPM effectiveness – which provides useful insights for PPM practitioners.

## 5. Conclusions

Adopting PPM by project-oriented organizations requires also taking into account the intangible cultural dimensions of the organization. The current study argues that such an approach is a sustainable way to increasing the effectiveness of PPM and responding to the challenges of strategic goals of the organization. The results shed light on the recent practices of Bulgarian project-oriented organizations regarding the interrelations between particular dimensions of organizational culture and selected aspects of PPM effectiveness. They provide evidence for project portfolio managers that paying special attention on such cultural issues can be a driver of the effectiveness of project portfolio activities. In order to improve their results, it seems necessary for these managers to develop additional knowledge and skills relevant to the contemporary topics in organizational culture and its impact on PPM. A further study of the determinants of PMI effectiveness is still a challenge for project management research in Bulgaria that can be supported by sound empirical evidence.

The dimensions of organizational culture and their impact on the overall project portfolio appear to be prospective topics for future conceptual and empirical studies. The current study demonstrated that organizational culture enters in complex interactions with core elements and processes of PPM. Future research and more detailed analysis in a multivariate causal framework can reveal new underlying mechanisms of the influences of the organizational culture on the success of PPM operations and organizational strategy in different corporate contexts.

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# Research on the Impact of Innovation Drivers on the Quality of Economic Growth in China

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**Abstract:** The quality of economic growth is a prominent issue in the process of economic growth worldwide. This paper builds relevant econometric models and uses the provincial panel data from 2003 to 2015 to analyze the impact of innovation drivers on China's economic growth. The empirical results show that technological innovation and institutional innovation have a significant role in promoting the quality of China's economic growth, and the effect of institutional innovation is stronger than technological innovation. In terms of regions, the innovation driver has the greatest contribution to the quality of economic growth in the eastern region of China, with the western and central parts ranked second and third. However, the role of institutional innovation in the eastern region is prominent, and the role of technological innovation is weak. Only institutional innovation in the central region has a significant role in promoting the quality of economic growth. Only technological innovation in the western region has a positive effect on the quality of economic growth, and the impact is weak. The regional differences in the impact of innovation-driven economic growth are obvious.

**Keywords:** quality of economic growth; innovation drivers; institutional innovation; technological innovation

**JEL Classification:** 032; 047

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## 1. Introduction

The quality of economic growth is a prominent problem in the process of which worldwide. At present, in order to solve the contradiction between the people's growing needs for a better life and unbalanced and inadequate development, we need not only the quantitative economic growth, but also steady improvement in the quality of economic growth (Shi and Ren 2018). Xiao and Li (1998) conducted the earliest research on quality of economic growth in China. Subsequently, Yang (2000), Wang (2001), Li (2001) and others started to try to determine the dimensions of the quality of economic growth, establish an evaluation system of which and then to evaluate it in China. Since 2009, the team represented by Baoping Ren and Xiaojing Chao in Northwest University has conducted a concentrated and systematic study on the quality of economic growth. Also, as the quality of economic growth was taken as the theme of the 2011 Davos Forum, it has gradually become a hot topic of domestic economic research and received a lot of attention.

Innovation is the core element of economic growth, and the improvement of the quality of economic growth is inseparable from innovation. Since the reform and opening up, China has always put the increase in R & D investment and the expansion of the scale of R & D personnel in an important position. However, taking 2008 as the cut-off point, the growth rate of total factor productivity (TFP) and its contribution to growth in China have changed from a steadily high level to a continuous decline, and the trend of economic growth quality has also changed significantly, which has been confirmed by increasing studies. The expansion of the "scissors gap" between the intensity of technological innovation input and the growth rate of TFP is an important characteristic fact of economic system in the context of the New Normal in China, which can be referred to as the mystery of innovation in the process of economic development in China (Gao 2017), also known as the "Solow paradox" of R & D investment in China (Li et al. 2017). As innovation plays an important role in transforming the growth mode and improving the

quality of economic growth, it is undoubtedly vital to study the decline in the quality of economic growth since 2008 and the so-called mystery of innovation.

The debate on China's pattern of economic growth in the past and the current strategy of boosting innovation-driven development can be effectively combined in terms of the quality of economic growth in China (Wang and Yang 2015). Facing the current economic situation, in order to change the mode of economic growth and improve the quality of economic growth, it is necessary to explore the impact of innovation drivers on the quality of China's economic growth, so as to find such a way to improve it. However, the existing research on the quality of innovation-driven economic growth is limited to the theoretical level, and the relevant empirical research is rare. In addition, the existing generalized quality indexes of economic growth (QEGI) are not suitable for directly econometric analysis as they mostly contain technological innovation factors such as R & D, patent. Therefore, there are few empirical studies so far on the improvement of quality of economic growth driving by innovation especially the impact of institutional innovation on it. This paper attempts to put forward its own views on the above issues.

Innovation drive in the context of quality growth focuses on technological improvement, which is the reshaping of the production factor combination (Ma 2017). It reduces the impact of the changes in the number of input factors on the production process taking the improvement of TFP and the contribution rate of production efficiency as the main path, and then reaches the stably economic structure as well as the optimal consumption rate of resources and environment under a certain technical level and finally achieve the comprehensively improvement of the quality of economic growth which covers the procedure and results of economic operation. Innovation drive can continuously improve the quality of economic growth by increasing TFP because it is the key factor to change the production function and the effective way to break the old development model.

This paper expounds the relationship between innovation drivers and the quality of economic growth from the perspectives of technological innovation, institutional innovation and their combined effects. By constructing the theoretical analysis framework for it, this paper proposes research hypotheses to be tested.

### *1.1. The mechanism by which technological innovation affects the quality of economic growth*

The Neoclassical economic growth theory provides sufficient theoretical basis for how technological innovation is able to promote economic growth. Also, the development practice in China shows that technological innovation plays an important role in promoting economic growth, transforming the mode of economic growth and improving the quality of economic growth. Technological innovation is conducive to optimizing the economic structure, which is reflected in the fact that it can improve the quality of economic growth by optimizing the industrial structure (Deng and Zhang 2018). For the consumption structure, financial structure and income and expenditure structure, the upgrading path of technological innovation mainly focuses on the maintenance effect on economic stability. Moreover, technological innovation is beneficial to enhancing the efficiency of economic growth (Zhang et al. 2007; Peng and Jiang 2011), which is embodied in the fact that the original scientific and technological innovation can improve the efficiency of resource development and utilization during the process of internal transformation within the production procedure. Technological innovation in the production process makes the productivity of the original input factors increase marginally with the technological spillovers, which is the improvement and optimization of economic growth model. In addition, it helps to reduce resource consumption and environmental pollution.

Hypothesis 1: technological innovation can improve the quality of economic growth.

### *1.2. The mechanism by which institutional innovation affects the quality of economic growth*

Institutional innovation is the foundation of economic growth. It promotes the quality of economic growth mainly through incentive mechanism, restriction of economic subjects, reduction of transaction costs and optimization of resource allocation. Firstly, institutional innovation is about providing the proper "incentives". The lack of "proper incentives" is the main obstacle to economic growth in developing countries (Easterly 2003). Secondly, institutional innovation can stimulate the government, enterprises and individuals to increase the investment on innovation and human capital. It is able to

encourage enterprises to engage in innovation activities and obtain excess profits by providing institutional protection for intellectual property rights, invention patents and “innovation subsidies”. Finally, institutional innovation improves the quality of economic growth by reducing transaction costs and optimizing resource allocation. Specifically, market intervention by government (Gao 2017), distortion of factor markets (Zhang and Zhou 2011), development of non-state-owned economy and so on are the serious realities faced by China's imperfect market-oriented system and its transformation from economic system to market-oriented system. The innovation of these system and directions is an important force that causes the quality of China's economic growth to rise.

Hypothesis 2: institutional innovation can improve the quality of economic growth.

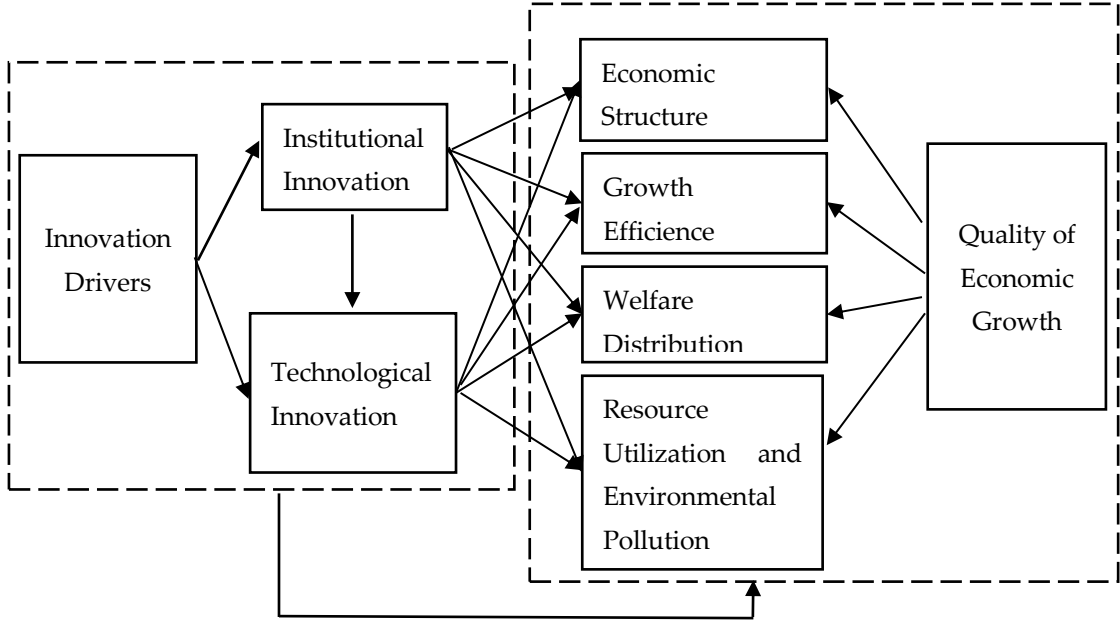


Figure 1. The mechanism by which innovation drivers affect the quality of economic growth.

1.3. The mechanism by which the combination of technological and institutional innovation affects the quality of economic growth

Technological and institutional innovation are unified, both of which work together on economic growth, thus promoting the quality of economic growth. In terms of improving economic efficiency, technological and institutional innovation are the keys to economic efficiency. Therefore, reforming them could bring many "dividends" to the China's economy. Also, in the aspect of reducing environmental pollution, it is possible for economy to realize the green growth model of high economic growth and low pollution in China relying on the transformation and upgrading of industrial structure and technological progress in the long run. At the same time, strong resource and environment policies are also effective inducements to reduce pollution emissions (Wang and Huang 2015). Additionally, in terms of perfecting the welfare distribution, the system improvement can also change the income distribution and then explore the potential for increasing resource utilization.

Hypothesis 3: institutional innovation promotes the quality of economic growth by strengthening technological innovation.

2. Methodology

2.1. Measurement

According to the connotation of the quality of economic growth, this paper constructs an index system to measure the quality of economic growth in China. All 15 basic indicators for measuring QEGI are listed in Table 1, and the brief introduction of sub items, measurement units and the attributes of which are also included.

**Table 1.** The index system for QEGI measurement.

Aspects	Sub index	Basic index	Measure unit	Criterion Attribute		
				positive	negative	comparative fit index
Progress of economic growth	Structure of industry	Value of secondary industry/ tertiary industry	—	√		
		Theil index of structural deviation	—		√	
	Structure of consumption and investment	Rate of consumption	%			√
		Rate of investment	%			√
	Financial structure	Balance of deposits and loans of financial institutions /GDP	%	√		
	Balance of Payments Structure	total imports and exports /GDP	%	√		
Results of economic growth	growth efficiency	TFP growth rate	%	√		
		Capital productivity	%	√		
		labor productivity	%	√		
	Resource Utilization	Energy consumption per unit of GDP	—		√	
	Environmental pollution	Air pollution degree per unit output	Multiple		√	
		Sewage discharge per unit output	Multiple		√	
		Discharge of solid waste per unit output	Multiple		√	
	Welfare improving	Population weighted urban-rural income ratio	—		√	
Composite Engel coefficient		—		√		

## 2.2. Data source

In this study the empirical analysis is conducted to verify the research hypotheses proposed earlier with panel data collected from 30 provinces (in view of the availability of relevant data, Tibet, Hong Kong, Macao, Taiwan four regions are not included in the research objects in this paper), (cities, autonomous regions) in China from 2003 to 2015. The selected explanatory variables mainly include the degree of R & D, the amount of patent application and the degree of marketization. In addition, considering the quality of regional economic growth could be affected by several other factors, the level of human capital, the level of fixed asset investment, social security, infrastructure, total amount of postal and telecommunications business as well as the degree of concentration of producer services are selected as control variables. The data are mainly from <China Statistical Yearbook> in 2004-2016, <China Urban Statistical Yearbook>, <China Science and Technology Statistical yearbook>, < China

Marketization Index 2011> and <China Marketization Index 2016>. Interpolation method is used to complete few missing data.

### 2.3. Variable declaration

The quality of economic growth ( $QEG_{it}$ ) as the explained variable is the core variable and the regional data of which is calculated according to the evaluation system in Table 1. It mainly includes two sub indicators which are process dimension ( $STRU_{it}$ ) and result dimension ( $RESU_{it}$ ). Furthermore, the key explanatory variables are those reflecting the level of regional technological and institutional innovation.

1. Level of technological innovation ( $tech_{it}$ ): two indicators including regional R & D expenditure ( $RD_{it}$ ) and the level of regional patent application ( $patent_{it}$ ) are adopted to measure the level of technological innovation. Specifically, the formula for calculating regional R & D expenditure is:  $RD_{it}$  = internal expenditure of Regional R & D and experimental development funds / regional GDP. The level of regional patent application is expressed by the number of patent applications accepted per 10000 people in the region. The calculation formula is:  $patent_{it}$  = the number of patent applications accepted in the region / 10000 people.
2. Level of institutional innovation ( $insti_{it}$ ): the total index score of marketizations ( $MI_{it}$ ) calculated by Wang and Fan (2011, 2016) is taken to represent the degree of marketizations and then measure the level of institutional innovation. Taking year 2007 as the base period, this paper adjusts the index of marketization from 2008 to 2015 according to the practices of Zhang et al. (2018), so as to make the data is comparable in different years.

Additionally, several factors which are the level of human capital ( $hum_{it}$ ), the level of fixed asset investment ( $inv_{it}$ ), social security ( $soc_{it}$ ), infrastructure ( $trans_{it}$ ), total amount of postal and telecommunications business ( $mail_{it}$ ) as well as the degree of concentration of producer services ( $service_{it}$ ) are selected as control variables ( $control_{it}$ ).

### 2.4. Model specification

According to the research objectives of this paper, firstly, the impact of innovation driver on the comprehensive level of the quality of economic growth is investigated. The corresponding econometric model is set as follows:

$$QEG_{it} = \alpha + \beta_i \times tech_{it} + \gamma \times insti_{it} + \theta_i \times control_{it} + \varepsilon_{it}$$

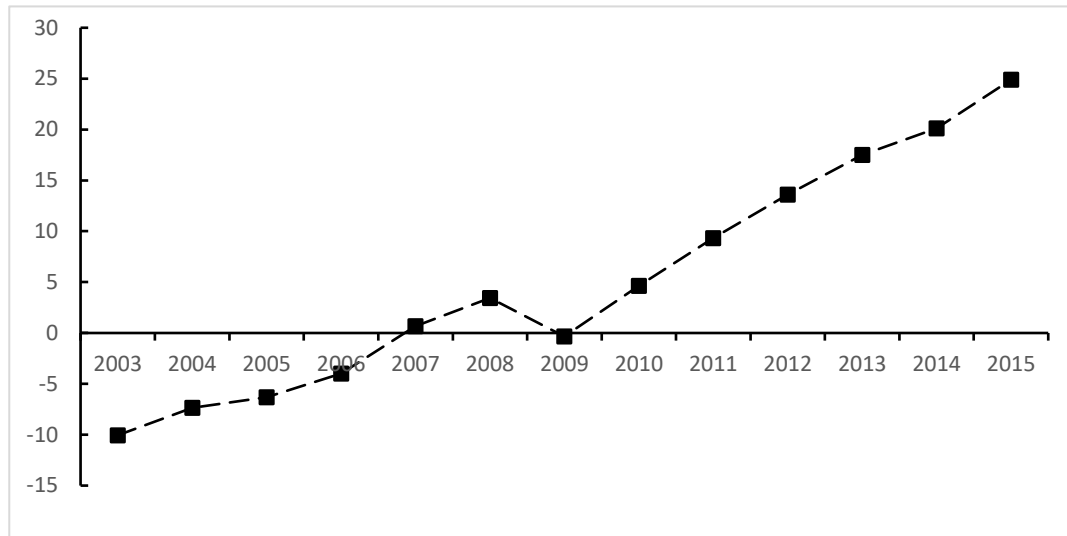
In the above formula, the subscripts  $i$  and  $t$  indicate the provinces and years respectively.

## 3. Results

### 3.1. National QEGI and Provincial QEGI in China

In this paper, principal component analysis (PCA) was adopted with SPSS18 software to obtain QEGI of all provinces (cities, autonomous regions) in China from 2003 to 2015. It can be seen from Figure 2 that QEGI is on the overall continuous rise from -12.77 in 2003 to 24.9 in 2015. In terms of time periods, it is clear that the time evolution process of China's QEGI over 13 years from 2003 to 2015 can be divided into two stages: the first stage is 2003-2008 while the second stage is 2009-2015 with 2008 seen as the turning point of the two stages.





**Figure 2.** The time evolution process of China's QEGI from 2003 to 2015.

From the perspective of spatial dimension, the quality of economic growth in the eastern region is the highest, which in the northeast region is the second, followed by the central region. The lowest one appears in the western region. Moreover, the eastern region increases most in the quality of economic growth with aspects of range and speed. The western region and the central region are in the second and third places.

### 3.2. The innovation-driven impact on QEGI in China

The results of the empirical test of innovation-driven impact on the quality of economic growth in China are showed in Table 2. Using the mixed least square method (OLS), the panel fixed effect model (FE) and the random effect model (RE) respectively to run the regression on formula (1), this paper verifies the effects of technological and institutional innovation on the quality of China's economic growth.

**Table 2.** The regression results of the empirical test of innovation-driven impact on QEGI in China.

variables	OLS		FE		RE	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>RD</i>	0.491** (9.33)		0.252** (2.01)		0.489** (5.60)	
<i>Patent</i>		0.309** (10.13)		0.0099 (1.45)		0.0104 (1.48)
<i>MI</i>	0.286** (10.44)	0.0299** (3.28)	0.241** (5.37)	0.267** (6.48)	0.241** (6.51)	0.292** (7.72)
<i>hum</i>	0.367** (6.54)	0.630** (11.17)	0.106 (1.11)	0.103 (1.08)	0.232** (2.93)	0.340** (4.18)
<i>inv</i>	-0.497** (-8.02)	-0.633** (-8.15)	-0.149** (-2.47)	-0.157** (-2.44)	-0.256** (-4.52)	-0.267** (-4.06)
<i>soc</i>	-0.0209** (-2.53)	-0.0211** (-2.31)	0.0232** (2.72)	0.0248** (2.91)	0.0100 (1.23)	0.0118 (1.41)
<i>trans</i>	-0.0237** (-3.30)	-0.0220** (-2.67)	-0.0299** (-3.17)	-0.0300** (-3.12)	-0.0331** (-3.83)	-0.0413** (-4.53)
<i>mail</i>	0.0003** (4.05)	0.0003** (3.29)	-0.0000 (-0.03)	0.0000 (0.04)	0.0000 (1.08)	0.0001 (1.54)

variables	OLS		FE		RE	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>service</i>	78.70** (4.49)	146.6** (8.45)	57.05** (4.56)	57.63** (4.60)	59.07** (4.64)	66.05** (5.05)
<i>Cons</i>	-5.063** (-12.32)	-6.848** (-16.62)	-2.718** (-4.16)	-2.612** (-4.00)	-3.876** (-7.06)	-4.525** (-8.04)
R <sup>2</sup>	0.8520	0.8209	0.8035	0.7324	0.8345	0.7869
Observed value	360	360	360	360	360	360

<sup>1</sup> Caption: \*\*, \*, and \* represent that the estimated results of the coefficient are at the significant level of 10%, 5% and 1%, respectively.

Column (1) and (2) show the OLS regression results. In column (1), the level of R & D is used for measuring technological innovation, and the level of marketization is taken as a measurement for institutional innovation. According to the output, the level of R & D and the level of marketization have a significant impact on QEGI in China at 99% significant level. The QEGI changes by 0.491 units and 0.286 units while the level of R & D and the level of marketization change 1 unit respectively on average. In column (2), the amount of patent application represents technological innovation. Similarly, regression results show that there is 99% probability that the amount of patent application and the level of marketization affect QEGI significantly. Moreover, the outcomes of FE regression are presented in Column (3) and (4). It can be seen in column (3) that the level of R&D and the level of marketization exert significant effect on QEGI in China at 95% and 99% confidence interval respectively. Unfortunately, the amount of patent application does not have a significant impact on QEGI while the level of marketization is able to affect it with 99% confidence. Furthermore, the outputs of RE regression are showed in Column (5) and (6). There is 99% confidence to believe that the level of R & D and the level of marketization have a significant impact on QEGI in China. However, the amount of patent application has the opposite effect. Moreover, among the control variables, the influence of the level of human capital is not significant according to FE regression, and the coefficients of fixed asset investment and infrastructure are significantly negative, which indicates that China's economy is still driven by investment before 2015, and the human capital does not play a strong role in improving economic quality.

### 3.3. The innovation-driven impact on QEGI in each region

Table 3 reports the regression results of the impact of innovation drivers on QEGI in each region. Comparing the effects of innovation drivers on QEGI in eastern, central and western parts of China, it is clearly that both the level of R & D and the level of marketization in the eastern region promote the quality of economic growth, even though the roles of the level of R & D is weak. On the other hand, there is only the level of marketization exerting positive effect on the quality of economic growth in central part of China while only the amount of patent application promotes it weakly in western region.

**Table 3.** The regression results of the empirical test of innovation-driven impact on QEGI in each region

	nation		Eastern region		Central region		Western region	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
RD	0.252** (2.01)		0.0396* (0.13)		-0.0755 (-0.99)		0.159 (1.58)	
Patent		0.0099 (1.45)		-0.0000 (-0.37)		0.0000 (0.46)		0.0000*** (6.76)
MI	0.241*** (5.37)	0.267*** (6.48)	0.216** (1.98)	0.241*** (2.73)	0.120*** (4.93)	0.129*** (5.51)	0.0069 (0.22)	0.0432 (1.64)

	nation		Eastern region		Central region		Western region	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cons	-2.718*** (-4.16)	-2.612*** (-4.00)	-2.430 (-1.37)	-2.736 (-1.50)	-2.372*** (-5.96)	-2.337*** (-5.65)	-0.686** (-1.99)	-0.826*** (-2.80)
R2 (within)	0.8035	0.7324	0.5274	0.5335	0.7924	0.7904	0.5359	0.6622
Observed value	360	360	132	132	96	96	132	132
entity fixed effects	control	control	control	control	control	control	control	control

<sup>2</sup> Caption: \*\*\*, \*\*, and \*\* represent that the estimated results of the coefficient are at the significant level of 10%, 5% and 1%, respectively.

### 3.4. The innovation-driven impact on QEGI in each stage

Table 4 and table 5 report the regression outputs of the impact of innovation drivers on QEGI in China during 2003-2007 and 2008-2015. In the first period, the level of R & D, the amount of patent application and the level of marketization influence China's QEGI positively. In the second period, the effects are less significant than which in the first one.

**Table 4.** The regression results of the empirical test of innovation-driven impact on QEGI during 2003-2007

	FE		RE		FGLS	
	(1)	(2)	(3)	(4)	(5)	(6)
RD	0.554** (2.54)		0.316*** (2.95)		0.184** (2.39)	
patent		0.260*** (4.57)		0.282*** (5.10)		0.419*** (7.19)
MI	0.0531 (0.74)	0.138** (2.06)	0.214*** (4.20)	0.276*** (6.07)	0.310*** (7.79)	0.291*** (8.32)
Cons	-2.568** (-2.29)	-1.538 (-1.41)	-3.979*** (-5.64)	-4.203*** (-7.08)	-4.304*** (-9.19)	-4.252*** (-10.48)
R2	0.7314	0.8128	0.8299	0.8711		
Observed value	150	150	150	150	150	150
Wald test					864.97 (0.0000)	1165.12 (0.0000)

<sup>3</sup> Caption: \*\*\*, \*\*, and \*\* represent that the estimated results of the coefficient are at the significant level of 10%, 5% and 1%, respectively.

**Table 5.** The regression results of the empirical test of innovation-driven impact on QEGI during 2008-2015.

	FE		RE		FGLS	
	(1)	(2)	(3)	(4)	(5)	(6)
RD	-0.0634 (-0.33)		0.536*** (4.37)		0.672*** (8.58)	

	FE		RE		FGLS	
	(1)	(2)	(3)	(4)	(5)	(6)
patent		0.0111 (1.19)		0.0167* (1.77)		0.0309*** (2.93)
MI	0.179** (2.54)	0.144** (2.31)	0.172*** (3.14)	0.231*** (4.19)	0.264*** (6.54)	0.334*** (7.30)
Cons	-3.885*** (-3.30)	-3.964*** (-3.39)	-5.289*** (-5.24)	-6.433*** (-6.32)	-5.621*** (-7.57)	-9.173*** (-12.47)
R2	0.6910	0.7476	0.8390	0.7716		
Observed value	210	210	210	210	210	210
Wald test					1383.86 (0.0000)	1018.05 (0.0000)

<sup>4</sup> Caption: \*\*\*, \*\*, and \* represent that the estimated results of the coefficient are at the significant level of 10%, 5% and 1%, respectively.

#### 4. Discussion

The quality of economic growth is a prominent issue in the process of economic development in the world. This paper focuses on the relationship between the quality of economic growth and innovation drivers.

The results show that the quality of economic growth in China during 2003-2015 is on the generally continuous rise with year 2008 as a turning point. According to the outputs of empirical test, both technological and institutional innovation promote the quality of China's economic growth significantly from 2003 to 2015. And the effect of institutional innovation is stronger than that of technological innovation. From a regional perspective, innovation driver plays an important role in promoting the quality of economic growth in eastern China, especially which of institutional driver is more significant. Furthermore, only institutional driver is able to exert a positive impact on the quality of economic growth in central part of China significantly while only technological driver influences which in western region of China significantly. In terms of time period, the role of innovation drivers in promoting the quality of China's economic growth during 2008-2015 is less significant than that during 2003-2007.

It should be noted that this study has examined only the data collected from 30 provinces (cities, autonomous regions) in China from 2003 to 2015. Therefore, the sample size and applicability are relatively limited, and which also provides a space for making progresses in the future studies.

Based on the above outcomes, the policy suggestions given in this paper are as follows: China should take the technological innovation and institutional innovation as the starting point to promote the construction of regional innovation system and improve the quality of economic growth. Enterprises, institutions of higher education and scientific research as micro subjects engaged in scientific and technological R & D and innovation should attach importance to forming a network alliance of multiple enterprises, universities and R & D institutions and establish a long-term cooperative scientific research alliance based on the industrial chain. The reform and opening up policy have entered a stage of comprehensive deepening since the 18th National Congress of the Communist Party of China, showing a good momentum of all-round efforts, multi-point breakthroughs and in-depth progress. In the field of economic development, it needs to accelerate the reform of the market economy system, release the vitality of the market economy through institutional innovation, further improve the socialist market economy system, consolidate the decisive role of the market in the allocation of economic resources and play the role of the government in macro-control better, so as to promote the continuous improvement of the quality of economic growth.

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# Public Marketing: Case of Self-governing Regions' Brands in Online Environment

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**Abstract:** Online environment, including brands of public institutions, is becoming a significant part of public administration. Nowadays, with a social media communication widespread, the public marketing managers representing self-governing regions are forced to work on their image and monitor and influence region's brand behavior in the online environment. Therefore, an article aims on the current state of art in the field of public brand marketing and the nature of mentions of users (citizens) about this brand. The study employed data obtained with use of Brand24.com application which automatically collect the data on region's brands behavior in the online environment. The analysis is oriented on following aspects: (1) brand's mentions in online environment, (2) number of social media views and interactions raised over the brand, and (3) the level of positive and negative sentiment related to the brand. The research sample included 13 out of 14 regions existing in the Czech Republic, for research reasons the capitol city of Prague was excluded from the sample. The findings showed that high regional differences in brand awareness, brand's social media reach as well as brand's associated text sentiment exist. Besides of this, several implications for public marketing managers are presented in the study.

**Keywords:** self-governing region; brand; online environment; social media; public administration; Czech Republic

**JEL Classification:** H30; M30

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## 1. Introduction

Increased citizen's participation in online environment together with the information and communication technologies (ICT) developments have created new challenges for public marketing. Fung (2015) asserts that citizen participation mainly supports "three aspects of governance: effectiveness, legitimacy, and social justice". The emergence of omnipresent use of online communication, particularly Web 2.0 and 3.0 and social media communication meant that public institutions, including government and local governments, and their brands need to be more visible to citizens in virtual space.

## 2. State of the Art in Brand Marketing Research

In the past decade, the "branding had become an open source activity, via which anyone and everyone had a say in matters of the brand" (Fournier and Avery 2011). Remarkably, it means that brands started to live with their own life, sometimes working against the creators. Fournier and Avery (2011) commented it in this way: "When marketers created stylized content that could be spread virally, they were horrified to see these same sharing capabilities used against them. Consumers hijacked brand messages and turned them into parodies". The brand oriented research mainly focus on business administration issues as consumer vs brand generated platforms (van Noort and Willemsen 2012), brand consciousness on consumption behavior in terms of consumption motivations, purchase intention, and brand loyalty oriented on Generation Y and luxury fashion industry (Giovannini, Xu, and Thomas 2015), or influence of parasocial (robotic) interactions in online social media (Yuksel and Labrecque 2016). There are also many studies related to health-related environment as branding of cigarettes its impact on smokers (Huang, Kornfield, and Emery 2016; Kim, Hopper, and Simpson 2015; Ulucanlar, Fooks, and Hatchard 2014; Farsalinos et al. 2013), use of psychotics (Corazza, Valeriani, and Bersani 2014), or food and drink consumption (Freeman et al. 2016; Holmberg et al.

2016). In the field of public sector, and particularly public institutions, there are exist only a bit out-to-date, studies related to the brand and community (Kane et al. 2009) or place branding (Anholt 2008).

Moreover, the brands are usually presented in different context, which is in the form of online comments available on websites or social media. For this reason, the sentiment of the text associated with the brand should be determined. These texts are presented as unstructured information source which is difficult to analyze and requiring time-consuming and expert focused approach (González-Rodríguez, Martínez-Torres, and Toral 2016). To avoid this approach, we applied a sentiment analysis tool incorporated in the software application presented later in this text.

As it was showed earlier in the text, there is unfortunately not enough up-to-date research done in the field of brand “behavior” in context of public institutions and the public sector, in general. Therefore, this study aims on identification of brand awareness of the region’s brand among users (and thus likely citizens) who communicate online with the region, and at the same time, on the engagement of citizens in this brand and the sentiment of communication about the brand.

### 3. Methodology

#### 3.1. Methods and Metrics

The study is based on the analysis of online environment to identify brand’s presence. This kind of analysis conducted in online environment is a part of so-called Internet mediated research (Hewson 2007). For the purpose of this study a new set of metrics to measure brand presence in the online environment as well as brand’s engagement by citizens and the sentiment of relevant communication was designed by the author. These metrics are mainly based on the definitions of terms outlined by social networks as Facebook, YouTube and Twitter.

**Table 1.** Metrics of brand’s word-of mouth, interactions, and sentiment.

Specific Metrics	Description of the metrics
Mentions	All available presences of the region’s brand in online environment. The brand can be mentioned as the passive presence (with not interactive linking on the brand’s profile) or in active presence (with an interactive link).
Social Media Mentions	Mentioning a brand (or person/page) on social media is the electronic way of tagging someone on the social media networks, and by mentioning the brand it links to that brand’s social media profile. Usually, it uses active mentioning of the brand.
Non social media mentions	Mentioning a brand in traditional online environment, mainly websites. Usually, it uses passive mentioning of the brand.
Social media reach	The total number of people who has seen the specific brand during a specific period (last 30 days in this study) in the online environment.
Interactions	The metrics involves how the brand’s institution talking to individuals on social media (Twitter and blogs interactions are considered in this study). This interaction can be both reactive (to people who have messaged your brand) and proactive (to people you reach out based on one or more factors).
Shares	Reflects how many times the text associated with the specific brand was shared on social media
Likes	Reflects how many likes the text associated with the specific brand received on social media
Sentiment	This metric reflects either positive or negative sentiment of the text associated with the specific brand. Texts with neutral sentiment are neglected.

#### 3.2. Collection of the Data Set and a Software Used for Data Gathering

The data of analyzed facets were gathered during a thirty-day period from January 12, 2020 to February 11, 2020. Data were collected with use of Brand24.com application tool and after the collection processed in MS Excel for the purpose of regional comparison. Brand24.com application was used in the past with many organizations as well as start-ups. For better picture, how an organization

can use this application, Krzysiek Radoszewski, the Marketing Lead for Central and Eastern Europe at Uber, says on this: “At Uber, we use social listening on a daily basis, which allows us to understand how our users feel about the changes we are implementing. As soon as we introduce a modification, we know which parts of it are greeted with enthusiasm, and which need more work” (Brand24.com 2020). Similarly, the success or failure of a specific regional policies, or regional administration quality can be measured with used application.

### 3.3. Research Sample

Research study focuses on analysis of online communication of self-governing regions. The Czech Republic regions are established according to the Act no. 129/2000 on Higher-level territorial self-governing units (Czech Republic 2018). The thirteen regions and one capital city with regional status exist. The capital Prague was excluded from the sample due to several facts: much higher tourist attention, almost doubled GDP per capita (39,902 EUR), as well as significantly higher population (1,272,690 inhabitants) than majority of regions. In the sample, there are three regions exceeding with population exceeding one million citizens; at the other end, there are two regions with population lower than a half million of inhabitants: Liberec region with population of 441 thousands, and Karlovy Vary region with population of 296 thousands.

The detailed characteristics of the regions researched are summarized in Table 2.

**Table 2.** List of regions included in the sample. (Czech Statistical Office, 2018)

Region's official name	Population <sup>1</sup>	Area (km <sup>2</sup> )	GDP per capita (EUR)
Středočeský kraj	1,345,764	11,014.97	16,930
Jihočeský kraj	639,180	10,056.79	14,698
Kraj Vysočina	508,664	6,795.56	14,893
Plzeňský kraj	579,228	7,560.93	16,737
Karlovarský kraj	296,106	3,314.46	11, 992
Ústecký kraj	820,937	5,334.52	13,112
Liberecký kraj	440,934	3,162.93	13,853
Královéhradecký kraj	550,848	4,758.54	16,791
Pardubický kraj	517,243	4,519	14,738
Olomoucký kraj	633,133	5,266.57	14,196
Moravskoslezský kraj	1,207,419	5,426.83	14,922
Jihomoravský kraj	1,180,477	7,194.56	17,098
Zlínský kraj	583,039	3,963.55	15,498

## 4. Analysis and Results

### 4.1. Brand's Mentions in the Online Environment

Brand's mentions were represented by all available *mentions* about the brand in the online environment. The total number of mentions recorded for all sampled regions was 2,654. The number of mentions in the individual regions ranged from 331 mentions about Středočeský (Central Bohemian) region to 101 mentions about Liberec region. The *non social mentions* were represented by higher percentage out of the all mentions, the highest number of these mentions was recorded in Olomouc region (294); the lowest was recorded in Liberec region. The highest number of *social media mentions* was found in Středočeský (70), Ústecký (65) and Zlínský (52) region. On the other side, the lowest number of these mentions was found in Vysočina (10) and Olomouc (14) region.

More detailed data about number of mentions in individual regions are available in Table 3.



**Table 3.** Brand's mentions according to official name of regions.

Region's official name	Mentions		Social Media Mentions	Non Social Media Mentions
	Abs.	Rel.		
Středočeský kraj	331	12.47	70	261
Ústecký kraj	312	11.76	65	247
Olomoucký kraj	308	11.61	14	294
Jihomoravský kraj	299	11.27	43	256
Moravskoslezský kraj	267	10.06	25	242
Zlínský kraj	243	9.16	52	191
Karlovarský kraj	227	8.55	46	181
Pardubický kraj	227	8.55	31	196
Jihočeský kraj	197	7.42	24	173
Plzeňský kraj	172	6.48	20	152
Královéhradecký kraj	171	6.44	19	152
Kraj Vysočina	130	4.90	10	120
Liberecký kraj	101	3.80	19	82
In total	2,654	100.0	368	2,286

#### 4.2. Social Media Reach and Interactions

Overall number of social media reach in all sampled regions was 616,369 views. On the contrary to the previous results in individual regions, the social media reach can importantly differ from overall number of mentions. The highest social media reach was recorded in Liberec and Zlín regions with more than 150 thousand of users who have viewed the region's brand. On the other side, there are five regions where the social media reach is lower than 10 thousand of views: South Bohemian (Jihočeský), Plzeň, Pardubice, Olomouc and Vysočina.

The highest number of interactions was found in case of Liberec (472) and Ústí nad Labem (340) region. On the other hand, very low number of interactions existed in case Hradec Králové (Královéhradecký) (44), Plzeň (37), Vysočina (31) and Olomouc (17) region. Much higher percentage of interactions is made by likes (91.1 %) in comparison to shares (9.9 %).

More detailed data about social media reach and interaction are available in Table 4.

**Table 4.** Word of mouth about brands of regions.

Region's official name	Social media reach	Interactions	Shares	Likes
Liberecký kraj	157,000	472	36	435
Zlínský kraj	156,000	240	25	213
Ústecký kraj	105,000	340	36	285
Jihomoravský kraj	87,280	128	19	107
Moravskoslezský kraj	38,267	97	3	91
Karlovarský kraj	30,114	383	57	324
Královéhradecký kraj	18,036	44	0	44
Středočeský kraj	12,900	495	42	453
Jihočeský kraj	9,794	57	5	47
Plzeňský kraj	7,038	37	1	32
Pardubický kraj	3,420	150	7	116
Olomoucký kraj	2,213	17	0	17
Kraj Vysočina	2,207	31	2	29

In total	616,369	1,996	191	1,740
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#### 4.3. Sentiment of Brand

The overall sentiment of all brands in sampled regions was slightly positive and reached ratio of 1.11, where the positive vs negative sentiment is measured. Significantly higher sentiment ratio for the brand was found in Plzeň (5.83) and Hradec Králové (Královéhradecký) (4.33) region. Negative sentiment of region's brand was recorded in five following regions: South Moravian (Jihomoravský) (0.83), Pardubice (0.65), Olomouc (0.62), Zlín (0.55), and Liberec (0.38) region.

More detailed data about social media reach and interaction are available in Table 5.

**Table 5.** Word of mouth about brands of regions.

Region's official name	Positive sentiment		Negative sentiment		Sentiment Ratio (positive vs. negative)
	Abs.	Rel.	Abs.	Rel.	
Plzeňský kraj	35	12.28	6	2.34	5.83
Královéhradecký kraj	26	9.12	6	2.34	4.33
Moravskoslezský kraj	23	8.07	9	3.52	2.56
Karlovarský kraj	23	8.07	11	4.30	2.09
Jihočeský kraj	14	4.91	9	3.52	1.56
Ústecký kraj	46	16.14	32	12.50	1.44
Středočeský kraj	14	4.91	12	4.69	1.17
Kraj Vysočina	10	3.51	9	3.52	1.11
Jihomoravský kraj	20	7.02	24	9.38	0.83
Pardubický kraj	26	9.12	40	15.63	0.65
Olomoucký kraj	39	13.68	63	24.61	0.62
Zlínský kraj	17	5.96	31	12.11	0.55
Liberecký kraj	6	2.11	16	6.25	0.38
In total	285	100.0	256	100.0	1.11

## 5. Discussion

The findings showed some interesting insights in the understanding of brand awareness and brand sentiment in individual regions of the Czech Republic.

(1) At first, the results showed that media mentions are still more present in the environment of traditional online tools as websites of the region itself, websites inter-connected with the region, local daily and weekly news, or communication of the police stations and social media do not play a significant role in the overall mentions about the brand, yet. (2) At second, the significant differences in approach to online marketing exist in individual regions. For example, the Liberec region, which recorded the lowest number of overall online mentions at the same time received the highest social media reach. Which can mean that the marketing or public relations managers focus rather on social media activities than website oriented online communication. (3) At third, there were also found high differences in sentiment associated with the region's brand. While there are two regions with highly positive sentiment and two other with moderate positive, there are also five regions with negative sentiment. In this case, the Liberec region is interesting example, because despite of very high social media reach, the region received the most negative sentiment of the brand. Such negative connotations can be considered as a danger for current political representation of the region.

From the general perspective, an inspiration of business sector practice in the field of online reputation management, can be useful. In this comparison, the regional office governing the entire region would correspond to a large-scale business entity with high number of employees and huge

number of customers. The research of Kantorová and Bachmann (2018) showed that such large business companies pay high attention to “strategic approach to online community management and also making their own online communities”. Regional authorities should therefore integrate such approach, at least to a limited extent, into their management practice.

## 6. Conclusion and Managerial Implications

This study has brought a new knowledge in the field of region’s brand awareness of the region’s citizens who communicate online with the region. Also, it examined engagement of citizens by this brand and the sentiment of communication which is associated with the brand.

Moreover, the study findings reveal several implications to public marketing managers of the regions. Nowadays, the managers should be familiar with the necessity to regularly monitor the brand’s awareness, reach, and sentiment because it can be done easily and with high exactness with the use of relevant software. Also, they should deal with the content analysis of citizen’s comments generating highly positive or highly negative sentiment of the brand mentions in online environment. At the same time, they should be prepared to influence and modify such positive or negative content by providing a proper and in-time online communication.

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# Utilization of Facility Management Concept in Real Estate Management

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**Abstract:** The aim of the study is to present the concept of facility management in real estate management. The article attempts to define the concept of facility management, a historical outline, the most important assumptions and the standardization process in Poland and in the world. The authors presented the activities of the facility manager in relation to the actions of the property manager - what distinguishes them, what activities fall within the scope of their work, in what context we can analyse them and what features should stand out. The analysis presents changes that occur on the real estate market in Poland in relation to the requirements of owners and users in relation to the space occupied. The conclusion is that the ongoing, dynamic changes resulting from Poland's pursuit (in the footsteps of other European countries) to the development of service society will increase the demand for services in the field of facility management.

**Keywords:** real estate management; facility management; real estate maintenance; real estate market

**JEL Classification:** R31; R39; L85

## 1. Introduction

Real estate along with the entire infrastructure, and above all, users of these properties require a special form of management. Real estate management is not only about issues related to technical and operational inspections of devices or fire safety, but also to the needs of people residing and working in a building in terms of facilities related to its use. The growing market of construction products and technologies connected with real estate causes that modern facilities require special knowledge from the person dealing with their management. Also entities existing on the market and investing in the rental market expect top-level service ensuring a return on invested capital and user satisfaction. Relations between property management and facility management are also often discussed, as well as their relationship with business strategy (Atkin and Brooks 2015).

Therefore, the purpose of the article is to indicate the difference between property management and management of facilities and activities that differentiate them. The authors also attempted to indicate the direction of Facility Management development in Poland.

The article is the result of analysis conducted by the authors of previous literature and their publication (Bartkowiak and Górska 2019; Bartkowiak and Górska 2020).

## 2. The Development of the Concept of Facility Management

The concept of Facility Management appeared in the mid-1970s, when office furniture manufacturers in the United States said that in the situation of existing, competitive market competition, the use of products is optimally dependent on the links between facilities, that is, furniture features and productivity of people who are their users (Pruszkowski 2009).

Today, facility management is a concept known and used not only on the international market, but also in Poland. The interdisciplinary nature of the activity has also caused that its statutory regulation is difficult, but measures are being taken to set standards and certification. (Dessoulavy-Śliwiński and Gabryelczyk 2016) For this reason, the International Facility Management Association defines Facility Management as a profession covering many disciplines to ensure the functionality,

comfort, safety and efficiency of the developed environment by integrating people, places, processes and technologies. (IFMA).

In Poland the facility manager's activity has not been regulated by law, however the norm EN-15221 published in 2012 by the European Committee for Standardization had an impact on the introduction by the Polish Standardization Committee of PN-EN 15221-1:2012P, which defines Facility Management as management actions aimed at "integrating processes within the organization as well as providing and developing agreed services that support and increase the effectiveness of the organization's core activities." (Standard Facility Management PN-EN 15221 2015) The norm referred to the essence of Facility Management by formulating its main assumptions and elements concerning (Forys 2014):

1. Terms and definitions - provisions regarding standardization of concepts and understanding of the scope of Facility Management, in order to support the relationship between the client and the service provider in Facility Management
2. Guidelines for the preparation of Facility Management agreements - defining provisions related to agreements and contracts in Facility Management, as well as the liability of both parties and the scope and level of services performed
3. Quality management - guidelines for measuring quality, but also improving it and achieving the best results
4. Taxonomy, classification and structures in infrastructure management - the concept of classifying products, as well as linking individual elements and structures in infrastructure management
5. Process approach - guidelines related to the development and improvement of processes that support basic processes
6. Surface measurement - definition of common standards for measuring surfaces in buildings and outside buildings, as well as definitions, terms and methods for measuring space and volume in buildings
7. Benchmarking - definition of deadlines, definitions, but also benchmarking methods. Basics defining quality, service performance and satisfaction

Starting from 2017, further parts of the international Facility Management (ISO) standard have been published as a result of the work of the International Committee for Standardization.

The market of Facility Management is a relatively young market in Poland, and the approaches and understanding of the services offered are different, therefore the process of normalization of concepts and activities in the area of Facility Management will be an important tool to support communication when determining the terms of cooperation.

Thus, it should be emphasized that the activities of the facility manager are primarily to support and improve the efficiency of the organization's basic activities. Therefore, its activities are aimed at improving the quality of basic services. However, the division of activities related to the basic and auxiliary activities, as well as the scope of services and their implementation are determined between the supplier and the client. it according to art.

### **3. Facility Management in the Context of Property Management**

Real estate management is in accordance with article 184b of the Act of 21 August 1997 on Real Estate Management "making decisions and activities aimed at ensuring rational property management, in particular:

- Proper economic and financial economy of real estate
- Safety of use and proper use of real estate
- Proper energy management within the meaning of energy law regulations
- Day-to-day real estate administration
- Maintaining the real estate in a non-deteriorated condition in accordance with its intended use
- Reasonable investment in real estate." (Act. on Real Estate Management of 21 August 1997)

Therefore, property management is perceived as a process of traditional building administration, where the main activities of the manager are focused on the building and its functioning. However, consideration should be given to the level of effectiveness of these activities. Professor Ewa Kucharska-Stasiak (2006) defines real estate management in a narrower and wider approach. The narrower approach to real estate management is identified with administration - maintenance and maintenance of real estate, covering operating costs and preventing rent arrears. The wider approach perceives real estate management as a process of creating visions and goals, both short- and long-term, in the prevailing market environment. Management is not only administrative tasks, but also activities aimed at increasing the value of the real estate. The second part of the definition shows the desirability of using the Facility Management concept in real estate management as management of facilities. Progress in both construction technology and equipment used in buildings, as well as the changing expectations of both owners, investors and users of facilities has resulted in the evolution of the perception of property management. Today, the property is not only a building, but mainly users and facilities offered in connection with the operation of real estate:

- in the case of residential buildings - residential purposes for running a household, leisure, family atmosphere or raising children
- in the case of commercial real estate - support, and even relieving both the users and the owner from the need to take care of spatial, technical and financial issues arising from the space occupied or rented (Pruszkowski 2009)

One of the basic problems associated with real estate management is the lack of a specific mission for real estate, and even the lack of strategies and goals. Many people dealing with real estate limit their operation to the activities required of them by law and so-called "extinguishing fires", which usually generates higher costs than preventive actions. Both the facility manager and the administrator who is trying to act in accordance with the Facility Management concept should define the strategy of action and then take actions related to its implementation and accomplishment. This concept means that property management includes not only building management, but also strategic management in the context of external factors that affect the property.

Strategic management is one of the most important aspects of Facility Management and refers to the elements of planning and then implementation and control of the adopted strategy taking into account the life cycle of real estate as well as the costs and benefits resulting from its implementation. This section is usually divided by subheadings. It should provide a concise and precise description of the results, their interpretation as well as the experimental conclusions that can be drawn. Include all the evidence needed to answer the questions/hypotheses you investigated. Present the results in a sequence that will logically support (or provide evidence against) your hypothesis, or answer your scientific question stated in the Introduction.

Facility manager is responsible for adjusting real estate management strategies to the property life cycle, where:

- The facility is adapted to the needs of users in the first phase, removing minor defects and errors created at the design or construction stage. In this phase, no investment activities are undertaken as this is a new facility
- Activities related to the exchange of selected technical equipment or systems for newer ones are carried out in order to optimize the renovation management and rationalization of costs as well as to meet the expectations of users
- Requires specific financial outlays resulting from the adaptation of the property to changes in the market environment and changing market standards

Another factor that the facility manager takes into account when defining the strategy are property maintenance costs. The ideal situation would be to apply the Facility Management concept already at the design and construction stage of the facility, which would allow the use of equipment and installations that would allow to achieve significant efficiency in the operation of the facility

without the need for repairs and changes in the future. However, if this option is not taken into account, the activities of the facility manager include the identification of costs (target amount of rent and other charges from tenants), categorization of costs (goal being optimization of costs and resources), and in the case of investments in the investment efficiency calculation (goal is to optimize the total costs associated with devices or installations). An additional advantage of the investment is to gain an advantage over the competition by offering users a more modern technology used in the building. The last stage, including reduction and rationalization of costs, is the coordination of costs and technological solutions (especially in intelligent buildings) in order to achieve their optimal level and synergy effect (Śliwiński and Śliwiński 2006).

Both the applied management strategy and activities related to the reduction of costs contribute to the increase in the value of real estate. The value of the real estate is not constant throughout the life cycle of the property - it changes along with the way the object is used and maintained. Therefore, active activities in the field of cost rationalization, adjustment of the building's function to market requirements and facilities for real estate users and the search for possible sources of income cause an increase in income from real estate, and thus an increase in its value.

In relation to operational factors, the activities within Facility Management can be divided into three groups:

- economic and financial - financial issues and planned investments
- technical - building management and real estate devices and installations
- infrastructure - additional services provided to real estate users (Dessoulavy-Śliwiński and Gabryelczyk 2016)

Economic and financial activities are activities related to relieving both the owner and users from the need to develop a property development plan, control budgets, carry out controls of concluded agreements and payments related to real estate and all financial activities. It should also be emphasized that as a result of the evolution of property management, the management of leases characterized by specialization related to a specific type of real estate was identified, including the scope of tenant-oriented marketing, property development focused on property rental, financial and insurance institutions supporting business activity, rental and evolution of the tenant status, which is not perceived as a "tenant" and "periodic owner" (Pruszkowski 2009).

Technical activities include operations related to building management from the level of devices installed in the facility and attempts to integrate them into one system that supports the entire facility, i.e. an intelligent home. Such buildings are modern objects (not only in terms of architecture and construction, but also in terms of equipment in installations), which are distinguished by features such as: comfort, safety, functionality, aesthetics and savings in operation. The "intelligence" of objects is demonstrated by modern technology that allows control of any installations (heating, lighting, air conditioning, ventilation) depending on the ambient conditions and the selected program. This allows you to optimize the reduction of heating, cooling and electricity consumption by up to several dozen percent. However, it requires coordinating all systems in one place.

From the management point of view Facility Management can be considered from the three aspects:

- object - building, construction, but also a production complex with network technical devices
- amenities - activities aimed at supporting basic processes in the organization by creating a comfortable working atmosphere and supporting people in performing their basic duties
- technological innovations - introducing changes and innovations in facilities and devices (Dessoulavy-Śliwiński and Gabryelczyk 2016; Sroka and Meyer 2019).

It is the management of amenities (or facilities) that is what distinguishes Facility Management from basic property management. Amenities are in other words all activities that allow you to achieve the desired level of functionality, quality, health, safety or minimizing costs. (Śliwiński and Śliwiński 2006) Therefore, the task of the facility manager is to create such facilities that meet the expectations of



the owner and users at the same time, taking into account the conditions and functional capabilities of the property. All activities performed as part of Facility Management can be carried out by the facility managers independently, while in the case of some of them (e.g., economic service, protection of facilities or cleaning) induce facility managers to use the outsourcing of services. The advantage of outsourcing is lower costs, the use of knowledge and skills of an external company, higher quality, and sometimes also the physical inability to provide services by the facility manager or his company.

The formulated scope of tasks carried out in this way leads to the fact that the facility manager person should be distinguished by a number of competences, which were defined by the International Facility Management Association in order to grant the Certified Facility Manager certificate. Based on research conducted in over 60 countries, the key competences of the facility manager include the following capabilities:

1. Leadership and strategic
2. Using new concepts of real estate management, including social responsibility and sustainable development
3. Interpersonal
4. Technical and technological
5. Innovative
6. Designing
7. Taking into account the risk
8. Interpersonal communication (IFMA)

The competences presented emphasize that in addition to activities related to technical maintenance of the building and administration, what is also important is management skills which focus on real estate users and their needs as well as the needs of other stakeholders.

#### **4. Directions of Facility Management Development in Poland**

“Facility management has evolved from a strategically irrelevant business task to a highly professionalised sector, which is worth billions in many countries.” This sector includes, among others: office buildings, banks, financial institutions, trade, shopping centers, production buildings, production halls, warehouses, hospitals, clinics, social institutions, public administration, military, schools, universities, public buildings, conference centers, museums, hotels, etc. (Stickelberger and Erdpresser 2018). The intense development of the real estate market in Poland in recent years and the growing interest of foreign investors meant that many multinational corporations that expect high quality of services have appeared on the real estate market (especially commercial). (Foryś 2006) Therefore, it is necessary to apply international Facility Management standards in real estate management. Requirements for administrators are growing, and the range of services they offer is expanding.

As a result, more and more people are employed in the services sector, and real estate is increasingly the most important property asset of companies. At the same time, expenses related to the management of these assets and investment expenditures increase (Śliwiński and Śliwiński 2006; Jaworek, Karaszewski, and Szałucka 2018).

The changes taking place on the property management services market have changed the perception of the property manager (especially in case of modern commercial buildings) and its services. Services offered on the market include more and more elements. Therefore, the legal functions of the manager are now not only to familiarize with lease agreements and verify their entries, but also to conclude contracts with tenants, which are usually the result of long-term negotiations, and the way they are constructed should not raise any doubts in the future when enforcing their provisions. The manager becomes the intermediary between the owner and the developer and the enforcer of the rights to complete the investment. It is also responsible for debt collection to ensure financial liquidity for property owners. Technical activities do not only include compliance with the law, but also activities related to improving the technical efficiency of the building, coordinating the work of all devices on the site and increasingly certification of buildings in accordance with the Green Building

idea, e.g. LEED, BREAM certificates. Property owners also expect that in the process of arranging or modernizing the building, the facility manager will coordinate the works performed on the site so that they do not hinder the activity of other users, they are in line with, among others, with fire regulations, health and safety, and will consult problems related to the implementation of individual stages. Not only the owner, but also the users require that the costs related to the maintenance of the property be minimized and the financial resources possessed are rationally spent. In its financial and economic activities the facility manager should strive to increase real estate income by looking for additional sources of profit and sources of investment financing for real estate (Najbar 2013).

Competition on the market, as well as an increase in the requirements of property owners, means that it is necessary to offer more and more services. Moreover, deregulation of the property manager's profession in 2014 caused an increase in the number of professional organizations and associations related to the profession of the manager, which may have a significant impact on the development of the real estate market. On the basis of this, it can be stated that the market of real estate management services in Poland is changing rapidly, which in turn leads to an increase in the importance of Facility Management mainly in large cities, where modern, "smart" facilities and shopping centres are emerging that require focus on searching for the best real estate management conditions and achieving the assumed goals related to the organization (Foryś 2014). Transparency Market Research reports "that the Polish facilities management market has excellent growth prospects in the next few years. The market is expected to exhibit a healthy 9.7% CAGR from 2016 to 2024, owing to which, the market, which held an opportunity of US\$14.34 bn in 2015, is expected to rise to US\$32.62 bn by 2024" (Transparency Market Research 2020). It is important to involve the facility manager person already at the stage of project creation, where it may have an impact on making optimal decisions in the field of building architecture, construction technology, equipping with equipment, and then participation in acceptance and training of facilities thanks to which an object with the best adaptation to people working in it will be created, taking into account both functionality, interior arrangement, organizational and economic issues.

## 5. Conclusions

The economic and technological development as well as the increase in foreign investments mean that complex management of facilities will develop dynamically. The factors that affect this are, firstly, investors and foreign funds that are eager to invest on the Polish market. They expect the real estate to bring profits. Therefore, a narrow view of property management focused on administrative activities and daily maintenance of the object is not enough. They expect to develop strategies and activities aimed at minimizing and rationalizing costs. On the other hand, the growing possibility of real estate related to modern technology, interior finishing, external companies with services that can be used and growing competition among managers means that using the services of people who have the knowledge and skills to use this potential is desirable on the market.

Facility Management is primarily interpersonal relations, the ability to coordinate activities and professional knowledge of real estate. The current main challenge facing organizations associated with Facility Management is to educate young people on the best practices in Facility Management.

The Polish market of Facility Management, despite the fact that it is dynamically developing, occurs mainly in large cities, and even there, not all owners and investors on the market are aware of the benefits of employing a facility manager. However, we anticipate that with the constant development of the market and the expectations of users, the activities of property managers will be increasingly performed in accordance with the Facility Management concept.

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# ICT in Food Processing Industry

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**Abstract.** Food industry is currently introducing fully automated production, similar to automotive industry for example. The food processing is a traditional part of processing industry of the Czech Republic, mostly due to the strategic nutritional needs of the population with the requirements for food quantity and quality. Information and communication technologies are today's phenomenon. It is a field developing highly dynamically and the development of the technologies is related to noticeable changes to the functioning of the post-modern society. The aim of the paper is to discuss the use of information technologies in the food industry in the Czech Republic with a focus on different parts of information systems. Using Mann-Whitney U-test and Person  $\chi^2$  test, different characteristics were tested for a sample of 52 enterprises. The results for example did not confirm the research of the Czech Statistical Office from 2018, saying that ICT (information and communication technologies) outsourcing is mostly used by large and middle-sized enterprises.

**Keywords:** food industry; ICT; outsourcing; ERP; CRM; Czech Republic

**JEL Classification:** M15; L86; M11

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## 1. Literature Review

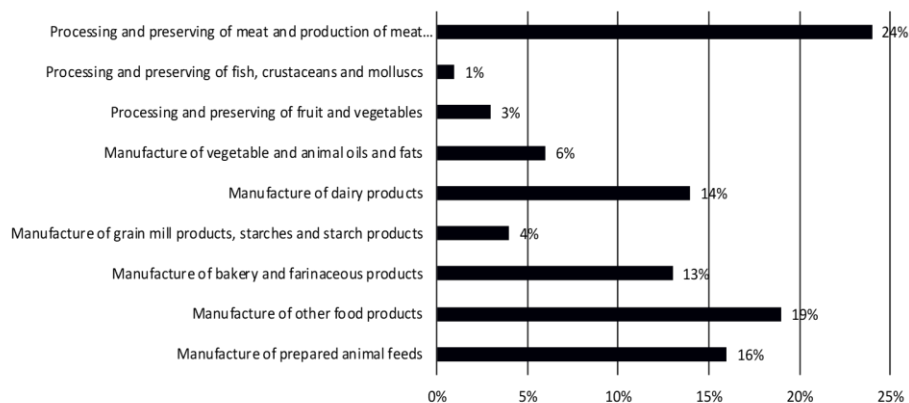
By Adamczewski (2016), information and communication technology are a key part of the world economy and social changes. ICT industry keeps increasing its trend share and it is an important factor of the global economic efficiency; different ICT solutions are the basis for entry into the development phase known as the information society in the case of modern organizations for which the advanced structure of ICT is a prerequisite for their effective management.

In the corporate sector, globalization is manifested primarily by the growth of multinational corporations and ICT with the ability to build large corporate networks, connecting the enterprises with the help of the Internet in the framework of global corporations. With the introduction of new technologies, enterprise information systems are created, connecting subsidiaries into international corporations, in many areas such as logistics, strategic purchasing of materials, building their own sales channels and management accounting (Volek et al. 2015).

Gála (2006) says that business informatics should primarily respond to business needs. It must provide the results and effects significant for the company on the market and at the same time adequate in relation to the investments made in it. To do so, it is important that IT specialists and qualified users accurately formulate their requirements, define their content, and work together on organizational, operational, and other business informatics elements. Informatics has become a common part of economic and business transactions, analyses, marketing and manufacturing technologies. The most important part of the current developments in informatics is related to its gradual integration into various business areas and everyday human activities. With a view to a qualified assessment of the level of enterprise informatics, it is necessary to define the basic demands on performance and its quality that it should bring to businesses.

Food production is a traditional part of processing industry of the Czech Republic, mostly due to the strategic nutritional needs of the population with the requirements for food quantity and quality (Puticová and Mezera 2008). By CZ-NACE, food industry is classified as section 10, further divided into nine sub-sections.

Figure 1 shows the share of each subgroup on the whole section, in percentages by revenue. The food industry is currently trying to produce fully automated production, similar to, for example, automotive production. However, there are some major differences.



**Figure 1.** Sub-group shares in Section 10 by revenue. (Mezera, Plášil, and Náglová 2018)

The issue, related to automation in the enterprises, is the complexity of information systems. The information system in the food industry must ensure not only the traceability of "components", but also monitor expiration, sample storage, batching, environmental monitoring and compliance with HACCP (Vokoun et al. 2015). Often, the enterprises are forced to install additional support information systems to ensure activity management and reliable operation.

In relation to ICT, 79.6% of the enterprises are equipped with an internal computer network and nearly 100% of the enterprises have Internet access. Manufacturing is a leader in robotics and 0.9% of employees are IT professionals. Bartoš (2017) notices that there are issues in the food industry enterprises in relation to Industry 4.0. In this case, as production lines should decide to start work, and be able to check the availability of raw materials for the product, the problem is that the raw materials in the food industry are often either free-flowing loose or liquid, and are very difficult to be provided with RFID chips (Kunal et al. 2009). Such problem is often solved by using containers provided with the chips easily (Ruiz-Garcia et al. 2018)

Another issue might be related to the equipment used in an enterprise. Often, the desired intelligent communication between an enterprise information system and production technology does not occur automatically, as currently used technologies often do not allow communication interfaces and need to be equipped with external sensors to provide information bridging technologies and enterprise information systems.

By Digital Development (2017), ICT include all technologies used to deal with information and communication. A similar term, IT (information technology) was complemented by an element of communication, given the ability of computers and other devices to communicate through a network.

With the development of such networks, the telecommunications infrastructure was digitized; at present, the difference between telecommunications and the Internet is primarily in the requirements for speed and reliability of data delivery. Technological progress is seen as a driver for economic growth and job creation, ICT transforms many aspects of world economies, governments and societies, even in developing countries, where public officials, citizens and businesses can leverage the transformational power of ICT to deliver more efficient services, support economic growth and strengthen social relations.

From the perspective of information system components, ERP (Enterprise Resource Planning) applications of manufacturing and trading enterprises are the most important part of enterprise informatics. They provide the enterprise with resource records, sales, purchases, and more. In addition to ERP applications, there is a number of other applications, known as Business Intelligence, implemented, significantly affecting the performance and efficiency of information systems (Duan and XU 2012). By Novotný, Pour, and Slánský (2005), Business Intelligence components include Executive Information Systems (EIS) that create their own multidimensional layer through which users access

the requested data. These are applications that incorporate all the most important data sources of the system relevant to the organization as a whole, they are analytical and presentation tools (Zadeh et al. 2018). These applications are designed with a view to future users – the managers who often do not have the knowledge of IT, this is what distinguishes these applications from other business intelligence tools. With the development of Internet infrastructure - ICT in general, individual information systems are interconnected with those of other businesses and business partners. These communications and collaborative ties have given rise to a group of e-Business applications, including e-commerce, supply, supply chain management, and mobile trading. The external part of the information systems consists of customer relationship management (CRM) applications that include business contact analysis, evidence, customer communication management, and the like (Hajiha et al. 2011). These parts of the IS can be used in as separate units - software, and as integrated parts of a complex IS, referred to as ERP II.

## 2. Methods

The aim of the paper is to describe the use of ICT in the food industry in the Czech Republic with a focus on different parts of information systems and outsourcing.

The sample consists of 52 enterprises of food industry. Data collection took place in 2017-2018 using a questionnaire survey, where twenty questions were used (using closed, dichotomous and scale question types). The overall return on the questionnaires was approximately 3.8% of the more than 1,300 businesses addressed, where the selection was based on the sub-groups of the food industry listed in Section 10 (see Figure 1).

The data were analyzed and an analysis of the current status of enterprises in the area of ICT was performed using statistical methods. Both descriptive statistics and three statistical tests (Mann-Whitney U-test and Pearson's  $\chi^2$ ) were used to analyze the current state. For a comprehensive analysis of the data, the results were in many cases compared with current research in the Czech Republic and abroad. Based on the mentioned researches, there were always formulated zero and alternative hypotheses. Regarding the description of the sample, there were 58% of small enterprises (<50 employees), 27% of middle-sized enterprises (<250) and 15% of large enterprises (>250 employees). The average number of employees in sample enterprises amounted to 156. In the classification of enterprises, depending on the type of market in which the business is located, a total of 23% consists of business to government markets. The largest group of enterprises (81%) is in business to consumer markets. The last group surveyed (50%) consists of businesses operating in business-to-business markets; however, the groups are intertwined as one enterprise can operate in multiple markets.

## 3. Results

At first, the relation of using information systems and the size of the enterprise was tested, Null hypothesis of non-existence of the difference between the number of employees of the enterprises using the information system and the number of employees not using it was tested by the Mann-Whitney U-test. In the sample, 83% of the enterprises use the information system, and the remaining 17% do not. All medium-sized and large enterprises use it.  $H_0$  was rejected at a significance level of 0.05, in favour of  $H_A$ : the enterprises using the information system have more employees; and the resulting p-value was rather close to zero (0.001).

**Table 1.** Pearson  $\chi^2$  test – area of activity – different IS.

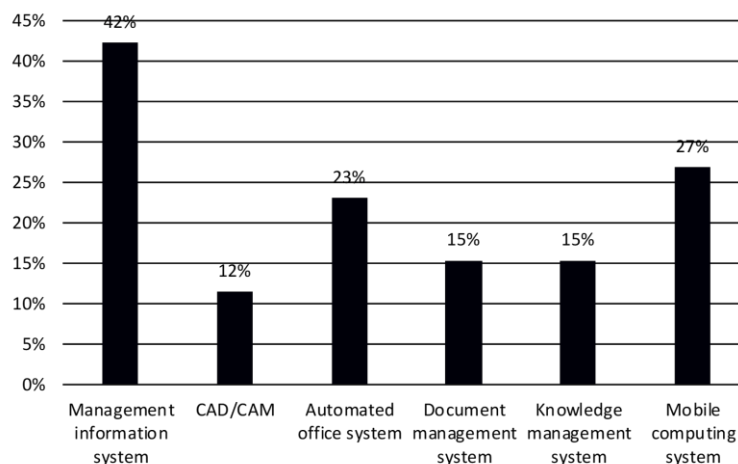
IS	$\chi^2$	df	p-value	$H_0$
SAP	17.85859	df=1	p=.00002	rejected
Karat	.0049256	df=1	p=.94405	not rejected
Pohoda	.9083779	df=1	p=.34055	not rejected

In relation to the use of information systems, the participants were asked which system they use. The results show that the most common information systems in the food industry include SAP (15%), Karat (12%) and Pohoda (8%). Byznys, Edison, HELIOS, Ports, K2, Origis IT, SOFIX and Twist Inspore are used too, their share in the sample ranges between 4-6%. A total of 23% of the sample do not use a specific information system or do not use it at all.

Using the Pearson test, the relationship between the areas of competence of the enterprises (CR, Abroad) and the above-mentioned most frequently used information systems was tested. The prerequisite is that the enterprises using these systems operate also outside the Czech Republic because of the frequency of use of these information systems and the availability of language versions of these three information systems.

As revealed by the table above, null hypothesis was rejected in the enterprises using SAP on the basis of available data in favour of the alternative hypothesis assuming the dependence of both variables, at the significance level of  $\alpha = 0.05$ . In the case of users of the Karat and Pohoda systems, the level of significance failed to demonstrate the dependence proving the relation of the system and business areas.

Another part of the research was focused on components of information systems, which are used as standard in business practice. The figure below expresses the percentage representation as used by the food industry enterprises.



**Figure 2.** Data distribution - IS parts.

As seen from the figure above, a total of 42% of enterprises use a management information system, 27% of enterprises use a mobile computing system. CAD/CAM (Computer aided design/manufacturing) programs are the least used.

Surprisingly, despite the characteristics and the very nature of these programs - with regard to the food industry - this possibility has been reduced by only two percentage points less than, for example, the document management system. Mobile computing system was the second most common answer to the question "Which parts of the information system does your enterprise use daily?", answered by 27% of the participants.

The Czech Statistical Office also addressed the expansion of mobile computing systems and the use of portable devices with Internet access. Its data show that the number of enterprises using portable Internet-enabled devices has risen by 27% in six years. In terms of the use of ICT, it is equally important that the number of employees using these facilities grew adequately over the same time period by 11%.

Furthermore, the Czech Statistical Office's research showed that 82.7% of enterprises, excluding micro-enterprises, use portable devices with Internet access. If we focus on manufacturing, including food industry, the use of portable devices is lower by only 0.6% than the above figure for all the enterprises in the Czech Republic (expressed as a share of the total number of the enterprises in the sector).

Based on the research of the authors, time analysis and research of the Czech Statistical Office, growth in the use of mobile devices with Internet access is expected, and thus the increased use of mobile computing systems in the processing industry. Furthermore, data from the Czech Statistical Office (abbreviated as CZSO) showed that mobile devices with Internet access are more likely to be used by employees of the small enterprises (30%) than medium-sized and large (25%).

**Table 2.** Mann - Whitney U test – business area – different IS.

Number of employees	Sum of orders No	Sum of orders Yes	U	Z	p-value	H0
Small	356,0000	109,0000	56,00000	-0.803638	0.421607	Not-rejected
Medium-sized	98,00000	7,000000	4,000000	1.369306	0.170904	Not-rejected
Large	11,00000	25,00000	4,000000	0.500000	0.500000	Not-rejected

The assumption was set at the partial conclusion of the CZSO research for performing Mann - Whitney U test.

H0 – There is no difference in the number of enterprises using mobile devices with access to the Internet and those that do not use them.

HA: The enterprises that use mobile devices with connectivity have more employees.

Based on the available data, the null hypothesis denying the difference in the number of employees and the use of mobile devices with connectivity was not rejected in the group analysis at the selected significance level. Thus, the conclusions of the CZSO comprehensive research were not confirmed in the food industry.

Another part of the research was focused on outsourcing services related to ICT. 65% of our sample companies use outsourcing to manage IT. The Czech Statistical Office's research in 2018 dealt with the use of ICT in the business sector, and one of the findings of the research is the claim of using outsourcing in ICT areas rather than medium-sized and large enterprises. The partial conclusion of the research was established as the basis for the use of Mann-Whitney U-test.

**Table 3.** Mann - Whitney U test – enterprise size - outsourcing of ICT activities.

Sum of orders No	Sum of orders Yes	U	Z	p-value	H0
881,0000	497,0000	286,00000	0.37506	0.707311	Not-rejected

H0: There is no difference between the number of employees in enterprises that use the outsourcing of ICT-related activities and the number of employees that do not use it.

HA: Businesses that use outsourcing of ICT-related activities have more employees.

As shown in Table 3, the null hypothesis in favor of the alternative was not rejected at the selected significance level  $\alpha = 0.05$ . Unlike the above-mentioned research, it cannot be argued that outsourcing companies in the food industry have more employees than businesses that do not.



#### 4. Conclusion

The data in the area of information systems show that IS is used in full by the medium-sized and large enterprises. The small enterprises do not use information systems in 100% of cases, this claim was also supported by statistical testing. The fact that not all small enterprises use IS is far from surprising.

However, it is necessary to note that the information system is not software solution only as the enterprises might think. The information system is not only a computer program, see the literature review, and it is therefore likely that although a certain percentage of small enterprises in the questionnaire said they did not use IS, they actually use a certain type of an information system. To support such statement, there is a part of an electronic documentation added to some answers: “we write orders manually, we don't have a code system in the stock, we do not post on Twitter and other social media.”

If we focus on different information systems used by the enterprises, as seen by a large number of IS used, the process of selecting a particular IS depends on personal preferences, economic possibilities, required functions and other variables not investigated.

Regarding the parts of information systems, the management information system are used by more companies than office systems. Although these components are closely linked, this is a positive phenomenon, as the management information system is a more comprehensive component and provides managers with important groundwork for future decision-making (Barthelemy 2004; Heiskanen 2008).

In relation to mobile computing systems in general, there is a growing number of portable devices with Internet access and their own computing system. However, today's digitalization is not an unexpected phenomenon. Positively, the mobile devices are used by medium-sized and large food enterprises, and also by small ones. Negatively can be viewed only 15% of the use of knowledge management systems. Given the fact that more than half of the enterprises are not considered knowledge-based businesses, the situation is all the more serious. The issue of outsourcing ICT-related activities is more than current. The data obtained and the data of the EU countries indicate that outsourcing is preferred to the employed IT specialists in the ICT field (Jalava and Pohjola 2011)

Surprisingly, this preference concerns businesses regardless of their size. In particular, food industry SMEs should take steps towards competitiveness. In the area of outsourcing ICT-related services, the enterprises should not rely on recruiting workers for information technology, but they should use the services of existing ICT-based businesses, as the data available suggest that they are faster, less costly and widely used (Amramovsky 2006; Versteeg 2006).

In addition, the enterprise should seek to change the main IS component from the automated office systems to management information systems that better match the characteristics of a competitive businesses. Emphasis on ecology and social responsibility is not a question for the enterprise but for their employees, who should contribute to sustainable development through their daily activities.

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# Evaluation of Standard of Living in OECD Countries

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**Abstract:** The present paper focuses on the comparison of wage levels across OECD countries, the research data coming from an official OECD website. The following eight variables are employed in this study – the average wage, minimum wage, GDP per head, tertiary education attainment, employment ratio, trade unions, labour productivity and inflation rate. The average wage represents the main explained variable in regression and correlation analysis, the remaining seven variables being used as potential explanatory ones. In order to compare living standards in different countries, average and minimum wages as well as per capita GDP data were adjusted to relative purchasing power parity. The principal objective was to identify which explanatory variables statistically significantly affect the average wage. The analysis showed that only three of them – namely the employment ratio, GDP per capita and labour productivity – have a significant effect at a 5% statistical level. The regression hyperplane with a forward stepwise selection was applied. Nine clusters of OECD countries were created based on both all the eight variables and four of them selected in regression analysis (the average wage and three explanatory ones) with the aim to identify the countries that coexist in the same cluster. Ward's method and Euclidean distance are utilized in cluster analysis, the number of clusters being determined with the use of the Dunn index. The study also aims at the prediction of the average wage by 2022, which was made via exponential smoothing of time series.

**Keywords:** average wage; GDP per capita; purchasing power parity; regression analysis; cluster analysis; time-series analysis

**JEL Classification:** D31; E24; I31

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## 1. Introduction

Recent OECD statistics show that unemployment in member states has fallen to a record level, employment rate exceeding the pre-crisis figures. Employment growth also affects disadvantaged groups of the population such as older workers or mothers with children. A record number of vacancies is registered in Japan, the Eurozone, the United States and Australia. Working poverty, on the other hand, has further increased to 10.6% in the European Union, the poverty threshold being set at a 60% level of the income median of the company. Wage growth, however, is slow, slower than before the recession. At the end of 2017, it was only about half of the growth a decade ago when the average nominal wage grew by 5.8% compared to today's 3.2%. Wage stagnation affects the income of low-paid workers more than that of high-paid ones.

Although all OECD member states are economically advanced, large wage differentials exist between individual countries. For example, the average nominal gross monthly wage in Iceland is more than 14.3 times higher than in Mexico. In the Czech Republic, it was CZK 31,109 in 2017, nine member countries reporting the average gross monthly wage above CZK 100,000 according to OECD statistics (conversion to CZK corresponding to the current exchange rate) – namely Switzerland (CHF 7,170), Iceland (ISK 741,976), Norway (NOK 48,139), Luxembourg (EUR 4,880), Denmark (DKK 34,459), Australia (AUD 6,962), the Netherlands (EUR 4,242), Germany (EUR 4,121) and Belgium (EUR 3,944). The average gross monthly wage did not reach CZK 25,000 only in six OECD states – Poland (PLN 4,131), Slovakia (EUR 952), Hungary (HUF 298,221), Latvia (EUR 909), Turkey (TRY 3,359) and Mexico (MXN 9,850). However, the average wage figure does not correspond to that of a regular employee in all OECD member countries since it is distorted by the wages of the best-paid employees. In the Czech Republic, only about a third of employees earn average and high income, wage differences being

among the lowest in OECD states, the highest ones being recorded in non-European countries in particular.

The standard of living and its measurement has become the point of action and interests of many national and international organizations. The present research focuses on the development of the average annual gross wage in OECD member countries grouped by the location, history and the level of development; see Table 1. The paper aims to describe wage developments in individual OECD countries from the beginning of the century. For this purpose, the analysis of average gross annual wage time series and predictions by 2022 were conducted. Also, the dependence of the explained (dependent) variable (i.e. the average gross annual wage) on other labour market and living standard indicators was verified. The specific objective of the study is to identify which of the seven potentially explanatory (independent) variables influence the average gross annual wage, using regression and correlation methods. Another goal is to create clusters of countries whose living standards are as close as possible to one another in terms of all the eight variables analysed applying the multidimensional method of cluster analysis. The main hypothesis predicts that clusters of countries that are the most similar to each other correspond to the classification of all OECD member countries into individual blocks as displayed in Table 1.

**Table 1.** Blocks of similar OECD countries (incl. international codes).

<b>Block</b>				
<b>Continental</b>	<b>Scandinavian</b>	<b>Anglo-Saxon</b>	<b>South-European</b>	<b>Baltic</b>
1. Austria (AUT)	1. Denmark (DNK)	1. Ireland (IRL)	1. Greece (GRC)	1. Estonia (EST)
2. Belgium (BEL)	2. Finland (FIN)	2. United Kingdom (GBR)	2. Italy (ITA)	2. Latvia (LVA)
3. France (FRA)	3. Norway (NOR)		3. Portugal (PRT)	3. Lithuania (LTU)
4. Germany (DEU)	4. Sweden (SWE)		4. Spain (ESP)	
5. Luxembourg (LUX)				
6. Netherlands (NLD)				
7. Switzerland (CHE)				

<b>Block</b>			
<b>Central-European</b>	<b>North-Atlantic</b>	<b>Advanced non-European</b>	<b>Developing non-European</b>
1. Czech Republic (CZE)	1. Iceland (ISL)	1. Australia (AUS)	1. Chile (CHL)
2. Hungary (HUN)		2. Canada (CAN)	2. Mexico (MEX)
3. Poland (POL)		3. Israel (ISR)	3. Turkey (TUR)
4. Slovak Republic (SVK)		4. Japan (JPN)	
5. Slovenia (SVN)		5. New Zealand (NZL)	
		6. South Korea (KOR)	
		7. United States (USA)	

## 2. Database

Data and variable names come from the official OECD website (see stats.oecd.org), the present analysis covering all the member countries. The eight variables are used, indicated in shortened forms in the text. The average annual gross wage – average wage – in 2017 constant prices in USD after conversion to purchasing power parity (PPP) is the main research variable, the study focusing on its development over the period 2000–2017. The other seven variables based on the 2017 data are as follows: real annual minimum wage in USD after the PPP adjustment – minimum wage; gross domestic product per head in USD PPP (expenditure approach) – GDP per capita; share of the population (in %) between 25 and 64 years of age with completed tertiary education – tertiary education; annual employment ratio (in %) of the population between 15 and 64 years – employment ratio; annual trade union density (in %) – trade unions; labour productivity measured by GDP per hour worked in USD PPP – labour productivity, and consumer price indices (CPI) representing change in 2017 from the previous year (in %) – inflation. (Minimum wage legislation not being enacted in some

countries – namely Austria, Denmark, Finland, Italy, Norway, Sweden and Switzerland –, the minimum wage is then considered as zero.)

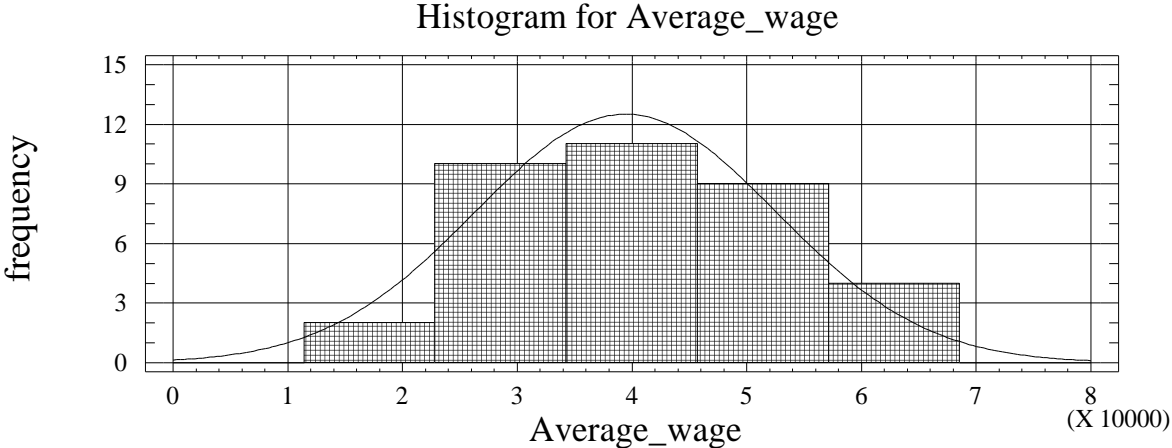
The data include employees in both business and non-business sectors of the economy. The wage is paid to an employee for work done in the private corporate (business) sphere, while the salary is earned in the state budgetary (non-business) sector. Within the present study, both wages and salaries are under the umbrella term of “wage”. Data were processed using SAS and Statgraphics software packages and Microsoft Excel spreadsheet. Table 1 shows the division of all 36 OECD member countries into nine blocks according to their location, history and the level of development. (Country codes are taken from the website of the Ministry of the Interior of the Czech Republic.)

There are the following nine groups of OECD member states: Continental block of advanced Western European countries; Scandinavian block; Anglo-Saxon block containing Ireland and the United Kingdom; South-European block; Baltic block of three OECD countries that were formerly part of the Soviet Union; Central-European block encompassing former socialist countries; North-Atlantic block including only Iceland; Advanced non-European block and Developing non-European block of the so-called newly industrialized countries.

**3. Theory and Methodology**

*3.1 Regression and Correlation Analysis*

The regression and correlation analysis of the 2017 data was performed; for details of this approach, see, e.g. (Darlington and Hayes 2017). The average wage represents an explained (dependent) variable, the remaining seven variables being used as potentially explanatory (independent) variables. The normality of the distribution of the variables was verified both visually and by conducting the Kolmogorov-Smirnov goodness-of-fit test, the chi-square test not being run because of too small a number of observations. Figure 1 and Table 2 show the results of normality verification for the average wage. Although the wage variable has mostly a lognormal distribution, i.e. with positive skewness, the average wage variable has a symmetrical distribution, which provides evidence in favour of a normal distribution; see Figure 1. P-value of 0.311443 in Table 2 indicates that the hypothesis assuming the normality of the average wage distribution was not rejected at any (i.e. 5%, 1% or 10%) level of significance. The normality of the other variables was verified analogously.



**Figure 1.** Results of visual verification of average wage variable.

**Table 2.** Results of Kolmogorov-Smirnov goodness-of-fit test for average wage.

Goodness-of-fit tests for average wage				
Chi-square test				
Lower limit	Upper limit	Observed frequency	Expected frequency	Chi-square
at or below	34,285.7	12	12.51	0.02
34,285.7	45,714.3	11	12.11	0.10
45,714.3	above	13	11.38	0.23

Insufficient data to conduct Chi-square test.

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Estimated Kolmogorov statistic DPLUS = 0.160795  
 Estimated Kolmogorov statistic DMINUS = 0.0938418  
 Estimated overall statistic DN = 0.160795  
 Approximate P-value = 0.311443

The regression hyperplane with seven potentially explanatory variables having been considered, stepwise regression with the forward selection method was used to determine the set of explanatory variables that have a statistically significant effect on the explained variable; see Table 3. The backward selection approach led to the same result. It is clear from the table that three explanatory variables were inserted into the model, namely the employment ratio, GDP per capita and labour productivity. All individual t-tests and total F-test are significant at the 5% level. The multiple determination coefficient shows that about 80.43% of the variability of the observed average wage values was explained by the selected regression hyperplane and the three explanatory variables. A Durbin-Watson statistic of 2.47733 lies in the interval (1.4; 2.6). Being close to 2, this value indicates that there is no problem with autocorrelation. The matrix of double correlation coefficients for verification of the existence of serious multicollinearity between the explanatory variables suggests that the absolute value of any of the correlation coefficients does not exceed 0.5. This means that there is no problem with multicollinearity. Figure 2 displays the residual plots corresponding to the model with the three selected explanatory variables, the residues being considered as random. In addition to the visual assessment, the Glejser test was undertaken, not showing any problems with heteroscedasticity.



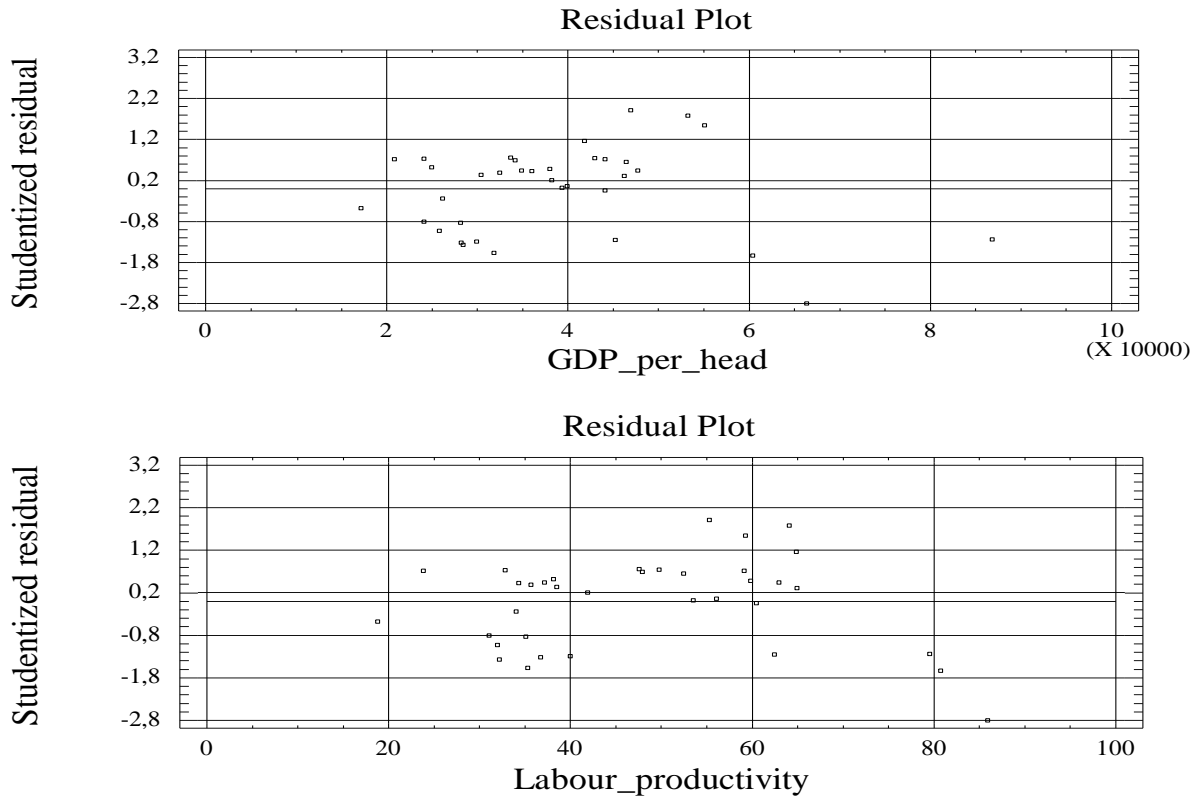


Figure 2. Residual plots.

### 3.2 Cluster Analysis

The basics of this multidimensional statistical method are explained, for example, by (Rencher and Christensen 2012). Ward's method and the Euclidean distance are the most widely used techniques that are also employed in this cluster analysis of the 2017 data, performed separately for both all the eight variables and only four of them, namely the average wage and the three explanatory variables selected in the regression and correlation analysis.

In the Ward's method, which is one of the hierarchical clustering approaches, the procedure is not based on the optimization of distances between clusters. The minimization of heterogeneity of clusters is carried out according to an increase in the intra-cluster sum of squares of objects' deviations from the centre (centroids) of the clusters. Ward's method tends to remove too small clusters, thus inclining to form those of roughly the same size, which is a welcome feature for the clustering of the OECD countries. As for the measurements of the distance and similarity of objects, the need to reinforce the influence of variables is taken into account. Since there is no such need in this case – points with the same distance from the centre lying on a circle –, the Euclidean distance was chosen.

Table 3. Results of linear regression analysis using stepwise regression and forward selection.

<b>Multiple regression analysis</b>				
Dependent variable: Average wage				
Parameter	Estimate	Standard error	T-statistic	P-value
CONSTANT	-20,402.5	10,420.0	-1.95801	0.0490
Employment ratio	420.915	158.114	2.66209	0.0120
GDP per capita	0.393688	0.178743	2.20254	0.0349
Labour productivity	317.248	148.38	2.13808	0.0402

### Analysis of variance

Source	Sum of squares	DF	Mean square	F-ratio	P-value
Model	4.84677E9	3	1.61559E9	43.83	0.0000
Residual	1.17951E9	32	3.68597E7		
Total	6.02628E9	35			

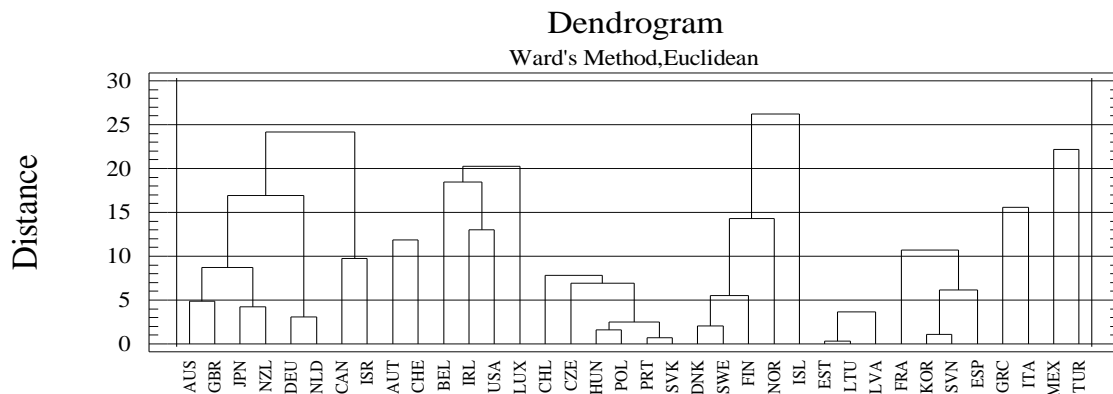
R-squared = 80.4272%

R-squared (adjusted for d.f.) = 78.5923%

Standard error of est. = 6071.22

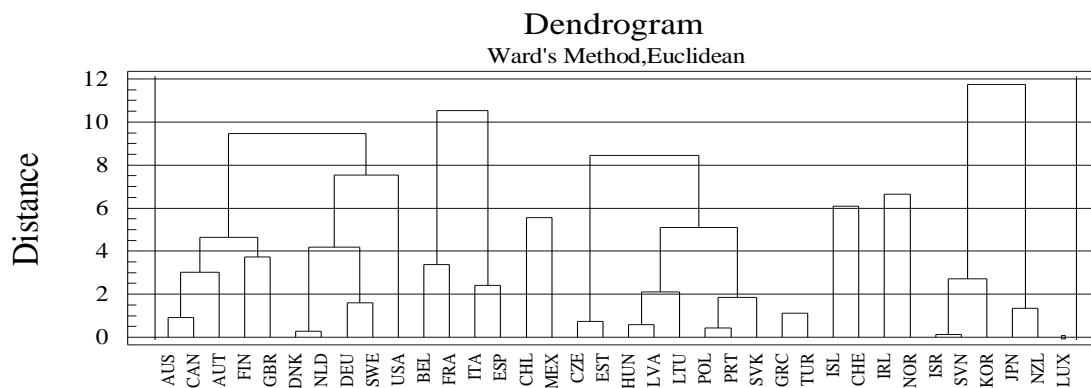
Mean absolute error = 4770.67

Durbin-Watson statistic = 2.47733



**Figure 3.** Results of cluster analysis applied to all eight variables.

In cluster analysis, there are different methods and recommendations for determining the optimal number of clusters. However, they do not justify any definitive conclusions because cluster analysis is basically a reconnaissance approach, not a statistical test. Exposition and clarification of the resulting hierarchical structure depend on the context. Theoretically, there are several possible approaches to determining the best number of clusters possible. One of the validation indices is the well-established Dunn index. It represents the ratio of the smallest inter-cluster distance to the largest one, the index values ranging from zero to infinity, high ones indicating the optimal number of clusters. In the present study, the Dunn index was also applied, nine clusters being determined as optimal; see Figures 3 and 4.



**Figure 4.** Results of cluster analysis applied to four selected variables.

### 3.3 Time Series Analysis

The essence of time series analysis is described in detail in, e.g. (Brockwell and Davis 2002). In the context of the trend development, exponential smoothing was done within the analysis of average wage time series to predict the average wage over the next five years. Exponential smoothing is one of



the adaptive approaches to modelling time series, using the weighted least squares method, with scales exponentially decreasing towards the past. Its advantage lies in the fact that the latest observations have the highest weights. Appropriate exponential smoothing was selected applying interpolation criteria. Figures 5 and 8 present the results of Brown's and Holt's linear exponential smoothing, respectively, as the most suitable approaches to the time series of the United States and Lithuania. In the case of Holt's exponential smoothing, the statistical software automatically evaluates the most advantageous combinations of equalization constants  $\alpha$  and  $\beta$ .

Figures 6 and 9 plot corresponding sample residual autocorrelation functions, Figures 7 and 10 illustrating sample residual partial autocorrelation functions. Brown's and Holt's linear exponential smoothing is satisfactory, a non-systematic component not exhibiting autocorrelation. Durbin-Watson statistics are close to 2, i.e. within the interval (1.4, 2.6). Random failures can be therefore considered as independent.

Table 4 shows the quality of models created for the average wage in the United States and Lithuania, based on which the prediction for the next five years was made. Annual time series for the period 2000–2017 were shortened by  $m = 5$  observations, i.e. for the 2013–2017 period, predictions for these five years being constructed using the appropriate exponential smoothing. Deviations between the predicted and actual values were calculated as

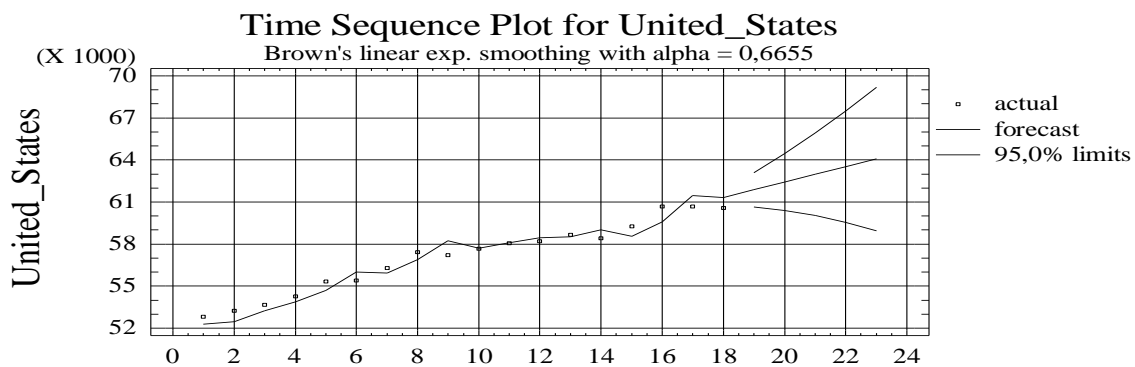
$$\Delta_t(i) = P_t(i) - y_{t+i}, \quad (1)$$

where  $P_t(i)$  is the forecast of the monitored indicator at time  $t$  of  $i$  time units forward (prediction horizon) and  $y_{t+i}$  is the real value of the predicted indicator at time  $t + i$ . These deviations are called predictive errors for a given time  $t$  and the prediction horizon  $i$ ; see Table 4. If  $\Delta_t(i) < 0$ , this is the so-called undervalued prediction, and if, on the other hand,  $\Delta_t(i) > 0$ , an overvalued prediction occurs.

The Theil mismatch coefficient (Theil index II) is a frequently used measure of the variability of relative predictive errors

$$T_H^2 = \frac{\sum_{t=1}^m [P_t(i) - y_{t+i}]^2}{\sum_{t=1}^m y_{t+i}^2}. \quad (2)$$

This mismatch index can be only non-negative. It gets the lower zero boundary only in the case of a flawless prognosis, where  $P_t(i) = y_{t+i}$ . The more the Theil coefficient deviates from zero, the more the prediction differs from an ideal prognosis. The root of the index can be interpreted as a relative predictive error.



**Figure 5.** Brown's linear exponential smoothing ( $\alpha = 0.6655$ ) for time series of average wage in the United States.

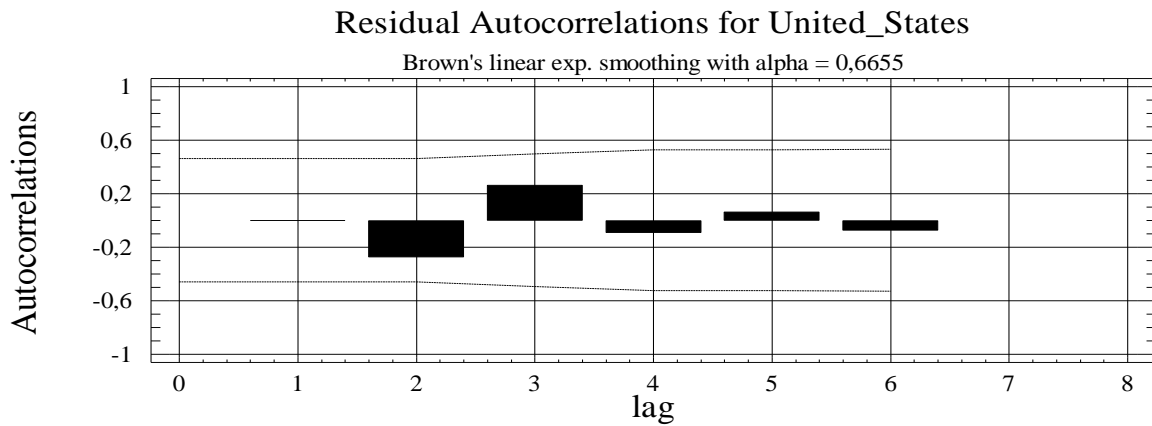


Figure 6. Sample residual autocorrelation function for time series of average wage in the United States.

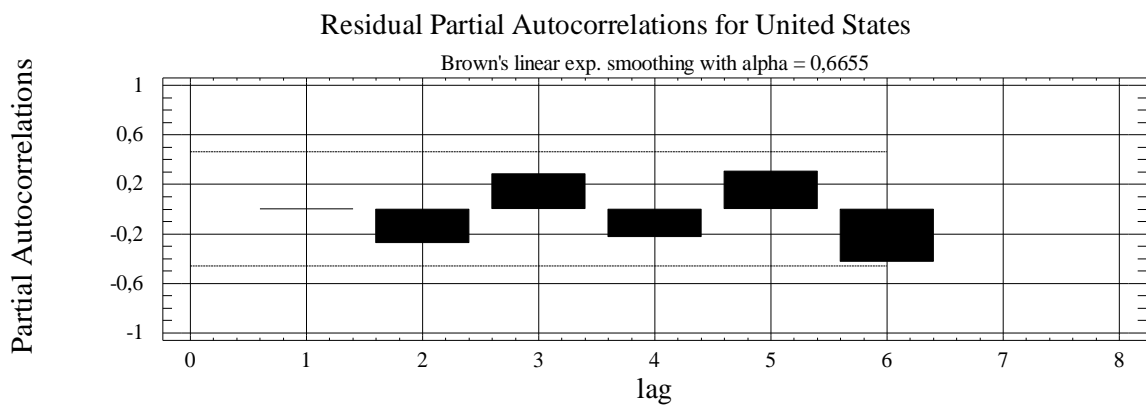


Figure 7. Sample residual partial autocorrelation function for time series of average wage in the United States.

Table 4 shows that when constructing extrapolation predictions of the average wage rate, average errors of 1.543% and 6.571% (for the U.S. and Lithuania, respectively) occurred. The values of the Theil coefficient and the relative predictive error indicate the high quality of exponential smoothing models. A similar verification of the suitability of the chosen smoothing models was also carried out for the other analysed countries.

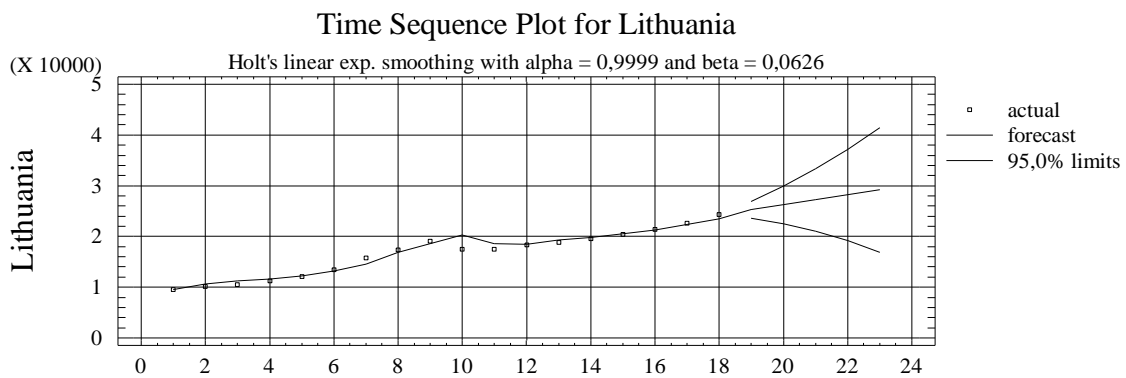


Figure 8. Holt's linear exponential smoothing ( $\alpha = 0.9999$  and  $\beta = 0.0626$ ) for time series of average wage in Lithuania.

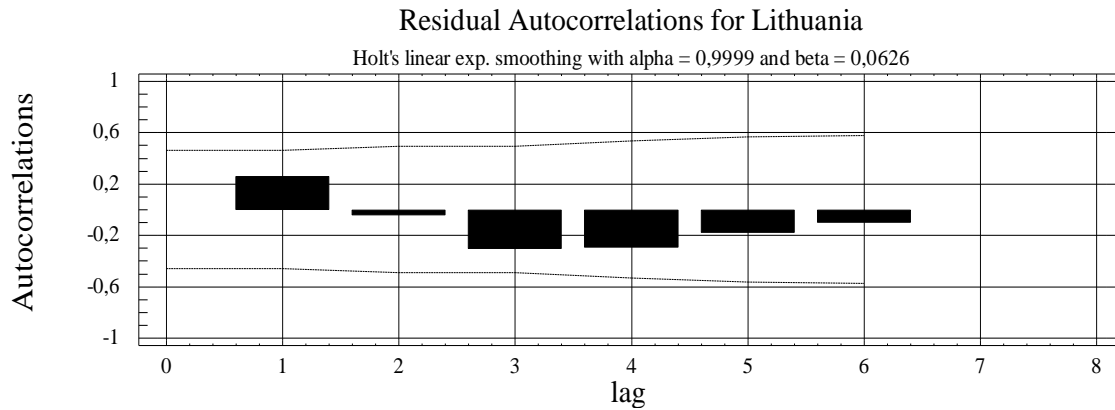


Figure 9. Sample residual autocorrelation function for time series of average wage in Lithuania.

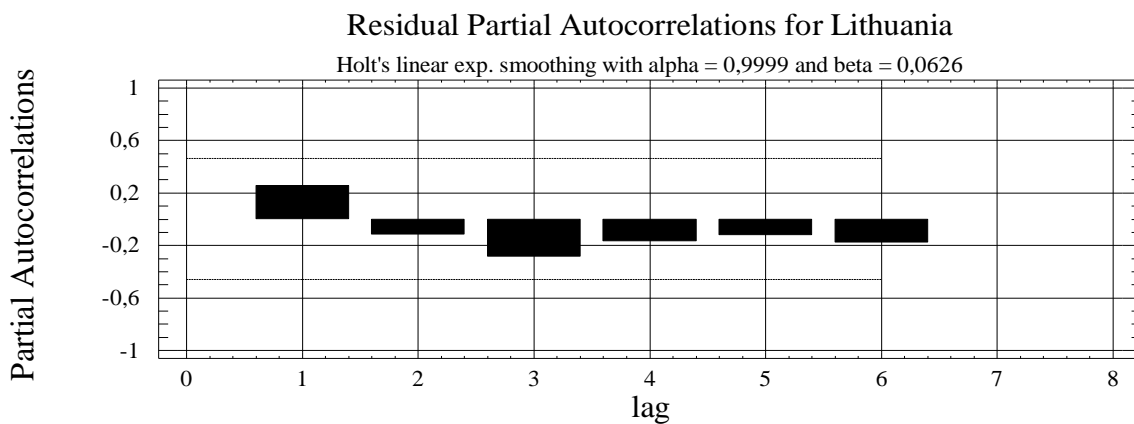


Figure 10. Sample residual partial autocorrelation function for time series of average wage in Lithuania.

#### 4. Results and Conclusion

The world economy has been heading toward a five per cent rate of unemployment, the lowest over the last four decades. A more relaxed budgetary policy has supported the economic growth (its effects are apparent in about three quarters of the OECD countries), tax reliefs (e.g. recent US cuts) also playing their role.

Only three explanatory variables were inserted into the model as statistically significant at a 5% level in a positive direction, namely the employment ratio, GDP per capita and labour productivity. The sample regression hyperplane has the following form (cf. Table 3)

$$\text{Average wage} = -20,402.5 + 420.915 * \text{employment ratio} + 0.393688 * \text{GDP per head} + 317.248 * \text{labour productivity}.$$

Table 4. Time series prediction errors for the United States and Lithuania.

Year	United States			Lithuania		
	Reality	Model	Error	Reality	Model	Error
2000	52,801	–	–	9,544	–	–
2001	53,244	–	–	10,091	–	–
2002	53,652	–	–	10,532	–	–
2003	54,280	–	–	11,232	–	–
2004	55,335	–	–	12,157	–	–
2005	55,391	–	–	13,469	–	–
2006	56,298	–	–	15,788	–	–
2007	57,420	–	–	17,403	–	–

2008	57,192	–	–	19,087	–	–
2009	57,687	–	–	17,519	–	–
2010	58,054	–	–	17,530	–	–
2011	58,200	–	–	18,345	–	–
2012	58,669	–	–	18,854	–	–
2013	58,412	58,734	322	19,608	19,412	–196
2014	59,250	58,991	–259	20,393	19,970	–423
2015	60,692	59,249	–1,443	21,417	20,528	–889
2016	60,686	59,507	–1,179	22,562	21,085	–1,477
2017	60,558	59,764	–794	24,287	21,643	–2,644
	$T_H^2$	0.000238		$T_H^2$	0.004317	
	$T_H$	0.015427		$T_H$	0.065706	

**Table 5.** Groups of countries that are always in the same cluster (for both eight and four variables analysed)

Groups of countries				
Group 1	Group 2	Group 3	Group 4	Group 5
1. Australia	1. Israel	1. Denmark	1. Czech Republic	1. Estonia
2. Canada	2. Japan	2. Finland	2. Hungary	2. Latvia
3. Germany	3. New Zealand		3. Poland	3. Lithuania
4. Netherlands			4. Portugal	
			5. Slovak Republic	

The blocks of the OECD countries broken down by their location, history and stage of development do not fully coincide with the groups of countries whose cluster analysis results are similar. However, there are many countries which are always in the same group, whether they are clustered by all eight or selected four variables analysed. These groups of countries are listed in Table 5. The first one comprises four countries, two of them belonging to the block of advanced non-European countries, the other two to the block of continental OECD states. The second group is made up of three countries which are also among the advanced non-European countries. The third group consists of two Scandinavian countries. The fourth one contains four states that belong to the Central European block of post-communist countries plus one southern European country. Finally, the fifth group is made up of the three Baltic states that used to be a part of the Soviet Union. Table 6 gives predictions of the average wage by 2022 for individual OECD member countries, except for Turkey. The highest expected average annual wage growth rates for the period 2018–2022 being predicted for the Baltic states, namely 4.58%, 3.66% and 2.15% for Latvia, Lithuania and Estonia, respectively. A relatively fast average wage growth can be also expected in most Central European countries, namely in the Czech Republic (3.44%), Slovakia (2.75%), Poland (2.58%) and Hungary (2.51%). The rapid annual increase in the average wage is also projected for Iceland (2.38%). The lowest wage growth values, on the other hand, are forecast for South-European countries – Greece, Italy and Portugal.

**Table 6.** Average wage prediction by 2022 (in USD).

Block of countries	Country	Prediction for year				
		2018	2019	2020	2021	2022
Continental	1. AUT	51,219	51,681	52,142	52,604	53,066
	2. BEL	49,721	49,766	49,812	49,857	49,903
	3. FRA	44,179	44,593	45,007	45,421	45,836
	4. DEU	48,613	49,368	50,123	50,878	51,633
	5. LUX	62,917	63,455	63,992	64,530	65,067
	6. NLD	53,089	53,298	53,508	53,717	53,926

	<b>7. CHE</b>	63,651	64,065	64,479	64,892	65,306
<b>Scandinavian</b>	<b>1. DNK</b>	51,935	52,404	52,873	53,342	53,811
	<b>2. FIN</b>	43,247	43,531	43,814	44,097	44,381
	<b>3. NOR</b>	51,941	52,669	53,397	54,126	54,854
	<b>4. SWE</b>	43,519	44,202	44,885	45,568	46,250
<b>Anglo-Saxon</b>	<b>1. IRL</b>	47,763	48,178	48,593	49,008	49,423
	<b>2. GBR</b>	43,969	44,205	44,442	44,679	44,916
<b>South-European</b>	<b>1. GRC</b>	26,226	26,176	26,126	26,076	26,026
	<b>2. ITA</b>	36,635	36,611	36,588	36,564	36,541
	<b>3. PRT</b>	25,369	25,296	25,223	25,150	25,077
	<b>4. ESP</b>	39,452	39,569	39,685	39,802	39,919
<b>Baltic</b>	<b>1. EST</b>	24,887	25,439	25,990	26,541	27,093
	<b>2. LVA</b>	25,204	26,441	27,678	28,915	30,152
	<b>3. LTU</b>	25,263	26,238	27,214	28,189	29,165
<b>Central-European</b>	<b>1. CZE</b>	26,231	27,181	28,131	29,081	30,031
	<b>2. HUN</b>	23,180	23,785	24,389	24,994	25,598
	<b>3. POL</b>	27,225	27,956	28,687	29,418	30,149
	<b>4. SVK</b>	25,239	25,964	26,688	27,413	28,137
	<b>5. SVN</b>	35,310	35,686	36,063	36,440	36,816
<b>North-Atlantic</b>	<b>1. ISL</b>	63,351	64,915	66,479	68,043	69,607
<b>Advanced non-European</b>	<b>1. AUS</b>	49,368	49,603	49,839	50,075	50,311
	<b>2. CAN</b>	48,081	48,540	48,998	49,456	49,915
	<b>3. ISR</b>	35,322	35,577	35,831	36,086	36,341
	<b>4. JPN</b>	40,748	40,780	40,811	40,843	40,874
	<b>5. NZL</b>	40,560	41,075	41,591	42,107	42,622
	<b>6. KOR</b>	35,791	36,391	36,990	37,590	38,190
	<b>7. USA</b>	61,871	62,420	62,970	63,519	64,069
<b>Developing non-European</b>	<b>1. CHL</b>	18,861	19,077	19,292	19,508	19,724
	<b>2. MEX</b>	15,411	15,421	15,430	15,439	15,448
	<b>3. TUR</b>	-	-	-	-	-

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# Innovation of Customer Chemicals Packaging in Concern of Sustainability

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**Abstract:** Increasing the environmental orientation of manufactured products and business activities is becoming the current trend in the area of corporate management. Logistics activities and the packaging of products are also becoming focal points as they have significant potential to reduce the environmental burden. Great attention is paid to primary packaging, especially if the company uses plastic packaging. The article deals with the possibilities of primary packaging innovation for selected consumer chemical products in order to reduce the volume of used plastics. Possibilities of innovation were identified by content analysis of information obtained in primary qualitative research in a medium-sized company engaged in the production of consumer chemical products. It has been found that the reduction of plastic packaging waste for a selected product can be achieved by replacing the plastic with another material, changing the colour of the plastic packaging, using recycled plastics in packaging production, changing the packaging production technology, through innovations of the packaged product, changes in the management of the sales process, introduction of a plastic packaging reuse system and application of recycling. However, the implementation of individual innovations always means an increase in operating costs, some of which will also require investment costs.

**Keywords:** supply chain management; packaging; chemical product

**JEL Classification:** M11; M21

## 1. Introduction

Today's world is characterized by a turbulent market environment and the search for ways to increase competitiveness. This aspect, together with society's growing interest in environmental protection, is making the concept of sustainability increasingly popular (González-Boubeta et al. 2018). Business entities tend to improve the activities carried out on the basis of this concept. They focus on improving a range of activities, much attention is paid to supply chain management activities. Improvement can concern any of the three pillars of sustainability. The most studied in sustainable supply chain management are the economic and environmental dimensions (Bendul et al. 2017), while the social aspect is usually left aside (González-Boubeta et al. 2018). According to Abdullah et al. (Abdullah et al. 2018) green supply chain management is essential for the enterprise's sustainability. Environmental aspects of supply chain management should be particularly addressed in achieving logistic excellence in the 21st century (Karia and Asaari 2013).

Environmental aspects are associated with both direct flow (shipping from producer-to-end user movements), and reverse flow (end user-to-producer movements - reverse logistics). Both of these flows affect environmental performance. Thus, in order to improve environmental performance, attention must be paid to the activities involved in these flows, in particular to activities related to transports, storage or warehousing, inventory management, packaging and materials handling (Karia and Asaari 2013). Packaging provides a great opportunity to increase environmental performance.

The authors (Saghir 2002; García-Arca and Prado-Prado 2008; Bramklev 2009) identify three main requirements that exist in the design of packaging - business requirement, logistic requirement and environmental protection requirement. From a commercial and logistical point of view, packaging in the supply chain plays an important role by providing customers with information about the product (size,

weight, colour, content, density), but also by minimizing product loss and damage at various stages of distribution. At the same time, it facilitates efficient storage and handling. However, the environmental protection requirement makes businesses also focus on the environmental aspects of packaging (Dharmadhikari 2012). Packaging is not just a carton or a box, but a system that enables safe, cost-effective storage, handling, transportation and marketing support (Dixon-Hardy and Curran 2009), while respecting environmental requirements. Some authors describe the development of the right packaging as an indispensable activity in building sustainable supply chain management (Mejías et al. 2016), as a strategic element in achieving the economic and environmental performance of the enterprise (González-Boubeta et al. 2018).

Plastics are a major environmental problem associated with packaging. They are often disposable multi-layer plastics that cause unsustainable consumption and environmental burdens (Meherishi et al. 2019). Therefore, packaging innovation to reduce plastics can be a very significant environmental improvement. At the same time, such an innovation can significantly contribute to strengthening customer relations, especially if they are large retailers. They want better environmental performance and ever-lower prices without sacrificing product quality. Therefore, they constantly put pressure on suppliers to invest in reducing packaging and energy consumption (Yenipazarli 2017).

Reducing the volume of plastic packaging is of particular interest to the food industry, which produces large volumes of plastic disposable packaging for everyday products. In other sectors, interest in the same is beginning to develop. Not surprisingly, manufacturers of consumer chemicals are also interested in reducing plastic packaging. Like food businesses, they produce products bought relatively often at relatively reasonable prices, packaged in standard plastic packaging. Innovation in the packaging of consumer chemical products can bring significant environmental benefits. Examples of practical innovations in this field are already known. For example, P&G has developed 2X" versions of their products to meet its customer's (Wal-Mart) requirements on liquid laundry detergents (packaging the same number of loads into a half-sized bottle) (Makower and Pike 2009). The same company uses sugar cane-derived plastic packaging for its Pantene Pro-V brand in the Western Europe region. The raw material for packaging is produced by a process that transforms sugar cane into ethanol by fermentation. Ethanol is further converted to ethylene by a polymerization process and subsequently to a high-density polyethylene plastic (Dharmadhikari 2012). In 2006, Unilever also introduced a detergent in a concentrated form. Using the concentrate, consumers could wash the same volume of garments with one third of the product. This resulted in significant savings in packaging material, with effects also on product storage (Atkinson 2008).

There are certainly more ways to innovate plastic packaging for consumer chemical products. Variants may be associated not only with the innovation of the product itself, but also with changes in packaging material or weight. Recycling systems for plastics used for packaging consumer chemical products or systems for the reuse of such packaging can also contribute to sustainability. The aim of the article is to define the possibilities of reducing the volume of plastic used to package a selected consumer chemical product. The aim of the article will be achieved through primary qualitative research, which was carried out in a medium-sized enterprise of the chemical industry.

The main outputs of the article will serve as a contribution to the identification of possibilities to reduce the volume of plastic containers used for consumer chemical products. These outputs will enrich theoretical knowledge in the field of packaging sustainability, but can also directly serve businesses producing consumer chemical products to manage innovations of the plastic packaging of their products.

## **2. Theoretical Definition of Plastic Packaging Innovations in the Interest of Sustainability**

Innovation of packaging to reduce the volume of produced and disposable plastics is a typical green innovation. It allows to reduce the amount of consumed resources and produced waste (especially from packaging) and various other, e.g. energy losses. It can be connected to any stage of production of packaging, its use and removal, i.e. the process of packaging production, packaging itself, distribution of products in the packaging, commercialization of the product (García-Arca et al. 2014), packaging reverse flow or recycling.

Environmentally oriented packaging innovations can be classified in two groups, namely (Karia and Asaari 2013):

- technical and technological,
- non-technological and administrative.

Technical and technological innovations may include all changes related to the production of the packaging or the product packaged therein. This group of innovations includes eco-friendly packaging design, saving material and energy resources in packaging production (Chen et al. 2006; Chen 2008) or reducing packaging volume in one-off sales.

The design of eco-friendly packaging may include:

- replacement of plastics with environment-friendly material (relatively easy-to-recycle material, e.g. paper, biodegradable material, e.g. starch, corn, sugar cane, or reusable, e.g. glass) (Liwen and Juan 2010; Dharmadhikari 2012),
- replacement of plastics with recycled plastics,
- adjustment of packaging size and/or weight. This group of innovations also includes technological changes in the production of packaging, e.g. removal of unnecessary packaging layers (Karia and Asaari 2013) or reduction of packaging density, e.g. by bubbling (by injecting gas to create gas bubbles in the middle layer of the bottle wall) (Magnier and Schoormans 2015).

Energy saving is related to technological innovations associated mainly with packaging production. In this context, it is not only energy savings, but generally any resource savings in packaging production, including the use of secondary sources for production (recycled materials as inputs, secondary energy or energy that comes from renewable sources) (Dharmadhikari 2012).

Reducing the volume of the packages may be associated with reducing the size of the packaging as a result of modification of the product placed therein, or also in the case of greater use of the package (e.g. the air layer is reduced). This may also reduce the number of re-purchases of products in plastic packaging.

Non-technological and administrative innovations may include changes in processes and techniques (including changes in business and transport processes), greening of supply, changes in customer relationship management, knowledge management (Karia and Asaari 2013), but also changes in the hardware and software used to manage environmental innovation (Flint et al. 2005). This group of innovations may also include the setting up of a packaging recycling system or its modification, the introduction of a packaging reuse system (including re-use for another purpose), but also the introduction of environmental management of the business (Chen et al. 2006; Chen 2008) and implementation of joint clean technology programmes with suppliers and customers (Karia and Asaari 2013).

### **3. Methodology**

The primary research in the medium-sized enterprise of the chemical industry was carried out as qualitative. The main objective of the research was to identify the possibilities of reducing the volume of plastic waste from the primary packaging for the selected product. The product selected was a detergent intended for cleaning and refreshing toilets. It consists of a cleaning gel in a cylindrical container and a dispenser (extrusion piston). The gel is applied by the dispenser, i.e. pushed in a measured amount, directly onto the sanitary equipment (toilet). It is gradually released with flushing.

The research focused on the possibility of saving plastic, which is used both for the container containing the gel and for the extrusion piston. The information was collected by personal interviewing according to an interviewing scenario. The interview scenario included the following areas of inquiry:

- The form of innovation process in the company. Forms of cooperation with business partners in technical and technological innovations.
- Possibilities of packaging innovation to reduce plastic for the selected product:
  - Saving plastic while keeping the current plastic packaging.



- Possibility to change the packaging material to remove plastic (glass, paper, metal, other materials).
- Possibility to change the package size.
- Possibility to innovate the product in order to reduce the package size.
- Possibility to introduce packaging-free sale of the product.
- Possibility to introduce reuse of the plastic packaging from the product.
- Possibility to recycle packaging from the product.
- Barriers to implementation of the individual types of innovation.

The main respondent of the qualitative research was the process engineer of the company. The information was collected in two stages. Either stage was followed by a check on the completeness of the information collected. Their content analysis followed, which resulted in formulation of conclusions.

#### 4. Results

The starting point for finding out the possibilities to reduce the volume of plastic waste for the selected product was to map the innovation process in the company. The results of this research phase are summarized in Table 1.

**Table 1.** Innovation Process in the Company.

<b>Characteristics of the innovation process</b>	<b>Application</b>	<b>Form of application</b>
Company's previous interest in product innovation for sustainability.	Yes	Efforts to reduce the volume of plastic in the blister, trying to save the plastic fixation material used in secondary packaging.
Respecting stakeholder requirements when innovating the product and its packaging.	Yes	In particular, end consumers and wholesalers as direct customers.
Existence of environmental stakeholder requirements for the product and its primary packaging.	Yes	Wholesalers, as direct customers, demand to reduce the volume of packaging plastics.
Existence of other environmental stakeholder requirements.	Yes	Requirement for the AISE logo - proof of participation in a voluntary association setting environmental requirements for manufacturers, products and their packaging.
Impact of legislative requirements on the innovation process of the product and its packaging in the interest of sustainability.	Yes	General requirements for REACH chemical products are set, legislative pressure to reduce plastics is increasing.
Collaboration in the packaging innovation process.	Yes	With packaging manufacturers.

After completing the research of the innovation process in the company, various possibilities of saving the plastic used for the primary packaging of the selected product and the obstacles to their application were examined. The results of this research phase are shown in Table 2.

**Table 2.** Variants of reducing the volume of plastic waste from the packaging for the selected product.

Identified option to reduce plastic	Obstacle to apply the option
Replacement of plastic material with another type of material (glass, metal, paper).	Glass is incompatible with the use of the product. Metal is theoretically usable for the piston and its reuse, but it is a costly material. Paper would require adjustments, generally layering and probably supplementation with a foil.
Replacement of plastic material with bioplastic.	Bioplastics decompose to form micro plastics, the environmental benefits are debatable.
Changing the colour of the plastic packaging for easier recycling. Use of recycled plastic in the production of packaging.	Decreasing the appeal to the end consumer.  25 percent and higher recycled content in the plastic for packaging significantly reduces the packaging strength. Recycling companies are not able to supply recycled materials of sufficient quality to the market.
Technological innovation in the production of packaging - bubbling.	Reduced product aesthetics and functionality.
Increasing the concentration of the cleaning gel.	Reflection in the price of the product unacceptable by customers.
Changing the product form - gel provided in capsules.	Radical reduction of functionality.
Changing the method of sale - through packaging-free stores.	The need to innovate the product into a liquid form, the problem with ensuring microbiological safety of the product. The company does not facilities for washing and disinfecting the containers; refilling of the containers is not yet technologically mastered.
Introduction of plastic packaging reuse.	The problem is the collection of packaging. Re-use is uneconomical compared to the use of new packaging (costs of collection, washing, inspection, storage). Environmental impacts on wastewater and wash water consumption.
Application of recycling.	The company does not have a developed packaging return system or recycling system.

## 5. Discussion

The primary qualitative research confirmed some conclusions of previous studies while producing new knowledge. The possibility to save the volume of plastic packaging was confirmed by making the product in a concentrated form as described by Makower and Pike (2009) on the example of P&G and Atkinson (2008) on the example of Unilever. The possibility reported by Dharmadhikari (2012) to replace plastic with a more environmentally friendly material (bioplastic) was also confirmed. In addition, however, other potential technical, technological and administrative innovations have been identified to reduce plastic packaging: replacement of plastic material with another type of material (glass, paper), change of colour of plastic packaging, use of recycled plastic and technological innovation (bubbling) in production of packaging, change of product form (capsule), sales through zero waste stores, reuse of plastic packaging, and recycling.

However, some of the identified innovation possibilities have such barriers that they are implementable only in theory (replacing plastic with glass or paper). Also, the replacement of plastic with bioplastics is basically out of the question because of the disputable environmental benefit. Other options of plastic primary packaging innovation for a selected product are feasible, but they all represent an increase in operating costs, some of which would also require investment costs. Changing the colour of the plastic container, increasing the concentration of the cleaning gel or changing the form of the product may be considered less expensive. The high costs of innovation would most likely arise from a change in the packaging technology (use of recycled plastic, bubbling) as well as with all innovations that would mean a fundamental change in the reverse flow system (introduction of packaging reuse, recycling) or direct flow system (packaging-free sale).

However, when choosing a suitable innovation option, it is necessary to take into account not only the costs (and expected losses resulting, for example, from the lower value of the product for the

customer), but also the environmental benefits. The optimal option should ensure the biggest difference between the total environmental benefit and the total costs of innovation (García-Arca et al. 2014).

Various models have been developed to select the optimal variant. These models combine quantitative and qualitative scales to allow bringing subjectivity into the assessment (Grönman et al. 2013). The most commonly used of these models is the model by Olsmats and Dominic (Olsmats and Dominic 2003) "Packaging Scorecard", popular with companies like IKEA and Wal-Mart (García-Arca et al. 2014).

## 6. Conclusions

Packaging is a key element in increasing the sustainability of supply chains and the companies involved (García-Arca et al. 2019). In packaging innovation, product design needs to be integrated with packaging design (García-Arca et al. 2014) as integrated product and packaging decisions make it possible to optimize the overall environmental impact. Innovative activities require the development of cooperation between the company, as the manufacturer of the product, and its business partners, especially the suppliers of packaging. Where the intended innovation affects the substance of the packaged product and/or the management of the direct or reverse material flow through the chain, it is also necessary to involve direct suppliers of inputs and product purchasers. Environmental innovation will then affect a much larger part or even the entire supply chain, or supply network, as the case may be.

The conclusions of the qualitative research carried out can be considered inspiring from the point of view of the identified possibilities of product innovation (not only in the chemical industry) as they were carried out on the basis of exploring possibilities of reducing the plastic packaging of one selected product. This limits the possibility of generalization. Therefore, it is possible to recommend further research, which can be conducted in two ways:

- exploring the possibilities of plastic packaging innovation for other chemical industry products or chemical industry product groups (e.g. detergents, washing and sanitary products); and
- exploring the possibilities of developing collaboration with other partners in the chain to innovate plastic packaging for products of the chemical industry.

In combination with the previous research, follow-up research could significantly contribute to discovering the real possibilities to reduce the volume of plastic packaging, especially for products of the chemical industry.

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# The Acceptance of Corporate Training – Case Study

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**Abstract:** Our era is driven by digital technologies; business models and approaches to management are in the unstoppable changing mode. Key changes in corporate learning are in the design of learning experiences that directly reflect the needs of learners and their work context. But does the actual situation corresponds to academic statements? Before approaching to the analysis of the whole structure and content of the corporate educational system with incorporated reflections of the desired changes, it is recommendable to focus on the acceptance of corporate training by the employers themselves, which is one of crucial factors influencing the success in implementing new educational trends in corporate training. The research subject of here presented paper brings up-to date view of the acceptance of corporate training on the local scene. Research objective of this paper is to analyze employer attitude to corporate training of their employees in two interconnected areas: requirements for staff to attend the training and financial contribution from the employer. Authors tried to define the dependency between requirements and financial support from employer. Authors highlight in the discussion chapter the crucial findings and focus on the future areas of the research.

**Keywords:** corporate education; employer attitude; acceptance; benefits; research; finance

**JEL Classification:** I20; I22; M53

## 1. Introduction

This paper discusses corporate education, which is a specific part of the life-long education. Our era is driven by digital technologies, business models and approaches to management that are in the unstoppable changing mode. It is clear the changes in society and management of businesses generated by technological revolution has to be reflected in the corporate learning to keep the pace with the development. Key changes in corporate learning are in the design of learning experiences that directly reflect the needs of learners and their work context and in the shift from the focus on quality content to focusing on customization of learning solutions to meet customers' needs (Reference Dictionary 2019).

*The paper deals with the real situation on the local scene; the employer acceptance of corporate training is analysed, whether employers are involved into their employees' further corporate education, to what extension they require this activity from their employees and whether employees are provided by some financial support.*

The structure of the paper follows the standard pattern: chapter 'Methodology' encompasses formulation of the research design and goals, within the sub-chapter State of art selected relevant sources are presented, 'Findings' is the core chapter bringing answers to research questions which were gained via processing data collected from questionnaires and accompanied by visualisation of the results into graphs. 'Discussion' highlights the crucial findings and faced pitfalls during processing the data and focuses on the future areas of the research.

## 2. Methodology

### 2.1. Research Goal, Applied Methods and Research Stages

*The research subject brings up-to date view of the acceptance of corporate training on the local scene of East Bohemia region.*

*The research objective of this paper is to analyze employer attitude to corporate training of their employees in two interconnected areas: requirements for staff to attend the training and financial contribution from the employer.*

- *The sub goal is to find out if there is dependency between requirements and financial support from employer.*

*Research was carried out* in 2019 based on a specially designed questionnaire within a regional search on an accessible research sample of 128 Czech employed adults. The return of questionnaire ratio was quite high; researchers collected 95 completed forms with all essentials.

*Research questions* on employer's attitude to corporate education are defined into three categories from necessity via support to unconcern through three research questions, the fourth question refers to the statistical dependency between variables:

- RQ1 Does the employer require further education of their employees?
- RQ2 Does the employer support further education but doesn't require employees attendance in the trainings?
- RQ3 Does the employer support employee training?
- RQ4 Is there dependence between variables 'Employer requires employee training' and 'Employer financially supports employees training (further education)?'

*Methods used in this research* included primary sources processing, analytic-deductive and comparative methods and statistical-descriptive methods, basic technique for examining the relationship between two categorical variables: cross-tabulation, non-parametric Chi-square statistic and Symmetric Measures.

*Stages of the research* are visualized in the Figure 1. They consisted of: acquisition of primary data; getting an overview of current situation on further education including company involvement from statistical surveys of the Czech statistical Office; formulation of research questions; creation of a questionnaire; conducting a questionnaire survey; processing the obtained data, presenting and visualizing the results of the questionnaire survey; applying two kinds of statistical methods on dependency between two key variables.



**Figure 1.** Methodology stages.

## 2.2. State of Art

The State of art sub-chapter encompasses literature review bringing selected studies from foreign and national sources. The aim of the paper is to strive to explain the rough sketch of the corporate education concept and clarify key terms associated with the investment into further education, which are used in this study: employee benefits, cafeteria system, concept of the cultural and social needs fund.

### *Corporate education definition.*

In today's society, qualification and level of education are determining aspects of human existence. Education can therefore be seen as part of the cultural evolution of people, which means that there has always been some kind of education. Education is considered a fundamental driver of personal, national and global development. Training and job creation becomes a lifelong process in which the business itself plays a major role. Employees are the bearers of ideas, experience and knowledge, and the success and competitiveness of the entire company often depends on their approach. In order to achieve excellent results, businesses need not only have good technology, internal processes and customer care, but also need to recruit qualified staff to maintain and develop their knowledge and skills, see more Drucker (1999), Armstrong (2009) or Gómez-Mejía et al. (2016).

Batalla-Busquets and Pacheco-Bernal (2013) define training as an investment for both the two participating agents: businesses and workers. They analysed employees' attitudes and perception towards training. Their research was conducted with more than 2000 respondents (employees) of the leading European savings bank. Their findings didn't correspond to the widely promoted trend in

unambiguous utilization of latest technologies. Face-to-face training with the course trainers stayed to be perceived as a more motivating methodology compared to virtuality.

Another inspiring study for the design of this paper was Živčicová and Gullerová (2017) quantitative empirical study in which the attitudes of employees to corporate education were analysed and compared. Here presented study focuses not on the employees but on the employers and their attitude to training. The authors have been involved in the research of aspects of corporate education for about a decade, e.g., they focused on the use of advanced technologies (Svobodová and Černá, 2018). As for corporation setting, they analysed utilization of social media in small businesses (Černá and Svobodová 2013).

Employee education is widely discussed not only on the global scene but it has reached highly professional achievements on the national scale, see more (Bartoňková 2007; Bartoňková 2010; Dvořáková 2007; Palan 1997; Tureckiová 2009; Vodák and Kucharčíková 2011; Koubek 2015). According to Bartoňková (2010), *corporate education is a certain type of care provided by employers to employees for the benefit of both parties*. She describes corporate education as "... seeking and subsequently eliminating the difference between 'what is' and 'what is desirable' " (Bartoňková 2010). She distinguishes the following categories of corporate education: adaptation and orientation processes, employee job-related further training, partial or full retraining, re-entry programs for employees whose health condition prevents them from performing their jobs on a permanent or long-term basis, and qualification improvement programs (Bartoňková 2007). In this study authors perceived corporate education as one unit, not divided into individual categories. This will be explored in the following stage of the research. Corporate education also includes educational activities required by law and vocational training activities required for employee job performance. 86.4% of employers organized at least in one year employee educational activities. In 2010, law required more than 90% of educational activities performed. In 2010, more than 80% of employers also organized professional skill-development activities. 57% of educational activities focused on improving general knowledge and skills. Less than 10% of employers provided educational activities to maintain jobs and prevent collective consultation (Kešelová 2012).

In the following part, three important terms, which were used when the financial aspect was analysed, are described for clear understanding of the issue. Employee benefits, cafeteria system and Concept of the Cultural and Social Needs Fund are understood as ways of financial support of employees in corporate training is in this paper.

#### *Employee benefits*

Employee benefits are provided to employees in addition to wages, salaries or salaries as a so-called non-claim component. The Labor Code does not know the concept of employee benefit; it only regulates minimum standards of employee care - professional development of employees, upgrading and deepening of qualifications and allowance for meals. *Therefore, it is entirely up to the employer to decide whether or not to provide benefits to employees and to what extent.*

However, employee benefits beside motivational stimulus carry other positive feature. *From the tax advantage point of view, the provision of some benefits is more advantageous than the salary increase itself,* despite the plethora of forms and types of employee benefits that are currently offered on the labor market (Dostál 2017).

#### *Cafeteria system*

Companies often choose the so-called Cafeteria system which offers *various types of bonuses from which employees can draw in a certain financial volume*. Cafeteria system is used by about 65% of companies in our country. They find the system beneficial for all counterparts. Cafeteria has a modular principle, so any company can choose the module that is convenient for it. *A big plus is a detailed overview of staff costs*. The Cafeteria system was introduced primarily because employees come from different age, social or interest groups, and each has a different order of priority for their life needs (Kubičková and Patáková 2018).

### *Concept of The Cultural and Social Needs Fund*

The Cultural and Social Needs Fund serves to meet the cultural, social and other needs of employees and other persons for whom the relevant legislation permits. The creation and drawing of the Cultural and Social Needs Fund is regulated by the Decree of the Ministry of Finance of the Czech Republic No. 114/2002 Coll., On the Fund of Cultural and Social Needs, as amended (Morávek 2018).

## **3. Findings**

This chapter consist of two subchapters. The first one brings findings on adult education from the Czech Statistical Office and forms a kind of starting point for the own research. The other subchapter brings findings and answers to stated research questions based on processed data gained from the applied questionnaire.

### *3.1. Findings Drawn from the Czech Statistical Office*

Highly motivated people who strive for reaching higher qualification prevail in participation in the formal education. The criterion of reached level of education plays an important role, adult with just primary education get involved into tertiary education only sporadically.

The proportion of non-formal education participants in the Czech Republic is approximately at the European average, it means about 40% adults participated in one activity of the informal tertiary education. However, the Czech adults spent least time on education. The following finding is important for the focus of the research. Most of the activities are related to work; in women it is 86%, as for men, the ratio is even higher as it reaches 91%. These work related activities were motivated by acquiring higher qualifications, improving work performance or improving the labor market position. Generally speaking, *the vast majority of non-formal education in the Czech Republic is carried out during working hours and at the employer's initiative. For nearly 70% of employees work-based non-formal education activities, employees reported that their employer required participation in the education (CSU 2016).*

If participation in education is not directly required by external circumstances, e.g. by law or employer, the decision to be engaged in further education is determined primarily by personal motivation and by the value which individual adults can see in education. However, in a situation where educational aspirations are based mainly on the level of the reached highest level of education related qualifications in the labor market, this often leads to the reproduction of educational inequalities established by the formal education system.

*The possibility of corporate training is very closely linked to funding.* Most of the companies are aware of the importance of educating their employees and these companies participate in financial support. However, if the economic situation is getting worse, they provide less or no education at all. *The total amount of training costs can vary greatly from one type of company to another.* It depends on the needs of the company, the employees, the general characteristics as well as the specialization of the company and especially on its goals.

*Main findings from the Czech Statistical Office report on Investment into adult training follow:*

- The share of education expenditure per employee in 2015 was CZK 3,134 on average.
- Companies with more than 250 employees and companies in the Information and Communication Business sector spent the highest costs.
- The share of education costs in the total labor costs of firms was 0.71% on average in the monitored year.
- Drawing money from the education grants from the European Union is extremely low.
- Most companies (91%) in the Czech Republic did not use any education subsidies in 2015.
- A small share (7%) of companies benefited from subsidies from the European Union.
- The vast majority of companies also did not provide any education contributions (CSU 2016).

The following sub-chapter 'Findings from the research' shows the actual situation on a local scale with the accessible sample of 95 adult working respondents.



### 3.2. Findings from the Research

Findings give answers to all research questions on the attitude of employers to corporate education in sense of their requirement on employee involvement into the training and employers financial support.

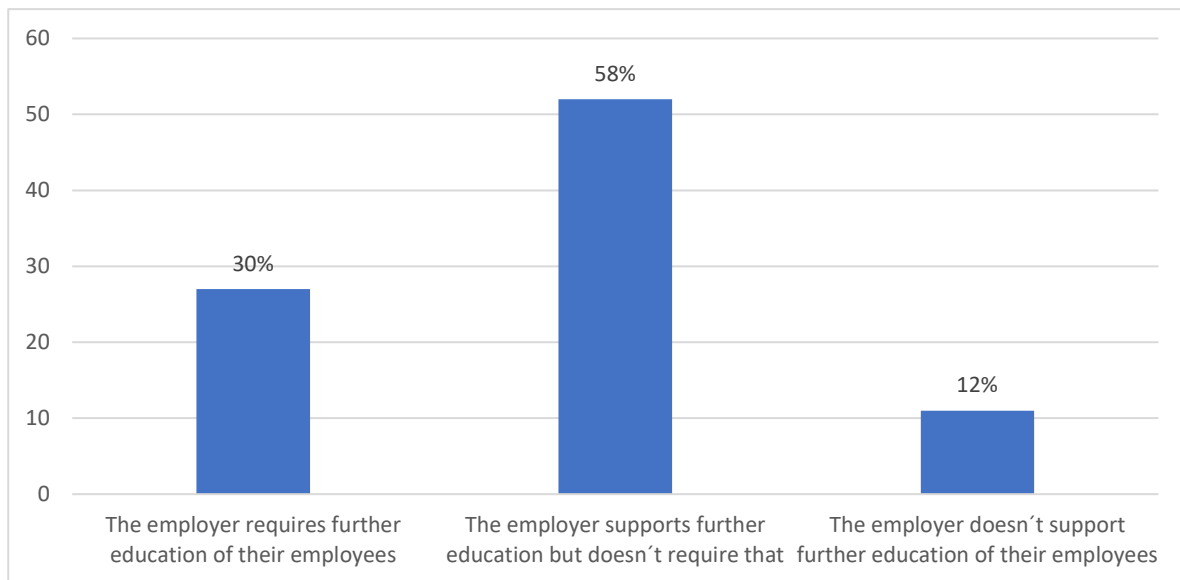
#### *Answers to research questions*

The answers to research questions are visualized in the Figure 2. Called Employer's attitude to corporate education with 3 researched categories.

The answer to RQ1 Does the employer *require* further education of their employees? is positive. Yes, 30% of employers of respondents require further education. There is big discrepancy with the report from the Czech Statistical Office where the proportion reached 70%.

The answer to RQ2 Does the employer *support* further education but doesn't require that? Is positive and is visualized in the second bar.

The answer to RQ3 The employer is *not involved* or interested in further education of employees? is visualized mainly in the third bar when perceived from purely the perspective of interest and support. However, the second bar shows the employer readiness to support the employee in corporate education even without strict requirement to participate in the training activities.

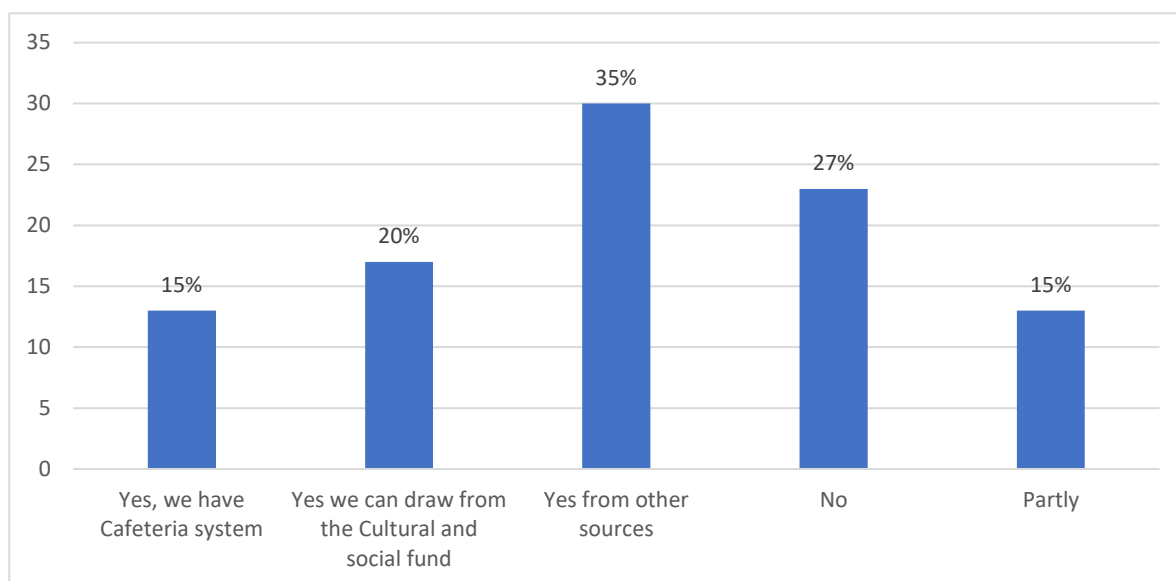


**Figure 2.** Employer's attitude to corporate education.

As can be seen in the Figure 2, the second category dominates; 58% of respondents employers support further education, however they do not require further training of their employees. Employers realize the importance of training but leave the decision on the involvement on their employees. Only 30% of employers require further education. Still there is quite high percentage of employers who do not require and do not support employees' training. These findings call for further research so that it could be revealed why in current changing times influenced by the turbulent development and involvement and impact of technologies it is possible "to stagnate" and "survive".

#### *Corporate education financing*

The following researched area relates to *financing* of corporate training activities and reveals the rate of potential sources used in corporation training payment. This issue is strongly interconnected with the acceptance of corporate training in the company that will be analyzed in the next part.



**Figure 3.** Does the employer pay or contribute to their employees' further education? Sources for corporation training payment.

Only 15% of respondents can draw from the cafeteria system. This system is not implemented in all companies. More over cafeteria system might be implemented in the company of the respondent, but he/she finances from this modular system something different, e.g., medical devices or holidays. This issue will have to be more clarified in the next survey.

One fifth of employees draws from the Cultural and social fund. The situation in some aspects coincides with the cafeteria system. Not all companies can offer this source of financing to their employees and if they offer that, the employees can use the money on medical care or children holiday, etc.

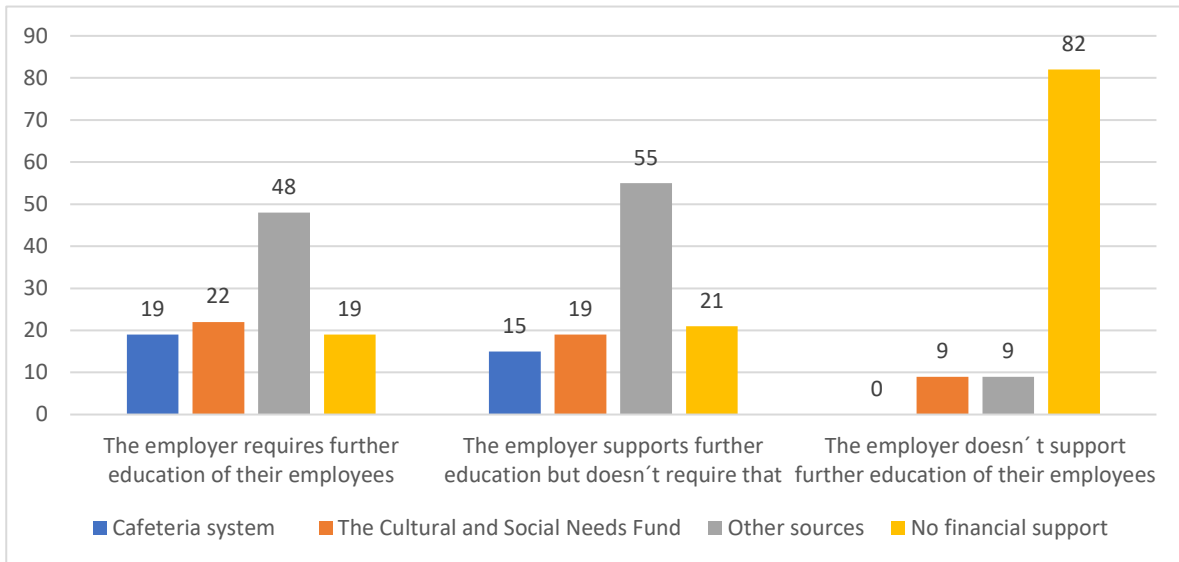
Out of these findings one is worth highlighting – More than a quarter from the respondents answered that they didn't get any financial incentive from their employers. This finding calls for further discussion as no support in financing can act as strong demotivating factor in employees, even disrespectful in some cases.

#### *Interconnection between requirement and offer*

Next section on findings refers to the interesting interconnection between requirements and offer; between the employer attitude to further education in sense of requirement of further training of their employees and financial sources offered by the company from which employees can draw on their trainings. The graph illustrates the findings, see Figure 4. RQ4 Is there dependence between variables 'Employer requires employee training' and 'Employer financial support in their employees training (further education)?' is answered in this part of findings and especially in the final part Statistical methods on dependency.

Results are given in nominal numbers. Due to the small amount of representatives in individual sections the conversion to the percentage would be biasing. The total sample consists of 95 respondents. In financing corporate education, 'other sources' dominate in both categories where employer requires further education from their employees as well as in the category where they do not require but support employees financially. When slightly generalized rate of individual sources is comparable in both categories where training is required and where training is supported.

Note – if employer requires further education, it might be expected that they would support their employees financially but there is a quite high rate of employees who get no financial incentive in this aspect.



**Figure 4.** Interconnection between employer requirement on employee participation in corporate training and sources for corporation training payment.

*Statistical methods on dependency*

Applying two kinds of statistical methods on dependency between two key variables was made: Crosstabulation and Chi-Square Test.

Statistics brings cross tabulation on requirements to employee participation in corporate training and employer financial support.

**Table 1.** Crosstabulation – contributes \* requires education x contributes.

		Requires			
		No	Yes	Total	
Contributes	0	Count	15	2	17
		Expected Count	5.5	11.5	17.0
	1	Count	16	62	78
		Expected Count	25.5	52.5	78.0
Total		Count	31	64	95
		Expected Count	31.0	64.0	95

The condition of the test is that the theoretical occupancy of each box is higher than 5. In this case, the conditions are met. It is also written below the table.

*The results show that 15 employers do not require employee training and they do not financially support employee education. Two employers require employee training, but do not financially contribute.*

*Furthermore, 16 employers do not require attendance of employees it, but they support them. The largest number of 62 employers require employee training and at the same time they financially support their employees.*

Then the Chi-Square Test of Independence was made to determine if there is a significant relationship between two categorical variables that are in this case employer 'Requirement' and 'Contribution' as in the previous table.

In the table, we took the chi square value and compared it with alpha (0.05). In this test, the resulting value is lower, so the null hypothesis of independence can be rejected and H1 accepted. It means, if the employer requires or supports further education, it has the finances available. On the other hand, if the employer does not require further education, it does not create finances for it.

Table 2. Chi-Square Tests.

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	29,120 <sup>a</sup>	1	0.000		
Continuity Correction <sup>b</sup>	26,121	1	0.000		
Likelihood Ratio	28,518	1	0.000		
Fisher's Exact Test				0.000	0.000
Linear-by-Linear Association	28,813	1	0.000		
N of Valid Cases	95				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.55. b. Computed only for a 2x2 table

## 5. Discussion

All the research questions were answered.

Out of findings the following should be highlighted, because of a quite big discrepancy between the report from national statistical office (CSU 2016) or the general developmental trends and gained results from the conducted research.

- 58% of respondents' employers support further education; however, they do not require further training of their employees. Why only 58%? In this time of changes, turbulent development of technologies affecting all spheres of life and businesses who can afford stagnation and no more further education?
- Only 30% of employers require further education. This finding differs so much from the report of the Czech statistical office where about 70% of employees work-based non-formal education activities stemmed from their employer requirement on participation in the corporate education.
- As for financing training activities, the findings show rather high rate of employer disinterest towards employee training. Researchers' remark is – if the employer requires further education, it might be expected that they would support their employees financially but there is a quite high rate of employees who get no financial incentive in this aspect. Beside this, there is still quite high percentage of employers who do not require and do not support employees' training.
- Only 15% of respondents can draw from the cafeteria system. This system is not implemented in all companies. More over cafeteria system might be implemented in the company of the respondent, but he/she finances from this modular system something different, e.g., medical devices or holidays. This issue will have to be more clarified in the next survey.
- One fifth of employees draws from the Cultural and social fund. The situation in some aspects coincides with the cafeteria system.
- Out of these findings one is worth highlighting – more than a quarter from the respondents doesn't get any financial incentive from their employers. This finding calls for further discussion as no support in financing can act as strong demotivating factor in employees, even disrespectful in some cases.
- Kešelová (2012) study brings findings showing much higher involvement of employers into employee education than findings from study presented in this paper, see chapter Findings.

Researchers are aware of the fact that the research sample was limited. Slight adaptations in the formulation of questions in the questionnaire have to be made. In the next phase of the research on the acceptance on the corporate training, qualitative methods will be incorporated. This paper dealt with employers' perspective. Next phase will be focused on employee attitude to corporate training, on their needs, motives to participate and willingness to invest own money into education.

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# Synchronicity and Interaction Perspective on Knowledge Management Initiatives

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**Abstract:** Current technological development enables processing of large volumes of data. Moreover, data conversion into information has significantly changed during the last decade. Enriched with context, information may be turned into knowledge which allows organization to profile themselves as knowledge organizations. Acquired information and knowledge are used for decision support and introduction of new operational tasks in business organizations and academic institutions. There are many knowledge and knowledge management classifications available in textbooks, monographs, white papers or research studies. This paper presents analysis of the application and implementation of ICTs in knowledge management. As an added value it classifies ICTs into several categories based on extensive literature research. It also provides an original type of classification that connects synchronicity and interaction and main classification criteria. A better understanding of ICTs aimed by this classification may lead to improved technological knowledge management implementations and applications based on advantages of involving ICTs in processing operations.

**Keywords:** knowledge management; information and communication technology; classification; knowledge; synchronicity; interaction

**JEL Classification:** M15; O32

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## 1. Introduction

Already in the earliest signs of human existence, people communicated with one another. Through the decades and centuries, people were developing various methods and channels for communication. With the beginning of the current digital era, information and communication technology (ICT) was developed that allows not only communication, but also automated capturing of data, its storing and processing. ICT has brought about revolutionary changes in the way people work, communicate, learn, spend time, and interact (Jorgenson and Vu 2016). In recent decades no technology has had a global impact on the same level as ICT (Al-Rodhan 2011). ICTs bolstered productivity more effectively than earlier technologies (Hidalgo Pérez et al. 2016).

Today communication is a basilar process for business and is a very important dimension of working in virtual environment (Gonçalves et al. 2014).

ICT provides the base for computer applications to execute business processes (Broadbent and Weill 1997). Capital per worker, mobile cellular and telecommunication technology are the dominant drivers of output per worker and hence have relatively high contributory power to support the long-run economic growth (Kumar et al. 2016). ICT offers now large spectrum of possibilities that changed the way we live, perceive and imagine. ICT became a substantial part of our life.

This paper aims to add to the knowledge in the field of ICT impact on knowledge management in business organizations by performing an extensive research through analyzing ICT in knowledge management applied so far. This paper classifies the ICTs into categories based on the attributes of selected ICTs to enhance the perception of given ICTs that may lead to efficient application and implementation of available technology. The main purpose is to inspire future research on the

application of ICT in knowledge management domain and to advance future knowledge in the field of ICT application and its implementation in business organizations.

This paper is organized as follows. Next section describes applications of ICTs in various aspects of knowledge management used so far in business organizations and discusses the potential impediments and opportunities for future exploiting of the use of ICTs in the field of knowledge management. The consequent section provides classification of known ICTs into categories based on the findings from sections previous sections. Such a classification aspires better understanding of ICTs for their efficient implementation in the field of knowledge management in business organizations. Conclusion summarizes the research carried out.

## **2. ICT in Business Operation**

In today's business life, workers interact daily with software applications for processing of data and information to carry out working tasks benefiting from the possibilities offered by the information and communication technology that performs automated processing through demanding computations and tedious actions. Working with text processors, spreadsheets, sending electronic mail, calling everywhere at any time through mobile phones and several other applications of ICTs became a substantial part in all spheres of our everyday life: at work, in the school and at home. Companies rely on IT solutions to support their business operations by automated processing of data much faster than was possible before the development of digital information and communication technology. IT is not a mere enabler for business activity anymore (Cherbakov et al. 2005). ICT drives business strategy, open new markets and possibilities.

ICT gained wide application in the field of knowledge management. Several applications of ICT have gained considerable popularity as instruments for knowledge management (Hendriks 1999). ICT gained interest based on its potential of using them to systematize, facilitate, and expedite firm-wide knowledge management (Maryam Alavi and Leidner 1999).

ICT can enhance knowledge sharing by lowering temporal and spatial barriers between knowledge workers, and improving access to information about knowledge (Hendriks 2001). ICTs in connection with knowledge management are called organizational knowledge management systems (Meso and Smith 2000) or knowledge management systems (Alavi and Leidner 1999a, 1999b; Huysman and de Wit 2004; Maier and Hädrich 2011). These are seen as enabling technologies for an effective and efficient knowledge management. The objective of knowledge management systems is to support construction, sharing and application of knowledge in organizations (Alavi and Leidner 2001).

ICTs are used for knowledge management in form of infobase, knowledge base, mobile knowledge base, network, electronic rappers, knowledge mapping, Lotus Notes, digital discussion platforms (Huysman and de Wit 2004). Technology based perspective on knowledge management contains ICTs used in form of executive information systems, expert systems, intelligent agents, multimedia, search engines and smart systems (Alavi and Leidner 2001), computer resident knowledge repositories (Huber 2001), data mining, data warehouse, routines that are programmed in the logic of computational machinery and on data residing in data warehouses, use of email or group support systems, codification approach, in which a central repository holds knowledge under categories such as programming bugs, quality control reports, new developments (Desouza 2003), World Wide Web, Lotus Notes, the Internet, and intranets (O'Leary 1998), Wiki (Raman et al. 2005).

Research in the field of knowledge creation based on data stored in databases and data warehouses through mining not only raised new questions of how to store and access data efficiently (Hewlett Packard Enterprise Development LP. 2000; Han et al. 2012; Inmon 2005; Pavlo et al. 2009; Reddy et al. 2010; Taylor et al. 2015), but also created new perspective on the perception of knowledge, information and data connections that confirms Tuomi's insight declaring that knowledge is needed before data are collected and indeed, it determines which of these data to store (Tuomi 1999). This becomes significantly important in industries, where the data capturing is set like in software development industry this denotes the logging aspect (Oracle America Inc. 2005; Chuvakin and Peterson 2010; Marty 2011; Suneetha and Krishnamoorthi 2009). By deciding what to log, it can be

seen, that data emerges only after we have information, and that information emerges only after we already have knowledge (Tuomi 1999). In other words, only with sufficient knowledge the time of application development, it can be decided what data shall be logged to provide useful information for the bug investigation afterwards and that knowledge then becomes information (Maryam Alavi and Leidner 2001).

### **3. Methodology**

This classification is based on the following procedure. First, papers that associates ICT with knowledge management initiatives were identified with the help of “ICT knowledge management” as keywords in the ScienceDirect database, which represented the primary source of investigated studies. The secondary database was represented by Google Scholar. Single technologies described in papers were identified. The endeavor not to include papers focusing on integration of ICT into an enterprise, which represented the majority in the returned set of studies, was the primary applied filter. Second, since many paper related knowledge management with both data-warehouses and data mining, the next step was focused on search of paper associated with this technologies. Since identified papers were mostly connected with technologies themselves and rarely associated with knowledge management initiatives, the Google Scholar database was used together with keywords “classification ICT knowledge management”. Third, this was later extended by the keywords “knowledge management systems”, since many retrieved papers termed application of ICT in knowledge management as knowledge management systems. Fourth, keywords “data information knowledge definition” were used in Google Scholar. Fifth, real applications in practice were searched with the help of “application ICT knowledge management” as keywords. The main rationale was to avoid theoretical studies and to identify case studies. Last, keywords “application logging knowledge” were used. Although many papers were out of scope (nature sciences, physics, or ornithology), some valuable papers focused on knowledge management were identified.

### **4. Classification of ICT in Knowledge Management**

This section focuses on the classification of ICTs used knowledge management according to several classification categories divided into individual sections for the convenience of the reader.

#### *4.1. Transfer of Tacit and Explicit Knowledge*

Organizational knowledge is generally classified into explicit knowledge and tacit knowledge (Lin et al. 2008). Where explicit knowledge denote knowledge that is more easily codified (Levin and Cross 2004), it can relatively easily be formulated by means of symbols and can be digitalized. This knowledge can thus with relative ease be transferred to others by e.g. the use of information technology (Johannessen et al. 2001). On the other hand, tacit knowledge denotes now-how that is difficult to codify or explain (Levin and Cross 2004), it is represented by skills (Foray and Lundvall 1998; Johannessen et al. 2001). It is highly personal, context-specific, and therefore hard to formalize and communicate (Woo et al. 2004). It is also expressed by M. Polanyi by “we can know more than we can tell” (Polanyi 1998).

Based on the definition of tacit and explicit knowledge, it could be concluded that the knowledge transferred using ICT denotes only explicit knowledge and no tacit knowledge. This has been confirmed by research proving that tacit knowledge is mainly transferred by non-ICT methods, with explicit knowledge being transferred via a combination of methods (Nguyen and Burgess 2014). However, it has been already concluded, that tacit knowledge can be also transferred by video record (Linde 2001; Nonaka and von Krogh 2009), video conferences, over the phone and by email (Smith 2001). Considering these research findings, the ICTs could be classified into following categories: enabling transfer of explicit knowledge and allowing transfer of tacit knowledge.



#### 4.2. Technological Differences

Next classification of ICTs that can be found in the literature, is the classification of ICTs used in knowledge management by dominating technology. The majority of knowledge management systems as can be concluded through analysis of above cited technologies used in organizational knowledge management systems and as already stated in review paper (Alavi and Leider 1999b), all of these used in organizations are based on following technologies: browser, electronic email, search/retrieval tools, information repositories, www server, agents/filters, external server services and videoconferencing.

#### 4.3. Interaction and Synchronicity Aspects

The aspect analyzed in this section denotes the aspect of interaction. As it has been confirmed before by extensive research, learning by doing is the most memorable way of doing things, in other words, we learn best by doing (DuFour et al. 2006). As resulted from research in the field of learning, there is only one effective way to teach someone how to do anything, and that is to let him/her do it (Schank et al. 1999). The difference between memorizing explicit knowledge and the practical learning by doing become greater in the process of simulations as C. Aldrich stated: simulations may work in practice, but they certainly do not work in theory (Aldrich 2005).

The classification of this paper includes the aspects of synchronicity and interaction. This classification aspects were chosen based on learning by doing aspect that denotes synchronous practicing and with needed interactive user participation. Further, the asynchronous mode allows incredible flexibility (Wheeler and Fournier 2001) therefore it is considered to denote a very important factor of ICTs in organizations. These two aspects could be put on axes to divide the plane into 4 quadrants. Technologies associated with particular quadrants are stated in Table 1. Considering these 2 aspects (4 categories), all the above mentioned ICTs can be assigned into.

**Table 1.** Classification of mentioned ICT in specific quadrants.

<b>Quadrant</b>	<b>ICT focused on</b>
Asynchronous, Passive Interaction	Infobase, knowledge base, mobile knowledge base, network, electronic rappers, knowledge mapping, Lotus Notes, expert systems, intelligent agents, computer resident knowledge repositories, data mining, data warehouse, routines that are programmed in the logic of computational machinery and on data residing in data warehouses, use of email or group support systems, codification approach, in which a central repository holds knowledge under categories such as programming bugs, quality control reports, new developments, World Wide Web, Wiki.
Asynchronous, Active Interaction	Internet, Intranet, Search engines, Smart systems
Synchronous, Active Interaction	Digital discussion platforms

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Synchronous, Passive Interaction	Multimedia (Video record, Sound record)
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As it can be seen, the prevalently used ICTs in the field of knowledge management denote passive, asynchronous technology that constitutes explicit knowledge. However, observing the organizational daily life, we can see more uses of ICTs than those mentioned in cited articles. It is important to mention, that people memorize more by watching and seeing than by reading (Aitken 1994; Mattingly 1972). And also singing a melodic song is easy to memorize and thus, easier and faster to learn than by reading (Dixon 1991; Ludke et al. 2014). Pictures are easier to recall than words (Paivio et al. 1968). Although watching a clip is more than reading a text, people learn by repeating activities (Morris and Reid 1970) and not only from one time action.

The second quadrant denotes the “Learning by doing” way. It lists the ICTs that require active interaction by the user, e.g. simulation-based software applications or modelling tools (Otčenášková et al. 2011). They are creating the room for the end user to make questions, for the lector/leader to repeat actions and to transfer tacit knowledge on this way (Aldrich 2005; DuFour et al. 2006; Wheeler and Fournier 2001). Asynchronous but interactive courses allow to differently and efficiently divide time according to the time demands on the user side. The user can stop anytime and continue where he/she last broke up next time.

Asynchronous and passive knowledge bases are very often perceived to be tedious, boring as pure reading is very often being classified (Grauert and Remmert 2012). Therefore, learning only by reading theoretical articles, in particular in technical sciences containing several complex equations, is very demanding and boring and thus transforms only explicit knowledge.

The higher the synchronicity the higher the possibility of transferring tacit knowledge and the higher the interaction demand, the higher the learning comprehended by the end user. Considering these aspects, the business organizations should try to use the ICTs with interactive approach whereas possible for both, synchronous (transferring also tacit knowledge) or for asynchronous mode (efficiently using time) to assure efficient knowledge transfer and management.

## 5. Conclusions

Several aspects of knowledge management, such as its relationship with national culture (Brunet-Thornton and Bureš 2013) has already been investigated. This paper aims to add knowledge to the role of ICTs in the field of knowledge management by reviewing their role in various studies. Particular sections introduce complexity of knowledge management (Tučník and Bureš 2013), applicable on various economic systems such as cluster initiatives (Bureš et al. 2012), an overview of ICT uses in the field of knowledge management, while the last section provides various classifications of ICTs according to different criteria.

It opens a debate on appropriate usage of ICT in knowledge management. It emphasizes that knowledge is required before data gathering, otherwise it is complicated to promote data to information and consequently to knowledge. Moreover, the paper offers three classifications of ICT. Results from the first classification reveal that tacit knowledge are mostly transferred by multimedia. Results associated with the second classification shows that majority of technologies are based on the World Wide Web or databases. The third classification represents the novel point of view. While the first two classifications present various technologies, the third one focuses on synchronicity and interaction. It stressed that synchronicity positively influences independence and flexibility of work. On the other hand, it negatively affects time of work and causes delays. Interaction deals with increasing ability to learn by more intensive inclusion and activity. Thus, this aspect can significantly help with internalization of knowledge.

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# Sustainable Development of Agriculture in Russian Regions on the Basis of Inclusiveness

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**Abstract:** The main objectives of the study are to formulate the concept of inclusive development of the Russian agricultural economy, develop a system of indicators for inclusive development, and assess the level and key patterns of inclusive development of agriculture in Russian regions. The article considers the relevance of the inclusive model of development of the Russian agricultural economy, defines the inclusive development of the agricultural economy, and develops a system of indicators for evaluating inclusive development. The index of inclusive green growth is calculated on the basis of the presented system of indicators. Based on the grouping of regions by the index value, the inverse relationship between the development of agriculture and emerging problems in the field of environmental protection is revealed. Based on the results of the study, the following conclusions can be drawn: Russian agriculture is developing unevenly both regions and types of producers, a new approach to economic growth is needed, inclusive development will involve all regions and types of producers in the growth, the green inclusive growth index is a suitable measure for new quality growth, development of agriculture on the basis of inclusiveness will provide economic green growth, reduction of poverty and injustice.

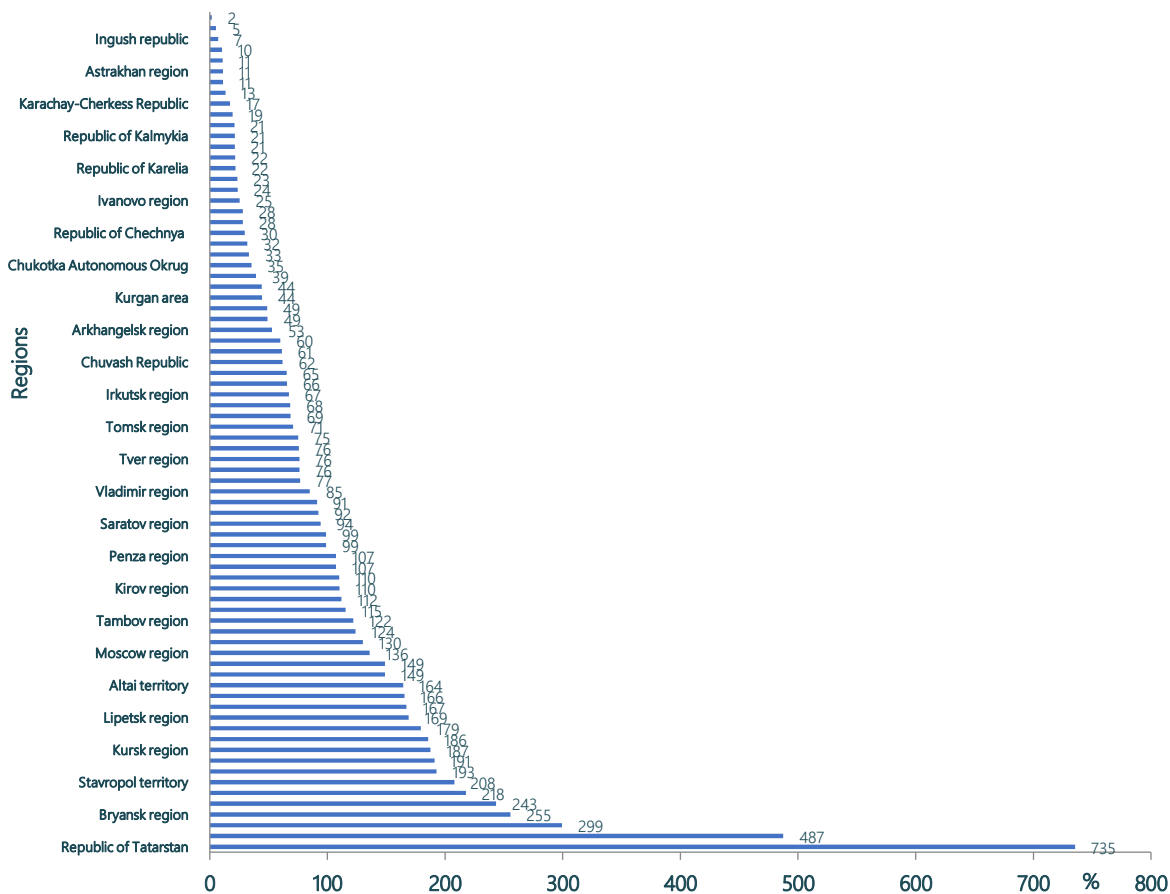
**Keywords:** agriculture economy; rural areas; inclusiveness; inclusive green growth index; sustainability; indicators of inclusive development

**JEL Classification:** P32; O4; R3

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## 1. Introduction

Despite the fact that agriculture is the most dynamically developing sector of the Russian economy (agricultural - on average 3.2% annually, economy - on average 2.2% annually for the last 15 years) and the production of agricultural products has increased by 50%. There are some issues in agriculture that make inclusiveness significant. Firstly, only one-third of Russian regions have increased the growth of the agricultural economy. It means that almost 70% of Russian regions have decreased agricultural production (Zinchenko 2016). Not at all regions included in growth. Secondly, governmental subsidies are distributed unevenly across the regions. And the government supports mainly the large investment projects.



**Figure 1.** The ratio of agricultural subsidies in the region to the average for all regions (the amount for the period from 2006 to 2017).

This is subsidies in the exact region divided by the average value of subsidies in a whole population of regions. We can say that 50% of budget subsidies fall on 15 Russian regions (out of 85 regions). As you can see some regions receive budget subsidies more than others. It helps them to modernize and to raise agricultural production. The government support directs mainly in large projects, large agricultural organizations because they have more opportunities to get government support. We can draw a conclusion about this from the data in Table 1.

**Table 1.** Share of organizations, peasant (farm) households and individual businessman received credit funds and subsidies, % of their total number.

Enterprises of all types	Credit funds	Subsidies (grants)
Agricultural organizations	24.6	68.8
Including: Large and medium-sized organizations	37.4	75.5
Small organizations	20.4	66.6
Peasant (farm) households	10.7	34.5
Including: Peasant (farm) households	11.7	39.0
Individual businessman	6.9	18.4

In Russia, agricultural products produce four tapes of producers - agricultural organizations, peasant (farm) households, individual businessmen and households of citizens.

The table shows that 37% of large and medium-sized organizations receive credits while only 6.9% of individual businessmen get credits. It is the same as subsidies. Almost 76% of large and medium-sized organizations receive subsidies and just 18% of individual businessmen get credits. In other words, organizations and other type's producers have different opportunities for development (Demichev 2019).

To make Russian food security more sustained there is a need to support peasant (farm) households, individual businessmen and households of citizens as a parallel alternative of the large producers, including studying the experience of other countries (Cheng et al. 2018, Berkhout et al. 2018, Mdee et al. 2019). Thus, there is a chance to promote the development of a new model of agricultural growth. And it can be the model of inclusive development.

## 2. Methodology

The study used General scientific methods of induction and deduction, analysis and synthesis. The following methodology was used to build the inclusive green growth index (Inclusive green growth index 2018):

The scores are converted to a 1–6 scale (worst to best):

$$5 \times \frac{((\text{country score} - \text{sample minimum}))}{((\text{sample maximum} - \text{sample minimum}))} + 1 \text{ (positive impact)} \quad (1)$$

$$-5 \times \frac{((\text{country score} - \text{sample minimum}))}{((\text{sample maximum} - \text{sample minimum}))} + 6 \text{ (negative impact)} \quad (2)$$

The indicators for each group are assigned equal weights and aggregated to compute the group scores.

IGGI of AE = 1/3 (Indicators of Economic growth) + 1/3 (Social justice) + 1/3 (Sustainability of the natural environment).

We have to do it in order to normalize our data. IGGI of AE was constructed across 78 Russian regions based on 2017 data.

Based on the calculated rating, the number of Russian regions were divided by the level of inclusive development of the agricultural economy. The regions were divided into groups according to the following principle:

$$h = \frac{((\text{max value of index} - \text{min value of index}))}{\sqrt{\text{number of regions}}} \quad (3)$$

The first group is from min value of the index + h, the second one is min value of the index + 2h, ..., the eighth one is from min value of the index + 8h. According to the value of the index, each region fell into a particular group in terms of the level of inclusivity development.

The study used official statistics from the Ministry of Agriculture of Russia and the Federal state statistics service of Russia.

## 3. Results

### 3.1. The Definition and System of Indicators of Inclusive Development Agricultural Economy

Inclusive development of agriculture is ensuring equal access to economic opportunities of development for all agricultural producers and interaction between producers and rural area population.

Inclusiveness is able to solve such problems as inequality of opportunities for all types of producers, regional differentiation, poverty in rural areas, the gap in living standards between urban and rural areas, the decrease in rural population. There is a need to measure the different aspects of the new model of growth (Demichev 2018), including using best international experience and practice (Inclusive development index 2018; Sun et al. 2020). It is possible to do a basis on the system of indicators that can be integrated into IGGI of AE.

There are three groups of indicators – economic growth, social justice and sustainability of the natural environment. All of these indicators refer to inclusiveness and enable the achievement of SDGs.



The first group of indicators reflects economic performance, economic sustainability, necessity to reduce concentration and diversification of producers. Economic performance and sustainability are fundamental for inclusive growth, as this provides the basis for creating expanding economic opportunities. The decrease in the concentration of production helps to overcome the consolidation of land in the possession of one owner. Diversification of producers enables us to save business diversity (Chiengkul 2019). A whole list of these indicators closely interacts with the second group.

**Table 2.** Mapping indicators of inclusive development of agriculture to elements of inclusiveness and SDG goals.

<b>Group of indicators</b>	<b>Indicator (Description)</b>	<b>Elements of inclusiveness</b>	<b>SDG goals</b>
1	2	3	4
Economic growth	Gross value added of agriculture per capita, rubles	Economic performance	No poverty
	Coefficient of variation of agricultural production growth, %	Economic sustainability	Decent work and economic growth
	The average number of agricultural organizations per 1000 hectares of arable	The decrease in the concentration	Industry, innovation and infrastructure
	Hirschman-Herfindahl Production Concentration Index (cereals, potatoes, vegetables, livestock, milk) by enterprises of all types	Diversification of producers	Responsible consumption and production
	An average level of profitability for the last five years, %	Economic sustainability	Decent work and economic growth
An average level of debt per 1 ruble of agricultural productions, rubles	Economic sustainability	Decent work and economic growth	
Social justice	The ratio of wages in agriculture to wages in the economy as a whole, %	Access to income	Reduced inequalities Decent work
	Change in the number of people employed in agriculture, %	Access to work	Sustainable city and communities
	Employment rate of rural population, %	Access to work	Sustainable city and communities
	The change in the rural population, %	Well-being The preservation of the rural population	Good health and well-being
	Share of the rural population, in the age from 20 to 39 years old having higher education, %	Access to education Decent standards of living	Quality education

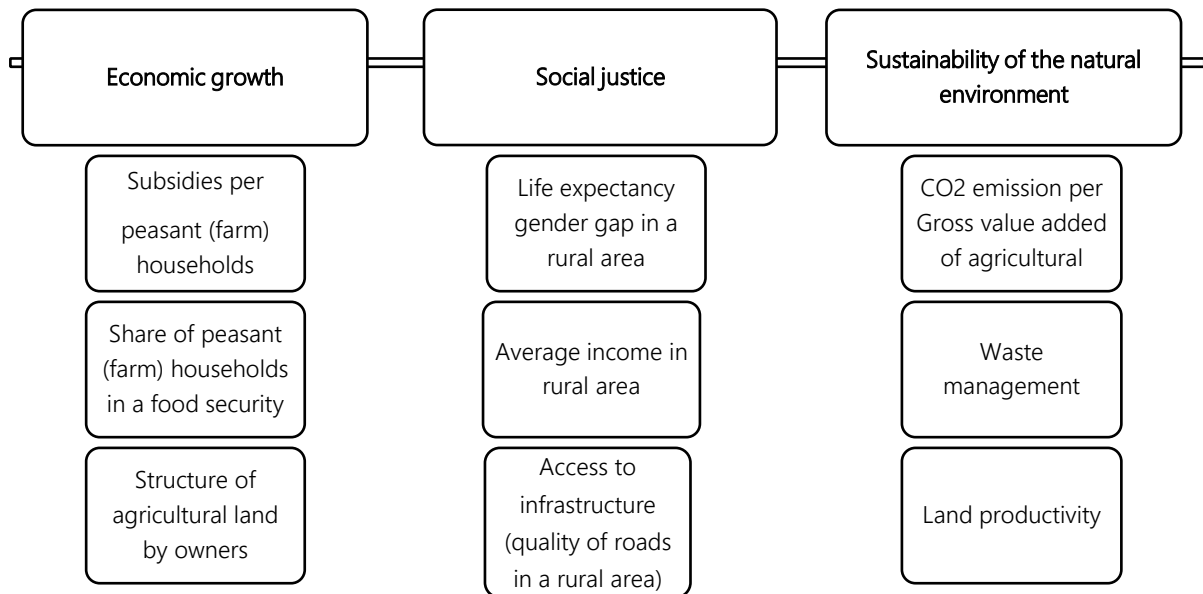
**Table 3.** Mapping indicators of inclusive development of agriculture to elements of inclusiveness and SDG goals (Continuation).

1	2	3	4
Sustainability of the natural environment	The methane emission coefficients from cows in the region, kilograms per cow annually	Reduction potential impact of climate change	Sustainable city and communities Climate action
	The methane emission coefficients from other cattle in the region, kilograms per cow annually	Reduction potential impact of climate change	Sustainable city and communities Climate action
	The costs of protecting the land per 1000 rubles gross value added of agriculture, rubles	Careful environmental management	Clean water and sanitation
	Investment in environmental protection for the last five years per 1000 rubles gross value added of agriculture, rubles	Careful environmental management	Life on land
	Air pollution by agriculture, according to Government Report	Reduction of air pollution	Sustainable city and communities

Economic growth does not necessarily involve the participation of a broad range of people and even areas. A growth is succeeding if all participants have the same opportunities to get income, work, education (Cobham and Klees 2016), well-being and high level of live standards. All of the social justice indicators illustrate it. The last indicator reflects the question of how many young and educated people rural areas have. It is essential because of this type of citizen the readiest to develop and create something new, something innovative.

The potential impact of climate change is measured in terms of methane emission from cows and other cattle. The costs of protecting and investing in environmental protection show careful environmental management as an essential element of sustainability of the natural environment (Green Growth Knowledge Platform 2013).

The level of air pollution is measured according to the government report about air pollution by agriculture. If there is the air pollution, we put 1, if not, we put 0.

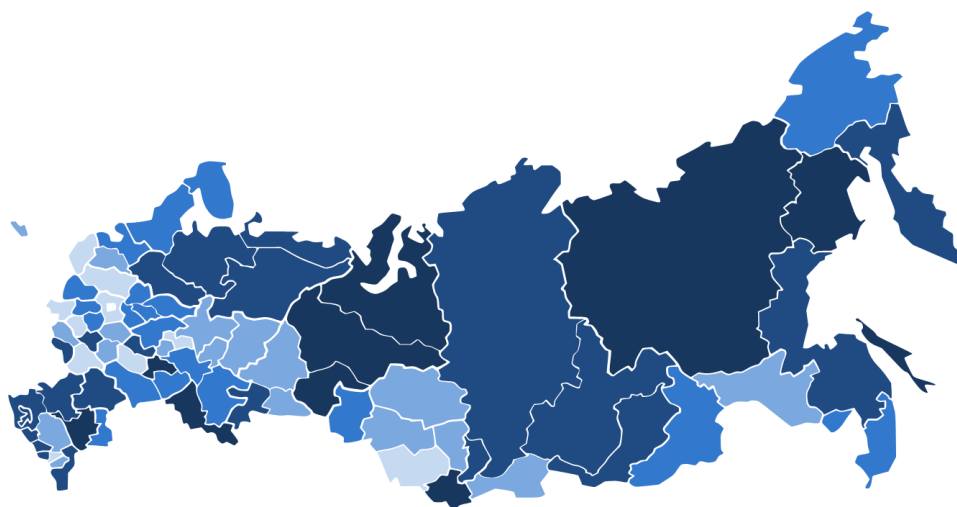


**Figure 2.** Indicators that were not constructed because of lack of data.

The system of indicators, however, does not cover important aspects of inclusiveness of agriculture (Figure 2) such as subsidies per peasant (farm) households, share of peasant (farm) households in a food security, structure of agricultural land by owners, life expectancy gender gap in a rural area, average income in rural area, access to infrastructure (quality roads in rural area), CO2 emission per GVA of agricultural, waste management, land productivity because of lack of data. And these are not all indicators that can be used in calculating the inclusive green growth index (Ginige et al. 2018; Struik and Kuyper 2017; Van Vuuren 2017; Ziankova et al. 2019). In addition, this system of indicators should be further improved by studying the factors that affect the modern economy and climate (The New Climate Economy Report 2018).

### 3.2. *Inclusive Green Growth Index of the Agricultural Economy in Regions of Russia*

Now we have to turn to the system of indicators. Using three groups of indicators (16 indicators) and using the methodology of the Asian Development Bank enable to construct Inclusive Green Growth Index.



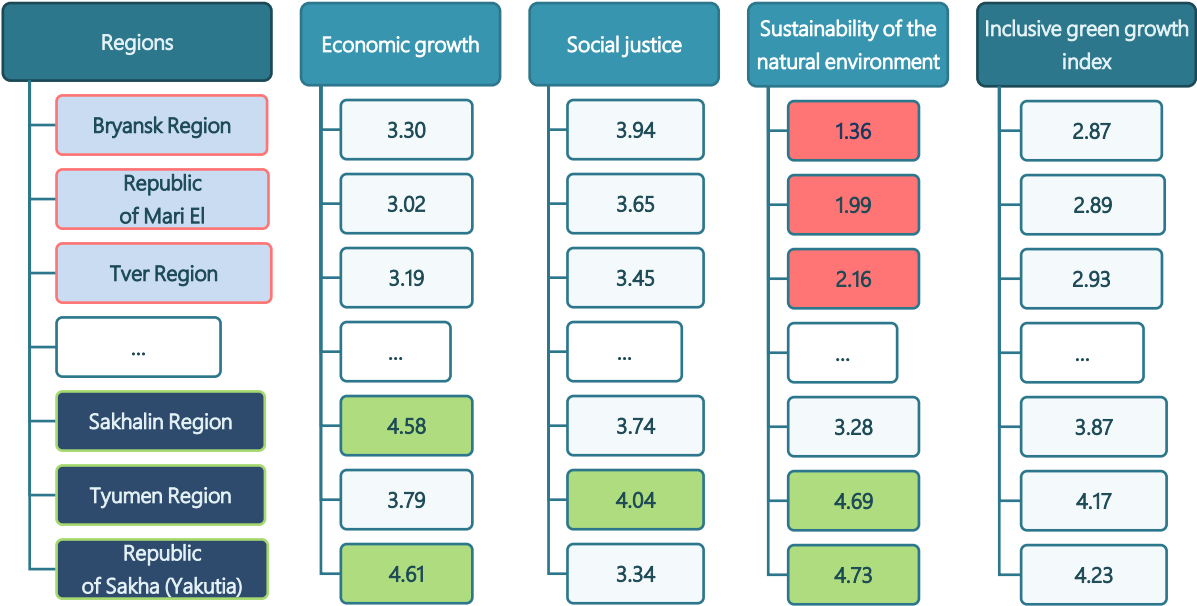
**Figure 3.** The level of inclusiveness of agricultural in Russian regions in the 2017 year.

We can see that 8 regions have the best value of the Index (The darker the color of the region the higher the level of inclusivity). It is possible to assume that there is no association between the climate and the value of the index. There are high-level of indexes on the East and West, North and South. Regions that are successful in agriculture often have low Index values. This is largely due to the negative impact on the natural environment of agriculture in these regions, the high level of production concentration and the increased debt burden of producers, and some other factors.

**Table 4.** Number of regions by the Index value.

Group of regions	Number of regions	Index value	
		From	To
I	9	2.87	3.19
II	18	3.20	3.37
III	22	3.37	3.54
IV	21	3.55	3.72
V	8	3.73	4.27

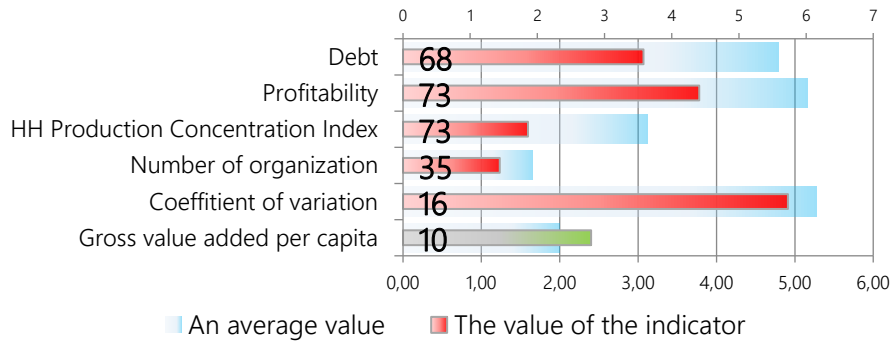
If we look at the best and the worst regions according to inclusive development, we can see that environmental sustainability remains the most neglected of the three groups of indicators. The best regions have a high level in all of these three groups of indicators.



**Figure 4.** Inclusive Green Growth Index in three the worst and the best regions.

If we take the worst region, we can see that in economic growth the region has a lot of problems. Succeeded in agricultural production the region not sustainable and has a high level of concentration and debt. In addition, there are some problems with social justice, air pollution, and methane emission. In general, focusing on the sustainability of the natural environment indicators is the top priority for the regions. As you can see, analysis of indicators enables to set development priorities and align investment decisions with broader sustainability objectives.

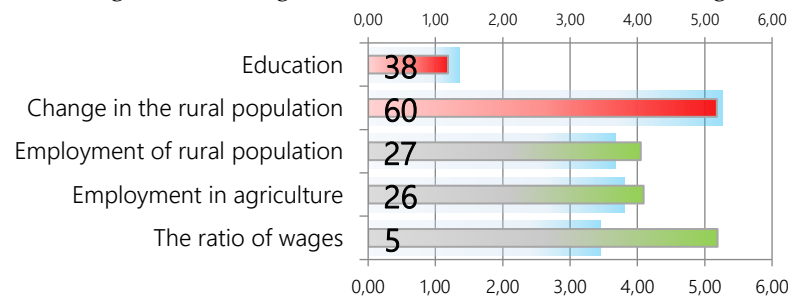
Consider the region that occupies the last position in the ranking – the Bryansk region. This is an agricultural region that has received significant investments in the development of agriculture in recent years (2.5 times more than in Russia on average). The Inclusive green growth index equals 2.87. It is the last position in our rating. Economic growth is position 67.



**Figure 5.** Values of economic growth indicators in the Bryansk region.

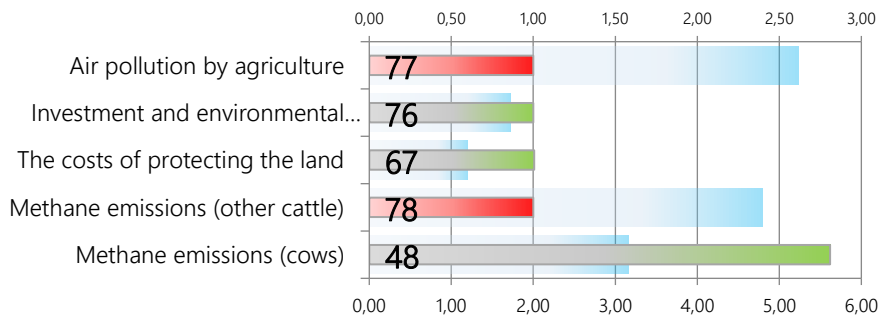
Having high values of gross value added per capita, having a high level of state support, the region has a high level of debt, a low level of profitability (largely due to specialization in the production of low-profit cattle products). It is also worth noting that the region is increasing the concentration of production, resources are increasingly consolidated in large enterprises. The Index of social justice leads the region to position 9.

Thanks to the development of agriculture in the region, a high level of employment, including in agriculture, is achieved a high level of wages relative to the values of the average in Russia.



**Figure 6.** Values of social justice indicators in the Bryansk region.

Special problems for the region developing agriculture arise in the field of environmental protection. We see that air pollution and methane emissions are high (the region specializes in veal meat production). Thus, the regional authorities will have to solve the identified problems in order to increase the sustainability of the region's economy. They should correct a model of growth in their regional agriculture as we know that better growth gives a better climate. (Global Commission on the Economy and Climate 2014).



**Figure 7.** Values of social justice indicators in the Bryansk region.

#### 4. Discussion

Thus, inclusive development is particularly relevant in the context of modern development of the Russian agricultural economy. Concentrating production in large enterprises, in parallel, there are

problems of excessive indebtedness of enterprises, reducing their number, and high load on the environment. An inclusive model that involves other participants in the agricultural economy in production will reduce these problems and thus increase the sustainability of the Russian agricultural economy. However, it is worth noting that further detailed research is required on the factors of inclusive development, including the impact of digitalization of agriculture on its inclusiveness, the relationship between inclusivity and quality of life indicators, infrastructure development, inclusivity, and climate change issues.

## 5. Conclusions

The results of the study allow us to make the following key observations:

- Russian agriculture is developing unevenly both regions and types of producers.
- Peasant (farm) households, individual businessman and household of citizens need special support because they receive less subsidies and loans and are also an integral part of inclusive development.
- A new approach to economic growth is needed because economic, social, and especially environmental problems accumulate.
- Inclusive development will involve all regions and types of producers in the growth.
- The green inclusive growth index is a suitable measure for new quality growth.
- However, a number of key indicators are missing from official statistics, including those directly related to SDG's, which indicates the need to improve the system of indicators that track inclusivity and sustainability.
- Many Northern, Siberian, Dalnevostochny regions (such as Sakhalin Region, Tyumen Region and Republic of Sakha) that is, non-agricultural regions of Russia, showed high index values, which also indicates the emerging contradictions between green inclusive development and the current model of the agricultural economy.
- In agricultural regions (for example, the Bryansk region), problems such as rising debt, excessive concentration of production, air pollution, and methane emissions are increasing. All these problems are amplified by the implementation of the current agricultural policy of concentration of production in certain regions and certain large organizations.
- Development of agriculture on the basis of inclusiveness will provide economic green growth, reduction of poverty and injustice. In particular, this will allow Russia to develop and support small agricultural enterprises and rural areas, reduce inequality between urban and rural areas, and fully include the rural population in economic growth and well-being.

In conclusion, it is clear that there is a need for a new type of growth that helps to involve regions and all producers in development, reduce the burden on the environment, and stop the decline in the rural population. Based on new indicators inclusiveness will help change our priorities, ways of investments and thinking. Inclusiveness has a lot of factors that should be researched further.

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# Forecasting of FOREX Price Trend Using Recurrent Neural Network - Long Short-term Memory

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**Abstract:** Algorithms of neural networks (NN) can search and represent both structured and not structured data, we employ then on financial time-series. This paper describes the use of Long short-term memory (LSTM) for FOREX pair EUR/USD price prediction. Aim of the paper is to test and proposes the best time block to predict based on a daily FOREX data. We employ the mean of absolute errors and the least mean squared errors to assess prediction results in order to find the time block. We tested time blocks from ten to fifty-eight days and 100 or 300 epochs. Training dataset contained daily exchange rate data from 1.4.1971 until 9.5.2019. The best performing network has been trained for 30-day period and 100 epochs. This paper also describes the effect of training for a high number of epochs.

**Keywords:** neural networks; FOREX; forecasting; long short-term memory; time block

**JEL Classification:** C45; C53; F31

## 1. Introduction

Forecasting is one of the essential tasks that humans are trying to achieve. That is why economic time-series were the aim of prediction for a very long time. In the late 90' financial time series, such as stock market and Foreign Exchange (FOREX), were described as a phenomenon with nearly like a random-walk process behavior, with statistical properties different at different points in time as the process is time-varying, making the prediction almost impossible (Hellstrom and Holmstrom 1998). Twenty-one years later is our set of tools wider and computational power incomparable. With their use we try algorithms to learn from repetitions and patterns to predict the next period. The methods are moving forward very quickly yet long-term or extremely short-term remains as a significant challenge and mainly intraday trading needs to be explored (Pradeepkumar and Ravi 2018).

Algorithms of neural networks (NN) can search and represent both structured and not structured data – for instance, natural language processing, time series or image data (Abdel-Nasser and Mahmoud 2019; Pena-Barragan et al. 2011). In image data processing can be found examples about fixing an image (Wolterink et al. 2017; Yang et al. 2018), compression (Sun et al. 2020), super-resolution (Ledig et al. 2017) or image classification (Krizhevsky et al. 2012). Algorithms of NN more often occur in the first position in many competitions. Image processing and time series are a very developed field. Some of the examples are image understanding, fixing old image damage, styling image and fake image generating.

Researchers try to improve their models with many variations. For instance, Francesco Rudo added a new layer of reinforcement learning to his model. With this new model, he got Return of Investment 98.23 % and with a reduction of drawdown 15.97%. (Rundo 2019)

One of the main problems is the time block used for a prediction. This is the aim of our research. We perform a mid-term FOREX analysis and test a different time block in order to find the least mean of absolute errors (MAE) and the least mean squared errors (MSE). Time block of a prediction is crucial to prediction accuracy. With an extended period, we get too far into the future and lost accuracy. With





## 2.2. Recurrent Neural Networks

Humans do not start their thinking from scratch every second. As we do something, we understand and we build our experience on previous knowledge. We do not throw everything away and start thinking from scratch again. During the reading, we understand every word in the context of other words.

Traditional neural networks don't have a memory. For instance, imagine your network is trying to solve a classification task. To be correct classify every frame of a movie. Every point of the timeline has to be described. It is impossible to understand a movie in context if the network does not have any information about previous events in the movie.

RNN is a network with architecture which address this issue. RNN contains a loop to allow the network to persist information. A loop allows information to be passed from one step to the next one. (Hochreiter and Schmidhuber 1997)

This loop makes a recurrent neural network less clear for understanding. For better understanding, we can imagine recurrent networks as multiple copies of the same network. Each new one is created from the previous network. Consider it as a loop.

This brings us to the general use of RNN. They are high with time series. The incredible success of RNN applied to a variety of problems: speech recognition, language modeling, translation, image captions, traffic predictions and our primary target price predictions. (Abdel-Nasser and Mahmoud 2019; Carapuço et al. 2018; Sidehabi et al. 2016; Zhao et al. 2017)

A special kind of RNN is LSTM. They are capable of learning long-term dependencies and were introduced in 1997. LSTM has been proven to be high performing on various problems. (Hochreiter and Schmidhuber 1997)

LSTM is designed to avoid the long-term dependency problem. They keep information for long periods. As we described in the previous part, all RNN have some form of a loop like repeating modules. LSTM also has a loop like a repeating module. The architecture of the LSTM cell is illustrated in Figure 3.

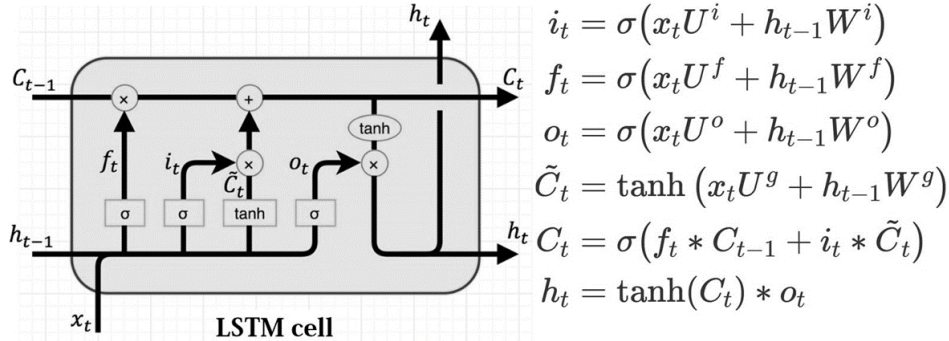


Figure 3. An illustration of LSTM cell with memory pipe. (Varsamopoulos et al., 2020)

The key part in a LSTM cell is C line. C represents a memory pipeline. LSTM has an ability to add or remove information to the memory regulated by gates. Gates x and + are a way to let information thought optionally. The  $\sigma$  layer outputs a real number between zero and one. This value represents the impact of information. Zero is for no impact one and one is for very important one.

## 2.3. Dataset, HW and Data Treatment

FOREX currency pairs are divided into three groups - major, minor and exotic. (Broto 2013; Laherrere and Sornette 1998) Major currencies are the most used. For instance, EUR/USD (our choice) or GBP/USD and others. Minor currencies are less traded and have lower liquidity - for instance, Norwegian krone. For different pairs a different behavior can be observed. Hence, similarly to a problem of various industry evaluation a different approach has to be taken in order to assess the development (Hedvicakova and Kral 2019), i.e. one strategy won't fit for all and for each pair the processing will results in a different NN settings. Regarding the settings, one of advantages is that FOREX is one of the most available sources of data which provides enough training data. It is one of

the reasons why we choose FOREX for our time series forecasting. Specifically, a public dataset from kaggle.com with the only date and close value of EUR/USD price. (Mahesh 2019)

For better results, we are using for pre-processing MinMaxScaler from library Sklearn. This feature scaler gets minimal value and maximal value. This value then recalculates all dataset values to fit the given range in the constructor.

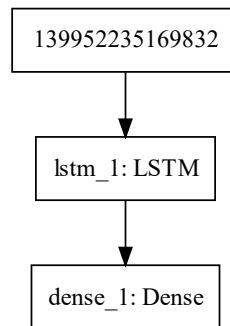
Feature scaling is a technique to standardize the independent features in a fixed range value. It is done to reduce network size. For instance, with the adequately distributed value, we can use a small network. We used feature scaling for the price value. That means our results are also scaled values. As for post-processing, we also used the same instance of feature scaler on predicted values.

To reach our goal, we divided the input dataset into slices in a range from 10 to 60 days. This period is a shape for training and also for later predictions.

The trained model is pure LSTM architecture from 1997. (Hochreiter and Schmidhuber 1997) We are using the LSTM layer provided by Keras framework. Our architecture uses three output units connected into a fully connected Dense layer. We used mean squared error (MSE) loss function with RMSprop optimizer.

LMST input has as many dimensions as time block used for a particular model. Generally, we are using a structure with shape (N, 1).

Our model is drawn by Keras utility method mode\_to\_dot in Figure 4.



**Figure 4.** Model architecture with one LSTM and one Dense layer.

LSTM, RNN and NN generally are very performance demanding. Our computation computer has two dedicated cards with a total of 7,934 CUDA cores. These cards are one of the top-performing gaming cards of current NVIDIA cards. Because of frameworks support, we decided to use NVIDIA cards only. One of our cards is 1080TI with 11,176 MB graphic memory and 1,607 MHz max clock rate. Another one is 2080TI with 11,019 MB of graphics memory and 1,545 max clock rate. Used processor is i7-8700 with 3.20 GHz clock.

We used as a programming language Python in version 3.7.3. For programing in Python, we used a web-based interactive computational environment Jupyter Notebook. Keras is our main used framework. Keras is a top-level framework with high abstraction on top of Tensorflow. In new versions of Tensorflow (2.+ ) is Keras integrated.

Prediction validation was calculated by MSE and mean absolute error (MAE). Both methods are commonly used for neural network loss calculation. In our case, used loss function was MSE.

$$e_t = y_t - \hat{y}_t \quad (1)$$

where  $y$  is the actual value and  $\hat{y}$  is predicted value.

For validation of results, we used MSE

$$MSE = \frac{\sum_{t=1}^N e_t^2}{N} \quad (2)$$

where  $e_t$  is the difference between the predicted and the the actual value.  $N$  is a number of observations.

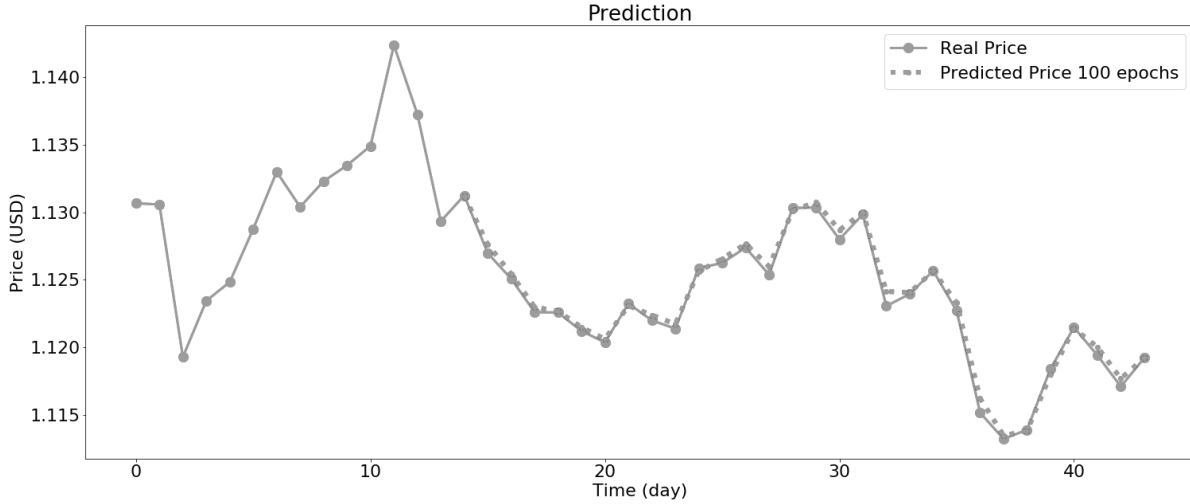
Mean absolute error is a measure of the difference between two continuous variables.

$$MAE = \frac{\sum_{t=1}^N |e_t|}{N} \quad (3)$$

where N is the number of observations.

### 3. Results

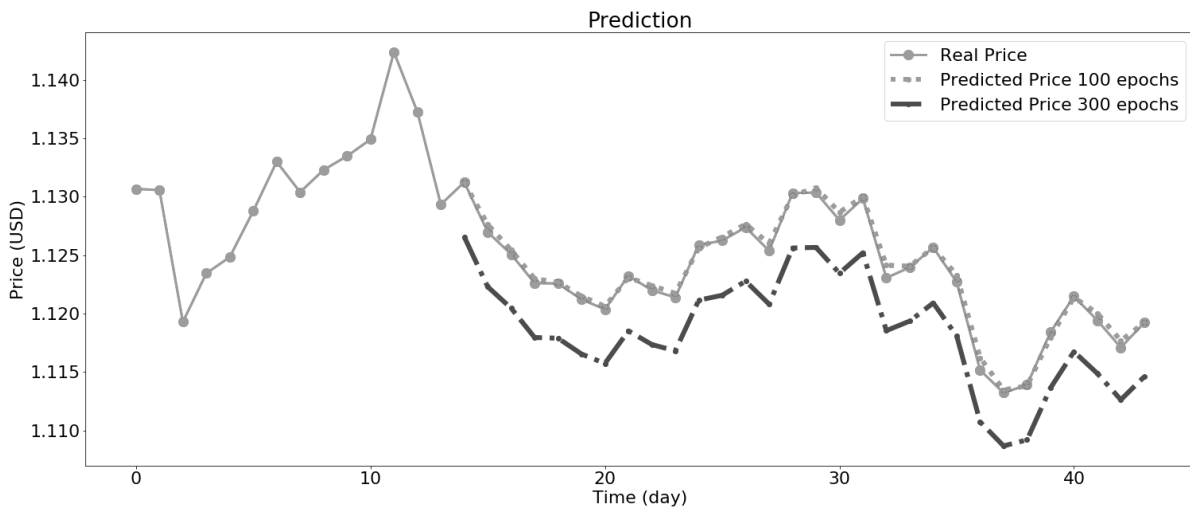
FOREX price forecasting is an exciting field of study. Our very simple model with only one LSTM layer shows excellent performance on this dataset. We proved the correlation between input time block and prediction accuracy. The best performing model has an MSE value 0.003052 and MAE 0.002390.



**Figure 5.** Best performing LSTM network on 30 days period trained for 100 epochs.

Impact of time block input on LSRM forecast accuracy can be seen in Table 1. Some time blocks are really close to the best performing 30 days period. An exciting result has a 26 days result. This block shows one of the worst accuracies. The worst block is 38 days, with 100 epochs.

We also test the impact of training length i.e. an impact of epochs counts on the accuracy. In the case of three times more epochs, we got very different results. For instance, the best performing 30-day period has 59 % worse accuracy. For a difference between 100 and 300 epoch training length see fig below.



**Figure 6.** Comparison of 100 and 300 epoch training length.

**Table 1.** Table 1 represents results of calculated errors MSE and MAE. Best performing combination is bold and second is italic. The best performing network is a combination of 30 days

period and 100 epochs of training. It is essential to know that these results are directly dependent on our architecture.

**Table 1.** Results table of MSE and MAE value for every tested network.

Time period in days	Number of epochs	MSE	MAE
10	100	0.003427	0.002776
14	100	0.004097	0.003015
18	100	0.004671	0.004050
22	100	0.004666	0.004056
26	100	0.005178	0.004641
<b>30</b>	<b>100</b>	<b>0.003052</b>	<b>0.002390</b>
32	100	0.004152	0.003531
34	100	0.003548	0.002768
36	100	0.003377	0.002634
38	100	0.006203	0.005553
40	100	0.003491	0.002788
42	100	0.004744	0.003843
44	100	0.003873	0.003068
46	100	0.003696	0.002895
48	100	0.003987	0.002976
50	100	0.004229	0.003231
52	100	0.004821	0.003797
54	100	0.003890	0.002917
56	100	0.006394	0.005796
58	100	0.003421	0.002556
10	300	0.003536	0.002752
14	300	0.003961	0.002930
18	300	0.005398	0.004468
22	300	0.005036	0.004475
26	300	0.003479	0.002725
30	300	0.005140	0.004565
34	300	0.004205	0.003436
38	300	0.005318	0.004628
42	300	0.004561	0.003661
46	300	0.004879	0.003844
50	300	0.004976	0.004276
54	300	0.003485	0.002605
58	300	0.005875	0.004888

Full length of training our 33 variations was around 27 hours. We used the method of parallel training to decrease the amount of final time.

#### 4. Discussion and Conclusion

Although not many papers described RNN and LSTM employment for the FOREX prediction, a heading of our research can be compared to results of e.g. (Sermpinis, Dunis et al. 2012) who chose the same pair EUR/USD pair and also a daily data. A larger set of methods was employed where RNN was compared to e.g. results of autocorrelation-based models but with mixed results. When RNN was compared to a hybrid model of adaptive particle swarm optimization and radial basis function in another study by (Sermpinis, Theofilatos et al. 2012), the hybrid model outperformed it by 9% in annualized return and needed only a half of positions taken. Although a trading pair was EUR/GBP. Daily time frame data were employed also by (Bagheri et al. 2014; Khashei et al. 2008) although they employed a hybrid model-based algorithms unlike us.

Study (Persio and Honchar 2016) employed the same approach as we when utilizing RNN, LSTM, and adding Multi-layer Perceptron, and the Convolutional Neural Networks (CNN) for a purpose of FOREX analysis (EUR/USD pair). They applied it also on the S&P500 index. Unlike our approach their focus was on intraday trading with a minute-by-minute setting regarding FOREX. The best results of accuracy after training for different architectures by their novel Wavelet + CNN algorithm which outperformed other NN approaches, including RNN in both stocks as well as forex market, with a very high 83% accuracy. However, the variation of results was not very high with maximum of 4% prediction accuracy showing RNN suitability for the task. Study (Maknickienė and Maknickas 2012) based EUR/USD trading strategy on LSTM resulting in 4% profit over the test period of three-day trading steps with an overall accuracy of 65% percent of Pearson's correlation between predicting and historical values. RNN and CNN were employed and compared to C-RNN algorithm by (Ni et al., 2019) for nine volatile currency pairs in the data set with 10 years timespan. Comparison of mean squared errors of predicted values by different forecasting algorithms where C-RNN performed better by 10% compared to CNN.

Employed RNN and LSTM methods in our study are suitable and they were successfully employed by other studies. Although a model specialization into hybrid models creation seems highly promising (Pradeepkumar and Ravi 2018) notes that more attention should be paid to image processing algorithms for the needs of FOREX prediction. This opinion is consistent with rather problematic but still practiced trading of chartism where a certain "image" formation types are being searched for in order to enter a trading position.

The best performing network is a combination of 30 days period and 100 epochs of training. It is essential to know that these results are directly dependent on our architecture. We understand that any algorithm can be, at least temporarily, unsuccessful in an environment with an unexpected fundamental changes such as economic distortion caused by the recent coronavirus. After reaching a certain point the market became bearish in a three-day panic which affected both the stock market as well as FOREX. Although algorithms can adjust in the after-initial-panic period the moment of panic itself cannot be handled properly since there not enough adequate cases of such events. Hence one of the main challenges will likely remain even after further research, in this promising and organically fast-growing research area, will be conducted.

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# Perspectives of the Implementation of Human Resource Diversity Management in Russian and Czech Organizations

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**Abstract:** The human resource (HR) diversity occurs as a factor that attracts growing attention in the recent three decades seen to increase the competitiveness and effectiveness of organizations. The tendency stands in the cultural transformation of society. For organizations in Russia, it becomes revolutionary thanks to its consequences because, unlike developed countries, this means a new direction of the management and HR diversity practices happen at the beginning of the development. However, long-term demographic trends on the Russian labor market and globalization determine that it becomes a priority for organizations' management. The paper aims at the approaches regarding HR diversity and the view of the specifics utilized by managers in Russian organizations. The methodology includes on-the-desk analysis, an online questionnaire survey in Russia in 2018, and two semi-structured interviews with top managers/co-owners of Czech companies in 2019 as a basis for sharing know-how. Perspectives can be a pragmatic approach to managing HR diversity. Recommendations covering HR practices include the new orientation of managerial activities on the targeted perception, use, and support of diverse labor force, mainly on training and development of line/operational managers in diversity value and interpersonal communication in diverse workgroups.

**Keywords:** diversity; diversity management; human resources; discrimination

**JEL Classification:** J80; L21; M14

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## 1. Introduction

One standard scheme cannot describe the behavior of most people. For an organization to be more effective in managing and leading people, it is necessary to consider their individuality, exploit their strengths, and reduce the negative impact of their deficiencies. This approach gives opportunities for human resource management (HRM) to find practices for managing employee diversity. The term diversity originated in the US in the 1960s and referred to people diversity in terms of their standard and mutually differentiated features. The concept of diversity management has a basis on the recognition that the workforce of an organization consists of people who are different from each other, and employers should consider these differences as an integral element of their personnel/human resource strategy and business development.

The relevance of the research presented in the paper is that the topic is on the edge of research and business administration, both in Russia and the Czech Republic, but increasingly becomes essential for the sustainable development and represents one of the human resource (HR) priorities in some countries. This interest evokes current trends related to globalization, border enlargement, and development of international cooperation. However, Hennekam, Tahssain-Gay, and Syed (2017) point at significant discrepancies between diversity policies in Europe and the US and the complications of its implementation in other regions where the local context has a significant impact on the strategies adopted.

The paper aims at the identification of approaches to human resource diversity in organizations and analyzing the situations in managing diverse staff in Russian and Czech environments. Diversity approaches to people management must introduce into the personnel/HR management system, especially in the case of Russian organizations due to the demographic situation in Russia and the task of maintaining competitiveness concerning foreign companies, both on the external and domestic markets.

## 2. Theoretical Ground for Human Resource Diversity Management

### 2.1. Analysis of bibliographic data

We retrieved 8,658 bibliographic records that matched the query in database search in the period 1990-2019: records from the Web of Science databases count for 3,775 and Scopus 4,883. The structure of bibliographic records shows Table 1. The enormous amount of literature of various sciences does not allow conducting a complete analysis of all of them. In this paper, the analysis is limited by the most significant works, considering the citation index related to diversity management, human resource diversity, human resource diversity management, discrimination and fairness, gender discrimination, and age discrimination. The study outlines the development of promising directions in several areas, mostly in management, business, industrial relations, applied psychology, economics, and social sciences.

**Table 1.** Bibliographic records by the query in Web of Science and Scopus database 1990-2019.

Query	Web of Science <sup>1</sup>	Scopus <sup>1</sup>
Diversity management	981	1,403
Human resource diversity	15	21
Human resource diversity management	7	8
Discrimination and fairness	13	14
Gender discrimination	1,873	2,414
Age discrimination	886	1,023
Total	3,775	4,883

Diversity management belongs to the most studied topics in the period 1990-2019 in the USA (247 publications in the Web of Science), England (110), Germany (73), Australia (63), and France (50). In the CR, it covers 29 publications and in Russia 12 publications. Articles dealt with diversity management cover according to categories topics from management (394 publications), business (114), industrial relations and labor (81), applied psychology (76), public administration (74), education and educational research (58), and economics (47).

In the case of human resource diversity, the order of the number of publications characterizes the following: Australia (6), Peoples Republic of China (2), and other countries only one publication (Czech Republic, England, Norway, Kenya, Romania, Slovakia, US). Human resource diversity management is a topic in publications from Australia (6), Peoples Republic of China (2), and Slovakia (1).

Publications about gender discrimination mainly print in the USA (714), England (150), Canada (116), Peoples Republic China (104), Spain (98), Australia (88), and in the same period in Germany 60 publications, in Russia 15 and the CR 11. They focus predominantly on economics (234 publications), women studies (198), management (137), public environmental and occupational health (121), education and educational research (114), and social psychology (112).

Age discrimination mostly becomes a subject of publications in the USA (367), England (102), Australia (51), Germany (46), Canada (39), Scotland (23), but in Russia 10 and the CR 7. They belong to gerontology (139), law (138), management (99), industrial relations and labor (93), applied psychology (73), and economics (68).

The number of literature deals with the most analyzed topics increases during almost the last 30 years, as shown in Table 2. It demonstrates that organizations see in diversity management and diverse human resources potential for development, sustainability, and competitiveness.

**Table 2.** Bibliographic records by the query in Web of Science database 1990-2019.

Query	Years <sup>1</sup>									
	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019
Diversity management	1	4	10	11	42	74	100	121	82	122
Gender discrimination	4	21	30	39	63	116	157	182	179	200
Age discrimination	15	24	19	15	32	47	63	59	58	73

## 2.2. Literature overview

Diversity management focuses on differences among people accepting innovative potentials of these differences and lessening human shortages. The result is an atmosphere of openness and tolerance, where conditions aimed at talent identification, full self-realization, the achievement of objectives thanks to an effective synergy of competencies of different employees.

The individual's personality traits, working conditions, and team characteristics influence the individual's behavior in the organization of which the human being is a part, in the context of corporate culture and national mentality. Personality traits create under the influence of:

- natural factors such as the physiological state of the body, higher nerve activity, memory, emotions, feelings, and perception,
- social factors such as education, experience, habits, and social groups.

Each person has the own individual character and is a representative of different national and group cultures and subcultures.

Diversity management policy recognizes that employees are different. If properly managed, these differences will contribute to more qualified and efficient job performance. This policy focuses not only on discrimination issues; it is about understanding the differences between people as a basis for strategic HR diversity management. The concept of diversity management assumes that mastering HR diversity creates a productive environment in which everyone will perceive their value, employees' skills will fully utilize, and the organization will achieve its goals (Kandola and Fullerton 1994; Kandola et al. 1995).

Diversity management can define in two levels:

- in terms of gender, age, nationalities and ethnics, health fitness, sexual orientation, which used to be the subject of a personnel / HR audit,
- in terms of differences between individuals, where the diversity of individuals means differences in IQ, professional and personal characteristics of employees, and in their EQ, values, opinions, and beliefs, which is the subject of managing and leading people.

A theoretical ground dealt with diversity management distinguishes between primary and secondary differences among people. Primary differences, i.e., gender, race, nationality, age, cannot change and must master them. Secondary differences, i.e., marital status, education, belonging to a professional group, income level, and professional experience, may change over time (Armstrong and Taylor 2014). According to Toplis, quoted by Armstrong (2009), a human being contains everything related to his/her behavior and ways how he/she organizes and coordinates interactions with the environment. A leader must, therefore, be able to work with different types of employees, understand their characteristics, integrate different talents, and their competencies to use them for development and enrichment of group activities (Jetten, Spears, and Manstead 1996).

HR diversity management can see as the art of effective decision making, considering the similarities, differences, and complexities that people cause. Thomas and Ely (1996) describe the reality in managing HR diversity based on their analysis of three culturally different organizations and

identify three distinct perspectives on workforce diversity: the discrimination-and-fairness perspective, the access-and-legitimacy perspective, and the integration-and-learning perspective which are acceptable as three basic principles for managing diversity. However, diversity efforts in the workplace have undertaken considerable goodwill, and, ironically, they often end up fueling tensions (Ely and Thomas 2001). The discrimination-and-fairness paradigm accepts that discrimination is wrong, and HR monitoring mainly focuses on the achievement of a company's recruitment and retention goals. This approach looks at assimilation as well as color- and gender-blind conformism through pink glasses. The access-and-legitimation paradigm, on the other hand, celebrates differences. Organizations try to get access to a more diverse clientele, matching their demographics to targeted consumers.

Nevertheless, that approach can leave employees of different identity-group affiliations feeling marginalized or exploited (Ibid.). We believe that the integration-and-learning perspective can use an HR practice for the achievement of benefits from diversity. Shen et al. (2009) see all three perspectives useful in motivating managers to diversify their staffs, but the inequality and discrimination still widely exist, and HRM mainly focuses on compliance with equal employment opportunity and affirmative action legislation.

As above-mentioned, the manifestations of discrimination persist and take the form of a prohibited unequal relationship whose purpose or effect is to put a person in a less favorable situation against another person who is otherwise comparable to that person but is based on a prohibited manifestation unequal relationships, including violations of a person's rights and instructions to discriminate a person (Roosevelt 1992). The management of the organization strives to combat discrimination in the workplace through the implementation of an equal employment opportunity (EEO) policy and declarations of tolerance towards people. Labor legislation provides legal means to combat discrimination, but none of these instruments can effectively counteract hidden forms of discrimination. The statement applies to the EEO, whose principles lay down in the charter of organizations and their implementation in order to prevent discrimination against employees (Sharma 2016). The main differences between diversity management and EEO policies are that the first one involves all employees, focuses on changing the culture of the organization and achieving the business goals of the employer, exposing people's potential and maximizing the contribution of employees to achieving the goals of the organization. EEO policy focuses on discrimination against women, representatives of national minorities, and people with disabilities, and has a weak link with the organizational culture and business objectives of the organization (Roosevelt 1992). Diversity management used to be primarily a fight against discrimination in the workplace, even though it positively and significantly relates to organizational commitment regardless of gender (Kim, Lee and Kim 2015).

Gilbert, Stead, and Ivancevich (1999) developed a useful diversity management model that shows that the introduction of the changes proposed in the diversity management concept has a positive impact on employees and, consequently, on the organization itself. The reasoning uses the fact that employees can generate many new ideas as they receive the opportunity to do something other than their usual routine and daily responsibilities. The combination of different skills and team experiments usually enable to achieve higher productivity than individual work, which is performed independently and stimulated by providing benefits (Nemeckova 2017). Besides, creative activity in groups significantly enhances in cases where a minority has the right to vote with the majority, or even a consensus needs to achieve. That legitimizes the role of the "devil's advocate," which seeks to find weak links in decision-making and criticize when minority views must include in the final decisions, and team members have different reasoning and views. The empowerment of representatives of minorities to express their views has a positive effect, even if these views are wrong (Nemeth et al. 2001). The best way to overcome the group's narrow focus is, according to Nemeth, Brown, and Rogers (2001):

- to establish competing groups working on the same problem,
- to build, with the participation of impartial experts, a professional position that critically evaluates various ideas and opinions,

- to generate groups of employees, each of whom has a different function.

The most productive groups characterize an uncertainty about the roles of their participants due to their active interaction and the absence of hierarchical structures (Janis 1972). The generated environment usually brings a significant effect - strengthening the spirit of innovation and creativity. The latest substantial research conducted in 165 corporations from 20 states also confirms the positive impact of diversity of nationalities on corporate entrepreneurship in the context of globalization of markets (Boone et al. 2019).

The innovation supports teamwork and the ability to escape, at least temporarily, the established pressure of organizational tasks. The most effective teams are those characterized by the influence of minorities, competition, heterogeneity, and interaction. In other words, people should divide (as experts in their field), and at the same time, they should connect (to build a team).

Dobbin, Kim, and Kalev (2011) believe that firms with workforce diversity intend to more extent than others to develop diversity programs. Kalev, Dobbin, and Kelly (2006) analyze three approaches applied by employers to encourage HR diversity. Their findings show that some programs aimed at the development of organizational responsibility for diversity, others at lessening managerial bias through training and feedback, and the last ones at minimizing the social isolation of women and minority workers. They provide arguments that initiatives focused on responsibility for diversity lead to the broadest increases in managerial diversity. Additionally, as D'Netto et al. (2014) discuss in the case of the Australian manufacturing sector, employers can utilize a potential covered by human resource diversity if they build trust among employees, monitoring the HR diversity, invest in diversity training, networking, and mentoring.

### 3. Methodology and Findings

#### 3.1. Methodology

The methodology insists on several methods that enable a triangular analysis. The research combines state-of-the-art knowledge identified by in-depth-analysis in secondary sources with data collected by online questionnaire surveys and semi-structured interviews. The online questionnaire method uses for collecting data in Russia and semi-structured interviews in the Czech Republic due to the possibilities to address respondents in the mentioned countries. Researchers utilize their observations as well as findings from their long-term research about toxic labor relations in both countries. The reasoning methods are first that ethical aspects of employment deal with social phenomena deeply rooted in history, culture, values, and behaviors, which influence a discrimination bias and prejudices. Secondly, based on bibliometric analysis, it is evident a need to formulate an umbrella view about approaches to diversity in Russian organizations and to identify main issues in managing HR diversity. HR practices in the Czech environment can be useful as a benchmark in the case if we find them as effective best practices applicable in another Slavonic culture. Therefore, research collects and analyses data by an interpretative group of methods that reveal the meaning-making practices of human subjects to get a basis for achieving results, emerging questions for the practice, and ideas for future research. Respondents are employees, HR professionals, senior and top managers, to understand their attitudes to HR diversity among both managers and employees. The questions asked in the questionnaire research and used in semi-structured interviews include Table 3.

Research questions reflect the state-of-the-art in secondary sources and gaps in knowledge about human resource diversity management in Russian organizations. The paper intends to find answers using HR best practices in the Czech environment to the following:

1. What approaches exist in human resource diversity management in Russian organizations?
2. Which approaches to human resource diversity management can develop in Russian organizations?
3. Which HR best practices can recommend for designing human resource diversity management in Russian organizations?

### 3.2. Findings of human resource diversity in Russian organizations

The online questionnaire research includes answers received from 29 respondents employed in different Russian organizations in different areas of economic activity in the period from September to October 2018. The most significant number of respondents work in production (28%), customer support (22%), services (13%), trade (8%), energy industry, construction, and healthcare (each of them roughly 5%). The survey involved respondents mainly from medium and large enterprises, namely 31% of respondents in enterprises with 50-249 employees, 42% of respondents in enterprises with 250 employees or more. In microenterprises, up to 9 employees were 8% of respondents and in small enterprises with 10-49 employees: 19 0 of respondents.

The sample of Russian respondents characterizes the following:

- 22 women (76%) and seven men (24%),
- Respondents are aged 21 to 34: nine (31%), 35 to 44: nine (31%), aged 45 to 54: seven (24%), aged 55 and more: four (14%),
- 15 respondents occupy senior positions (52%), three are top managers (10%), eleven respondents work as professionals (38%).

Respondents who work in the company for less than one year are five (17%), 1 to 2 years also five (17%), two to five years - eight (27%), five to ten years - five (1%), ten or more years - six (21%).

The results of the survey shown in Table 3.

**Table 3.** Results of the online survey of Russian employees in 2018 (% of respondents).

List of questions <sup>1</sup>	Yes	Rather yes than no	Rather no than yes	No	I don't know
1. Does your organization support employee diversity?	24.1	37.9	24.1	3.4	10.3
2. Does your organization's management show through its actions that employee diversity is important to the organization?	20.7	27.6	27.6	6.9	17.2
3. Does your organization commit to diversity?	20.7	24.1	31.0	17.2	6.9
4. Does your organization respect the individuality of its employees and value their uniqueness?	34.5	24.1	27.6	10.3	3.4
5. Is your organization trying to implement cadre diversity initiatives?	10.3	24.1	37.9	27.6	0
6. Can anyone apply for any job, regardless of nationality?	55.2	31.0	6.9	3.4	3.4
7. Does your organization ensure that employees are treated fairly, regardless of their unique characteristics?	44.8	24.1	20.7	6.9	3.4
8. Do employees of your organization respect their characteristics?	31.0	48.3	13.9	6.9	0
9. Have you ever witnessed or been the victim of discrimination in your organization?	24.1	0	0	62.1	13.9
10. Do all employees in your organization have equal opportunities for their career growth?	31.0	31.0	20.7	17.2	0
11. Did the experience gained by working in your organization contribute to a deeper understanding of the individual characteristics of people?	62.1	27.6	3.4	3.4	3.4
12. Do you efficiently deal with people who have values and characteristics different from yours?	58.6	27.6	13.9	0	0
13. Have you ever had to change your working style to suit different employee needs?	37.9	27.6	13.9	17.2	3.4
14. Do your organization policy and behavior discourage manifestations of discrimination?	27.6	34.5	13.9	10.3	13.9

15. Do you think that the organization must take appropriate measures in response to cases of discrimination?	72.4	27.6	0	0	0
16. Does the management consider as essential to meet the needs of employees with disabilities?	31.0	27.6	17.2	6.9	17.2
17. Are employees of different age groups equally evaluated by your organization?	37.9	24.1	24.1	13.9	0
18. Does your organization have jokes about racial, ethnic, and gender issues?	10.3	10.3	31.0	14	0
19. Does the organization provide an environment for free and open expression of ideas, opinions, and beliefs?	31.0	31.0	20.7	13.9	3.4
20. Does your manager support the idea of cadre diversity?	31.0	31.0	10.3	13.9	13.9
21. Does your manager address the diversity questions of cadres satisfactorily?	31.0	31.0	13.9	10.3	13.9
22. Does your organization work to increase the value of cadre diversity and the development of multiculturalism?	24.1	20.7	20.7	31.0	3.4

The sample of respondents represents a small insight into the Russian reality and gives information for assessing the situation in HR diversity management:

- 86.2% of respondents agree or somewhat agree that everyone can apply for any job, regardless of nationality.
- 89.7% of respondents gained or slightly gained a deeper understanding of people's characteristics through working in their organization.
- 86.2% of respondents say that they treat or rather effectively treat people who have different values and characteristics than they do.
- Everyone thinks, or instead thinks, that their organization must take appropriate measures against discrimination.
- 62.1% of respondents have not yet witnessed or been victims of discrimination in their organization.

### 3.3. Cases about HR diversity management in the Czech environment

Case studies as a qualitative research method enable to illustrate best practices in managing and leading people with the focus on their diversity. Based on data from two semi-structured interviews, they become a source for explaining the situation in the Czech conditions. It provides an insight in understanding and utilizing HR diversity in a small and the export-oriented economy and its two sectors: in the information and communication technology, and consultancy. The interviewees are two top managers – co-owners in November and December 2019. They partly demonstrate Czech culture in a highly competitive business and partly managerial approaches to HR practices in the context of a company's strategy. The questions of the semi-structured interviews consist of the same as in the Russian online questionnaire survey, but a critical benefit gives the unstructured part as it generates ideas for concepts applicable to Russian organizations. Their opinions help formulate recommendations when answering research questions.

Case study 1. Radek is a co-owner of an IT firm that serves as an Internet of Things (IoT) provider and supports its clients on a global scale. The firm is a small independent company of a worldwide network of independent local entities. The top local manager – a partner, makes decisions about essential HR processes, like recruitment and selection, compensation, promotions, and performance appraisal. IoT business depends on knowledge workers, so the co-owner is open to recruit and select job applicants regardless of their background. The only criterion of a perspective team happens if their members have multi-skills, an ideal member should have a combination of knowledge from IT, business or law, willingness to work hard, enjoy the fun at work, and continuously develop competencies (both professional and personal). The salaries are high above the average paid on the

local labor market as the company fights for talents, operates under intense competitive pressure, and builds a new portfolio of local customers. The owners accept the work-life balance practices and flexible working schemes as the main criterion of the employee characterizes at least standard performance and enthusiasm for development. Any team member can work on the more challenging projects if he or she performs excellent and has values matching with business ethics, i.e., regardless of gender, age, and nationalities.

Case study 2. Pavel is a managing partner of a multinational consultancy firm whose local subsidiaries are in several European countries, and five branches outside Europe. The company specializes in corporate training and development, coaching, and compensation. The Czech branch belongs to the micro-enterprise category and cooperates in the frame of an extensive network of freelance consultants. He prefers in recruiting and selecting people with abilities to be highly professional, with digital literacy and speaking fluently English. The team is multinational, and some of them train clients outside the CR in interpersonal communication skills; therefore, they must match the demographic characteristics of their clients. No written HR strategy or policies in the area of EEO exists. The company gives opportunities to develop a career from a junior assistant to a consultant or even a partner. The perspective of any employee depends on personal motivation and engagement as the company operates on a highly competitive consultancy market with a focus on soft training skills. No discrimination is acceptable as the core team members must cooperate, share their know-how, and participate in large projects that are usually for local subsidiaries of multinational enterprises. Flexible working time allows women to balance their work and family tasks. This practice serves as a useful tool on how to attract new employees regardless of their age, gender, and nationalities. Wages are comparable with similar businesses on the local market, but employees get no benefits, like meal tickets, supplementary pension insurance, and life insurance. Retention of staff is stable during the last decade and uses as a reference when the company applies for new projects.

#### **4. Discussion**

Three research questions focus on the human resource diversity management in Russian organizations and findings used for answering them are the following:

1. What approaches exist in human resource diversity management in Russian organizations?
2. Which approaches to human resource diversity management can develop in Russian organizations?
3. Which HR best practices can recommend for designing human resource diversity management in Russian organizations?

The results about the Russian reality in organizations show that they are trying to combat discrimination and the phenomenon not welcomed by both the top managers of the organizations and their teams. People are different, and this does not have only primary concern differences such as nationality but also secondary ones: marital status, education, place of residence, belief, level of income, and professional experience. The attitude towards individual characteristics of staff, both top managers and the teams, is tolerant, and everyone treats the diversity with understanding. However, full awareness of the need to formulate a diversity policy in working groups and the use of individual differences as a practice to improve outcomes of the organization has not accepted yet.

Respondents see a potential to develop human resource diversity management because Russia represents a multinational country with people of different races, cultures, and religions living in it; the globalization also plays a role in the need to deal with diversity management because many organizations are trying to enter into international cooperation. HR diversity management is thus becoming a priority, and organizations' management has already taken some steps towards developing diversity management.

HRM aims at the implementation of fairness and the reduction of discrimination. Employers may start with the mission statement declared their will to integrate diverse people in the corporate culture and to utilize sanctions against them who discriminate against anybody with different characteristics. In the long-term period, we expect pragmatic approaches to HR diversity management in business because the decisive factor determining any behavioral changes exists in personal values of



line/operational managers, i.e., how they motivate and use HR practices in day-to-day matters. A positive trend occurs among companies in the energy, high-tech, banking, and consultancy sectors as they monitor and audit the effectiveness of HRM, which covers indicators of people diversity, as well.

A starting point for the improvement in the area of HR diversity management involves a company's compliance program. HR departments must be responsible for its design, implementation, and control. Managers responsible for diverse workgroups must receive information and training about the compliance program, value diversity, and culture diversity. However, the crucial role in this process plays top managers who usually initiate activities in favor of diversity and give an umbrella for the development of any HR strategy. Line managers should feel their support and rely on systematic assistance from HR departments, effective internal communication from top-down, and on knowing that feedbacks from bottom-up regarding diversity workgroups accept. So far, well-known HR practices in managing people diversity deal with recruitment and selection; minimum attention focuses on onboarding, training and development, compensation and benefits, communication, and interpersonal relations in diverse workgroups.

## 5. Conclusions

The results of the study show that employers in Russian organizations strive to eliminate discrimination and try to facilitate the integration of new employees into the organization, while employees in teams also understand each other and respect their characteristics. It seems that no need exists to speak of the ultimate elimination of discriminatory practices established here for centuries. A small number of Russian respondents confirm HR diversity management or their practices in the organization aimed at utilizing the potential of human resources diversity. The reason is that the topic has not studied much yet and faces skepticism from both business and science. However, multinationalism and the pressure to achieve sustainable competitiveness not only on the domestic market but also on the external market lead to the gradual realization of a business strategy to establish a system for managing human resources diversity in Russian organizations.

Arguments in favor of HR diversity management cover their positive as well as negative aspects for employers and businesses. Prospective benefits seem to be an increased work motivation, an employee engagement to innovate and find unusual problem solutions, to modify personal attitudes to people with different backgrounds, develop networking, and make easier information exchange. However, obstacles for practical mastering diverse human resources stem from prejudices, management bias, language barriers, shortening time for onboarding, and integration into the enterprise culture. The most perspective HR practice occurs the training and development of line management in diversity values and mentoring and coaching in diversity management as it can decrease turnover and absenteeism on jobs occupied by people different than the majority staff.

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# The Analysis of Low-carbon Development of Czech Republic Economy

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**Abstract:** The Czech Republic is one of the dynamically developing countries of the European Union. However, economic development should take place while maintaining the quality of the environment. Air quality in the Czech Republic is worse than in most of the old European Union countries (EU-15). Air quality is negatively affected by road transport, heating buildings, agriculture and industry. Despite a number of actions taken to pursue low-carbon development, a lot remains to be done. Poor air quality contributes to over 11,000 premature deaths each year. The article evaluates the eco-efficiency of currently used solutions in the energy, industry and other sectors of the economy that have a negative impact on the environment. The publication also indicates the potential of using renewable energy sources (RES), which are an important element of low-carbon development. The aim of the article is to present the economic determinants of low-carbon development. In addition, the article analyses the development of renewable energy sources and ways to reduce greenhouse gas emission (GHG).

**Keywords:** economy; low-carbon development; energy; emission; Czech Republic

**JEL Classification:** O11; Q53; Q56

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## 1. Introduction

The economic development that has taken place in the Czech Republic over the past three decades has largely translated into the quality of life of the inhabitants. However, economic development has gone hand in hand with improving the quality of the environment (Zarębska and Dzikuć 2013). To a significant extent, this concerns the emission of greenhouse gases into the atmosphere. It should be noticed that in the Czech Republic, in addition to excessive GHG emission, other substances that are harmful to human health and the environment are released into the air, e.g. benzo(a)pyrene – B(a)P (Frankowski 2020; Woźniak and Pactwa 2018). Harmful substances that often accompany GHG emission contribute to the premature death of approximately 11,000 people in the Czech Republic each year (European Environment Agency 2018). It needs to be emphasized that the changes caused by excessive GHG emission are spread over time. However, an increasing number of violent atmospheric phenomena, such as fires in early 2020 in Australia.

The article evaluates the eco-efficiency of currently used solutions in the energy, industry and other sectors of the economy that have a negative impact on the environment (Usubharatana and Phungrassami 2018). The publication also indicates the potential of using renewable energy sources (RES), which are an important element of low-carbon development (Effiong et al. 2020).

## 2. Methodology and Goal

The aim of the article is to present the economic determinants of low-carbon development. In addition, the article analyses the development of renewable energy sources and ways to reduce greenhouse gas emission. The aim of the article is to analyse low-carbon development in the Czech Republic. Moreover, the purpose of the research is to identify, describe and explain phenomena that are associated with low-carbon development and its impact on the Czech economy (Oroszet et al. 2019; Poór et al. 2015). The research was carried out as part of the: Economic aspects of low carbon development in the countries of the Visegrad Group grant.

The methodology of own research was adapted to the assumed goal and scope of research. The presented research goal was a determinant of the use of methods characteristic of social sciences. To successfully achieve the research objectives, several research methods were used.

1. Analysis of the literature on the subject.
2. Analysis of source documents
3. Tabular and descriptive methods and charts.
4. Deductive method
5. Methods of descriptive and mathematical statistics.

The collected data was used to conduct low-carbon development in the Czech Republic. The conducted research also partly helped to indicate the directions and perspectives of further low-carbon development.

During the research, a number of statistical data and other information related to the studied issue were based. The acquired data became the basis for the socio-economic characteristics of the assumed scope of research. The research methods used in the article contributed to the achievement of the assumed research goal.

### **3. Analysis of Gross Domestic Product (GDP) Level and GHG Emissions in the Czech Republic and the EU**

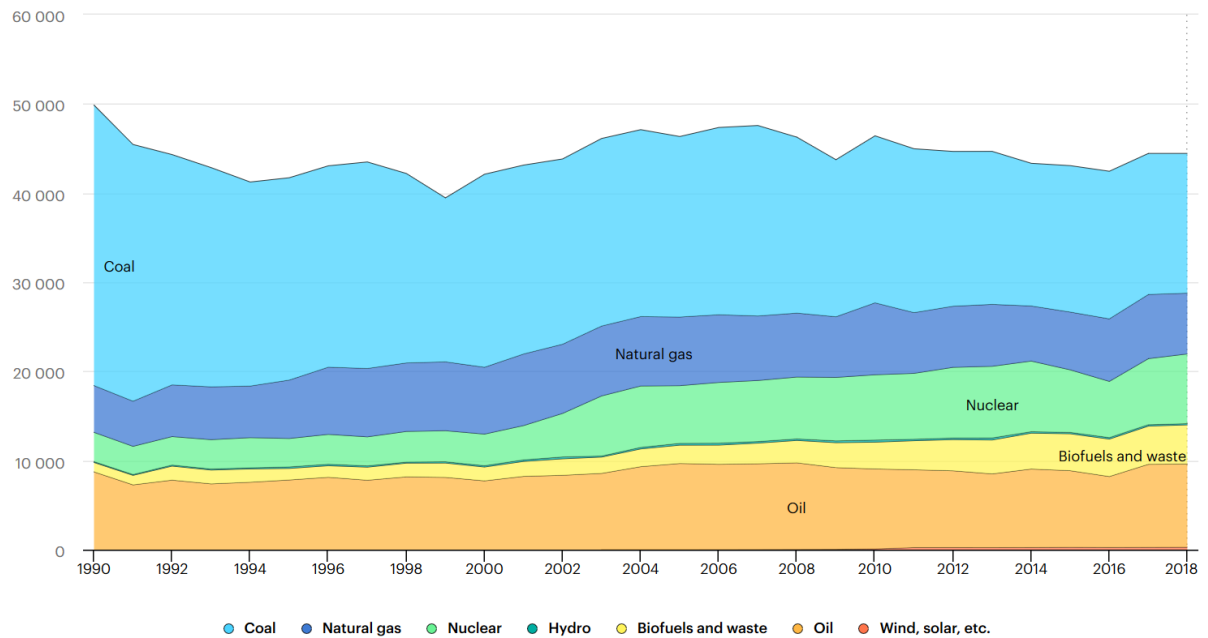
Real GDP per capita in the years 2004-2017 grew faster in the Czech Republic than it did in the EU (Eurostat 2019). This indicator is calculated as the ratio of real GDP to the average population in a particular year. Real GDP per capita is a measure of economic activity and also serves as an indicator of the development of the material standard of living in a particular country. However, it should be remembered that this is a limited measure of economic well-being. For instance, GDP does not cover the majority of unpaid homework, nor does it take into account the negative effects of economic activities, such as environmental degradation, which is extremely important due to the subject of the publication.

In recent years, the Czech Republic has developed economically, catching up with the so-called the old Union (EU 15). There are at least several reasons for the dynamic economic development of the Czech Republic, e.g. EU funding, growing internal demand, good condition of the global economy. However, despite the dynamic growth of DGP in the Czech Republic, it still deviates from the EU average. Real GDP per capita in the Czech Republic was 17,200 EUR (Table 1).

GHG emission level can be regulated to some extent by humans. However, these activities are expensive and often the authorities of individual countries are willing to take measures to increase GDP than to introduce solutions that will have less impact on the environment. Reducing GHG emission is possible through the wider use of low-carbon energy generation technologies (Dzikuć et al. 2019a; Llano-Paz et al. 2018). A large part of the efforts to improve the quality of the environment is aimed at decreasing GHG emission. There are several main sources of air pollution: industry, agriculture, transport, energy, households, waste management (Shane et al. 2018; Sztubecka et al. 2020; Piwowar 2019). Analysing the current low-carbon development in the Czech Republic, it should be noticed that there was a decrease in GHG intensity of energy consumption in 2017 compared to 2004. GHG intensity of energy consumption in the entire analysed period should be lower than the EU average. Moreover, this ratio was lower in the Czech Republic than in all neighbouring countries. The Czech Republic has already reached its designated share of RES in total energy production, which has been set for 2020. However, there is still potential for development of RES in the Czech Republic, since fossil energy sources still dominate (Fig. 1).

In analyses regarding low-carbon development, it is important to present how greenhouse gas emission per capita in the Czech Republic have changed compared to the EU average. In 2007-2017, average greenhouse gas emission per capita in the EU decreased. A similar situation also occurred in the Czech Republic. Economic growth did not prevent the Czechs from reducing GHG per capita.

Reducing (carbon dioxide) CO<sub>2</sub> and other greenhouse gas emissions is very important because of the need to slow down global warming (Piwowar and Dzikuć 2019). However, particulate matter PM<sub>2.5</sub> and other air pollutants, which contribute to approximately 11,000 of premature deaths annually, are particularly dangerous to human health in the Czech Republic. Despite the measures taken to reduce emissions, concentrations of harmful substances in the air are still too high and contribute to a reduction in the quality of life of the Czechs (Table 2).



**Figure 1.** Total primary energy supply (TPES) by source, Czech Republic 1990-2018 (International Energy Agency 2019).

Table 1. Real GDP per capita in 2004-2017. (Eurostat 2019)

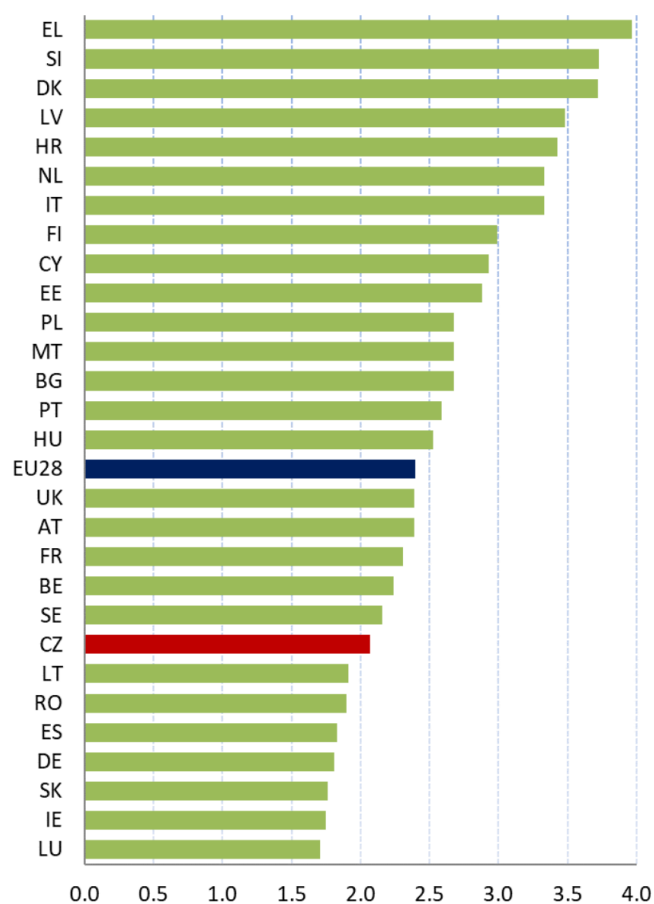
Specification	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
EU	24 410	24 820	25 560	26 220	26 240	25 020	25 500	25 900	25 730	25 750	26 140	26 680	27 140	27 780
Belgium	31 640	32 200	32 800	33 760	33 640	32 700	33 330	33 460	33 490	33 490	33 870	34 360	34 700	35 250
Bulgaria	3 890	4 190	4 500	4 820	5 140	4 990	5 050	5 300	5 350	5 400	5 530	5 790	6 050	6 310
Czech Republic	12 780	13 570	14 460	15 190	15 430	14 610	14 900	15 200	15 060	14 980	15 370	16 160	16 520	17 200
Denmark	43 520	44 400	45 990	46 210	45 700	43 220	43 840	44 240	44 170	44 410	44 890	45 630	46 720	47 360
Germany	29 470	29 730	30 930	31 920	32 320	30 580	31 940	33 200	33 280	33 330	33 930	34 220	34 700	35 420
Estonia	10 090	11 110	12 260	13 270	12 640	10 830	11 150	12 010	12 430	12 640	13 060	13 330	13 650	14 440
Ireland	38 190	39 470	40 400	41 300	38 600	36 300	36 790	36 760	36 690	37 010	39 890	49 470	50 710	54 240
Greece	20 850	20 910	22 030	22 690	22 560	21 530	20 320	18 500	17 240	16 800	17 040	17 080	17 110	17 410
Spain	23 020	23 420	24 000	24 380	24 200	23 100	23 040	22 770	22 080	21 840	22 210	23 080	23 760	24 410
France	30 050	30 320	30 850	31 400	31 310	30 250	30 690	31 210	31 160	31 170	31 320	31 540	31 770	32 370
Croatia	9 790	10 200	10 700	11 260	11 460	10 630	10 480	10 480	10 280	10 260	10 290	10 590	11 050	11 500
Italy	28 030	28 090	28 480	28 730	28 230	26 590	26 930	27 020	26 090	25 480	25 420	25 640	26 010	26 500
Cyprus	22 300	23 050	23 740	24 420	24 680	23 550	23 400	22 900	21 780	20 400	20 240	21 040	22 360	23 120
Latvia	7 290	8 170	9 220	10 220	9 990	8 710	8 500	9 200	9 700	10 030	10 310	10 740	11 030	11 560
Lithuania	7 260	7 950	8 670	9 750	10 110	8 710	9 030	9 790	10 300	10 780	11 250	11 590	12 040	12 720
Luxembourg	75 270	76 460	79 190	84 420	81 880	76 900	79 160	79 310	77 240	78 030	79 490	81 300	82 880	82 550
Hungary	9 490	9 910	10 330	10 370	10 500	9 810	9 900	10 110	10 010	10 230	10 690	11 130	11 410	11 930
Malta	14 340	14 790	15 000	15 550	15 960	15 450	15 920	16 070	16 370	16 910	18 030	19 520	20 180	20 940
Netherlands	35 920	36 570	37 780	39 120	39 810	38 160	38 470	38 880	38 340	38 180	38 580	39 170	39 810	40 730
Austria	33 200	33 710	34 700	35 870	36 280	34 830	35 390	36 300	36 390	36 180	36 130	36 140	36 430	37 090
Poland	7 250	7 510	7 980	8 550	8 910	9 070	9 390	9 860	10 020	10 170	10 510	10 920	11 260	11 820
Portugal	16 500	16 600	16 840	17 230	17 260	16 710	16 990	16 720	16 110	16 050	16 260	16 620	17 010	17 650
Romania	4 860	5 120	5 560	6 050	6 730	6 410	6 190	6 350	6 510	6 760	7 020	7 320	7 720	8 320
Slovenia	15 990	16 570	17 460	18 570	19 190	17 570	17 750	17 870	17 360	17 160	17 620	17 990	18 540	19 430
Slovakia	9 350	9 960	10 800	11 960	12 600	11 890	12 540	12 980	13 200	13 270	13 620	14 270	14 550	14 970
Finland	33 440	34 250	35 490	37 210	37 330	34 150	35 080	35 810	35 140	34 660	34 390	34 470	35 280	36 270
Sweden	36 860	37 770	39 290	40 340	39 930	37 910	39 920	40 820	40 270	40 360	41 060	42 430	42 910	43 350
United Kingdom	29 460	30 160	30 790	31 280	30 940	29 420	29 750	29 960	30 200	30 660	31 220	31 700	32 050	32 460

Table 2. Greenhouse gas emissions intensity of energy consumption in 2004-2017. (Eurostat 2019)

Specification	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
EU	97.6	96.7	96.1	96.3	94.8	93.8	92.5	92.1	91.8	90.5	89.1	88.7	87.6	86.6
Belgium	101.5	100.2	99.7	99.4	96.1	93.4	90.5	87.1	90.3	86.5	85.5	89.4	82.9	82.4
Bulgaria	108.1	104	103.3	113.2	113.5	114.9	117.8	122.3	115.4	108.8	109.9	111.5	106.1	107.9
Czech Republic	89.2	89.5	87.6	88.4	86.4	87.6	83.3	84.9	82.4	77.8	78.2	78.8	80.6	76.9
Denmark	97.5	93.3	100.6	94.4	90.9	91.8	87.6	84.2	78.4	81.9	77.3	72.5	73.1	67.3
Germany	96.9	94.9	93.4	95.3	95	94.1	94.2	96.4	96.6	96.6	95.3	95.4	95	93.5
Estonia	100.4	100.7	98.7	107.4	98.4	95	105.9	105.4	100.5	98.9	101.8	92.5	92.3	101.6
Ireland	98.2	100	98.4	94.8	96	90.8	90.8	90.2	89.5	90.4	88.1	87.5	86.2	84.9
Greece	97.7	99.6	98	100	96.6	95.4	94.9	96.3	93.5	93.5	89.7	85.4	81.8	83.1
Spain	99.7	101.8	99.1	99.7	95	92.2	87.5	88.8	87.9	84.8	86.6	88.6	84	84.8
France	94.2	94.4	93.2	91.4	89.8	90	88.7	84.3	84.9	84.8	80.1	80.4	82.4	83.2
Croatia	101.8	101.8	102.6	104.4	101.5	99.5	96.6	97.5	95.9	93.7	93	90.5	91.7	90.6
Italy	98	96.3	95.8	94	93.5	90.1	90	90	89.6	86.6	87.6	86.1	86.3	82.4
Cyprus	105.3	106.5	105.1	105	101.7	103.2	103.2	100.9	100.5	100	100.8	100.5	99.9	97.8
Latvia	93.6	92.7	94.2	95.4	94.1	89.6	96.4	91.5	84.6	85.4	83.6	86.5	87.2	83.9
Lithuania	87.1	99	100.9	95.3	93.7	93.7	125.7	113.6	112.6	112.7	108.9	106.6	106.7	102.5
Luxembourg	108.3	108.8	108.5	104.7	103.9	105.4	104.5	105	105.5	102.9	100.5	96.2	92.9	91.6
Hungary	98.6	90.6	90.3	89.7	90.1	86.5	84.6	83.3	81.6	79.7	79.2	79.4	80.2	79.8
Malta	86.3	88.8	88.9	89.6	90.5	90.5	86.3	89.2	90.3	88.7	87.2	72.4	62.8	62.2
Netherlands	97.7	96.8	95	95.5	98.2	97.3	97.3	96.2	94.4	96	96.9	100	98	95.8
Austria	105.5	103.5	98.5	95.3	93	93	91.4	90.5	87.7	86.2	82.9	84.1	84.8	86.2
Poland	100.2	99.1	97.4	97.1	94.4	95.2	93	92	93.7	92.2	91.9	92.1	90.7	90.2
Portugal	96.1	97.3	95.2	90	88.9	88.3	83.5	84.5	87	82.9	80.8	85.4	83.6	86.8
Romania	97.1	97.6	95.3	96.6	97.2	96.7	90.4	93.6	93.1	92.2	92.2	90.9	88.5	83.1
Slovenia	96.3	95.5	96.3	96.8	97	97.8	95.7	95.9	96.2	94.2	86.1	87.9	90.3	86.2
Slovakia	97	96.2	94.6	94.4	93.3	94.5	90.4	91.8	88	86.6	84.6	84.5	84.8	83
Finland	105.8	94	104.1	102.3	92.4	95.3	99.7	90.6	84.8	87.3	78.7	76	78	73.5
Sweden	93.1	90.3	92.4	91	87.9	93.1	90.3	82.7	78.3	76.6	74.5	76.2	70.7	70.5
United Kingdom	100.1	98.7	99.8	101.2	100.3	99.2	98.2	97	98.7	97.7	94.8	89.4	86.1	84.6

#### 4. Prospects for Low-carbon Development in the Czech Republic

Low One of the important elements supporting low-carbon development, which until now has not been used effectively in the Czech Republic, is taxation of environmentally harmful activities. The share of environmental taxes in GDP in the Czech Republic is one of the lowest in the EU (Fig. 2). One of the taxes supporting environmental protection is the air pollution charge that has existed in the Czech Republic since 1967, which was last changed in 2012, when charges increased by around 37%. At the same time, fossil fuel subsidies have been reduced over the past decade, mainly through the gradual abolition of excise duty refunds for diesel fuel used in agriculture (Eurostat 2019; Tucki et al. 2019).



**Figure 2.** Environmental tax revenues as % of GDP in 2017. (Eurostat 2019)

The Czech tax structure is characterized by a high percentage of labour taxation income in the country's total income. Increasing the taxation of environmentally damaging activities could reduce the taxation of income from work. However, the point is not to reduce taxes for all employees, because such a reduction would be imperceptible to them. Consideration should be given to extending the offer of solutions (e.g. tax deduction) for people who decide, e.g. to build small installations producing energy based on renewable sources (photovoltaics, biomass, wind energy) (Korys et al. 2019).

Decreasing the burning of fossil fuels is one important element in reducing greenhouse gas emissions to the air. Maintaining sustainable low-carbon development over the longer term (Azevedo et al. 2019). However, supporting low-carbon development entails significant costs (Adamczyk and Graczyk 2019). In 2017, energy efficiency in the Czech Republic was about twice lower than the average in EU countries (Eurostat 2019). Activities for low-carbon development in the Czech Republic should be oriented towards the implementation of modern technologies that will be more energy-efficient. Moreover, further reduction of the use of fossil energy resources that contribute to excessive



greenhouse gas emissions is necessary. The suggested actions are in line with the EU's long-term goals, which are focused on a radical reduction of greenhouse gas emission to the atmosphere (Dzikuć et al. 2019b). In addition, the EU, thanks to its economic and legal tools, can effectively put pressure on the Czech Republic. The attention should be paid to the Europe 2020 strategy, in which the EU allocated approximately 1 trillion EUR to sustainable economic growth. Furthermore, over 20% of the EU budget was dedicated to the transition to a low-carbon European economy (in the 2014-2020 budget). Reducing the use of fossil fuels for low-carbon technologies, including renewable energy, is a serious challenge for the Czech economy and its energy system. However, not investing in low-carbon development may result in high fines being imposed by the EU bodies. Moreover, rising CO<sub>2</sub> emission charges will also be a factor that can help speed up decisions that will increase the share of low-carbon technologies (Lubecki et al. 2019).

An important element of low-carbon development outside the industry and the production of electricity and heat is road transport (Burchart-Korol et al. 2018; Olszowski 2019). Much of the low-carbon development efforts should be geared to reducing the CO<sub>2</sub> emission that arises during road transport (Czekała et al. 2018; Dzikuć and Dzikuć 2018). The increasing number of cars in the Czech Republic in recent years is contributing to the higher level of CO<sub>2</sub> emission. It should be emphasized that in order to effectively reduce GHG emission, various solutions should be implemented, including the development of public transport and the development of electro-mobility. However, in the Czech Republic, almost half of the energy is still produced on the basis of coal, therefore it is necessary to further reduce the share of this fuel, so that the majority of energy is used on the basis of low-carbon technologies (Dzikuć and Łasiński 2014; Szatyłowicz and Skoczko 2019). It should be emphasized, however, that the share of carbon dioxide emissions from the Czech Republic in total global emissions has been limited in the last few decades (Table 3).

Supporting low-carbon development in the Czech Republic will require expanding financial incentives to activities that will implement technologies, which reduce greenhouse gas emission. These co-financing activities should apply to both enterprises and households. Economic instruments supporting ecological low-carbon solutions constitute an effective and efficient element of environmental policy.

**Table 3.** Fossil Carbon Dioxide (CO<sub>2</sub>) emissions of Czechia. (Worldometer 2020)

Year	Fossil CO <sub>2</sub> Emissions	CO <sub>2</sub> emissions change	CO <sub>2</sub> emissions per capita	Population	Pop. Change	Share of World's CO <sub>2</sub> emissions
2016	111,825,428	1.39	10.53	10,618,857	0.16	0.31
2015	110,295,387	2.22	10.40	10,601,397	0.10	0.31
2014	107,895,488	-3.86	10.19	10,591,108	0.04	0.30
2013	112,230,255	-3.78	10.60	10,586,533	0.05	0.31
2012	116,643,051	-1.77	11.02	10,581,293	0.14	0.33
2011	118,746,545	-1.14	11.24	10,566,517	0.28	0.33
2010	120,113,984	3.79	11.40	10,536,518	0.46	0.34
2009	115,726,118	-6.70	11.03	10,488,155	0.60	0.32
2008	124,040,652	-3.97	11.90	10,425,266	0.65	0.35
2007	129,174,906	1.14	12.47	10,357,538	0.57	0.36
2006	127,714,508	1.50	12.40	10,298,614	0.39	0.36
2005	125,825,458	-2.45	12.27	10,258,167	0.18	0.35
2004	128,979,027	1.13	12.60	10,239,439	0.00	0.36
2003	127,535,671	3.07	12.46	10,239,136	-0.13	0.36

Year	Fossil CO <sub>2</sub> Emissions	CO <sub>2</sub> emissions change	CO <sub>2</sub> emissions per capita	Population	Pop. Change	Share of World's CO <sub>2</sub> emissions
2002	123,731,756	-4.33	12.07	10,252,261	-0.18	0.35
2001	129,331,507	-0.41	12.59	10,271,008	-0.18	0.36
2000	129,862,968	9.57	12.62	10,289,373	-0.17	0.36
1999	118,523,620	-5.66	11.50	10,306,411	-0.16	0.33
1998	125,629,761	-4.30	12.17	10,323,247	-0.15	0.35
1997	131,270,718	-1.79	12.70	10,338,339	-0.12	0.37
1996	133,663,770	1.18	12.91	10,350,309	-0.08	0.37
1995	132,109,099	0.40	12.75	10,358,193	-0.03	0.37
1994	131,588,352	-4.66	12.70	10,360,969	0.02	0.37
1993	138,027,264	-3.00	13.32	10,358,690	0.05 %	0.39
1992	142,298,702	-6.91	13.74	10,353,028	0.06 %	0.40
1991	152,869,100	-9.45	14.78	10,346,452	0.05 %	0.43
1990	168,823,230	-5.39%	16.33	10,340,875	0.05 %	0.47
1989	178,444,623	-4.48%	17.26	10,335,884	0.05 %	0.50

## 5. Conclusions

In The article has presented selected aspects of low-carbon development in the Czech Republic. Moreover, the activities were identified which, if implemented, could contribute to low-carbon development. It is necessary to emphasize that the Czech Republic, like other EU countries, is obliged to implement the requirements of EU policy, which places a significant emphasis on CO<sub>2</sub> reduction. There are also a number of options at national level that can affect low-carbon development. These include national fiscal policy, which until now has been used to a limited extent in the Czech Republic. However, educational activities that promote low-carbon solutions should not be restricted. The Czech Republic has some backlog compared to the EU average in terms of energy efficiency and limiting the share of fossil energy resources.

However, the Czech Republic is also successful in the field of renewable energy implementation, because a few years before the set date, they reached their 2020 share. It should be noticed that the implementation of subsequent low-carbon solutions, which will require significant financial outlays, may be more efficient due to growing public acceptance.

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# A Comparison of Conditional and Unconditional VaR Models

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**Abstract:** This paper presents the empirical research on comparison of two different approaches for Value at Risk (VaR) measurement. The research objective is to compare the accuracy of out-of-sample VaR forecasts between conditional and unconditional models. We examine four unconditional models: Gaussian, alpha-stable, Normal Inverse Gaussian (NIG) and Generalized Pareto (GP) distributions and four conditional models: Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model with Gaussian and Student's t innovations, Exponentially Weighted Moving Average (EWMA) and conditional Extreme Value Theory (GARCH-EVT) approach. Calculations are performed on the basis of 5 world indices, 4 exchange rates and 4 commodity futures and the results are presented for left and right distribution tails. Backtesting methods indicate the GARCH-EVT as the model that outperforms all others.

**Keywords:** VaR; stable distribution; NIG; GPD; EVT; GARCH; EWMA; GARCH-EVT

**JEL Classification:** C22; G15; G17

## 1. Introduction

According to Basel Accords Value at Risk (VaR) plays a key role in calculation of regulatory capital for market risk. VaR is the maximum loss of a financial instrument or the entire portfolio  $X$ , that is not exceeded with a probability (confidence level)  $1 - \alpha$  in a given period of time. Formally, it is defined by the formula:

$$VaR_{\alpha} = -\sup \{q | P(X \leq q) \leq \alpha\}. \quad (1)$$

There are two methods which banks can use to measure VaR i.e. the standard approach (SA) and the internal models approach (IMA). The latter approach allows banks to use their own mathematical model to measure the market risk. The most popular and the simplest method is the variance-covariance method. Although, in practice, it is convenient to adopt the Gaussian paradigm, from a theoretical point of view, this is unacceptable. There are indisputable empirical properties of financial time series like leptokurtosis, the presence of fat tails of returns distribution, skewness and volatility clustering. Already in the sixties of the last century Benoit Mandelbrot (Mandelbrot 1963) rejected the normality of the distribution of returns and analyzed the alpha-stable distributions. Other distributions, such as generalized hyperbolic were the subject of other studies, including (Eberlein and Keller 1995; Barndorff-Nielsen 1997; Küchler et al. 1999). More sophisticated methods are derived from the Extreme Value Theory (EVT). EVT was applied for risk management in a number of publications e.g. (McNeil 1999; Embrechts et al. 1999; Gilli and Küllezi 2006).

In recent years, the conditional heteroskedasticity models, GARCH (Generalized Autoregressive Conditional Heteroskedasticity), introduced by Tim Bollerslev (Bollerslev 1986) have gained much popularity in risk management analysis. The conditional models can capture the dynamics and the most important properties of asset returns, e.g. volatility clustering and leptokurtosis. None of models, however, cannot predict exactly when the risk appears extreme and each has its strengths and weaknesses. Although the unconditional models use the strong assumption that returns are independent and equally distributed (i.i.d.), financial institutions often prefer unconditional risk

forecast methods to avoid undesirable frequent changes in risk limits for traders and portfolio managers (Danielsson and de Vries 2000). Moreover, trading strategies, which are continuously updated, generate high transaction cost (Cotter 2007). On the other hand, the conditional GARCH methodology implies more volatile risk forecasts than the unconditional approach, which is desirable when short horizons of investment, like one day (Dowd 2005) or intraday (Danielsson and Payne 2000), are taken into account. A comprehensive review of Value at Risk methodologies present Abad et al. (2014).

Finally, it seems, that it is not possible to clearly identify the most appropriate model and following (Gilli and K ellezi 2006) the choice between conditional and unconditional model should depend ultimately on the period for the analysis and type of risk measure. In this paper, we examine several models of VaR measurement. The aim of this study is to compare the accuracy of VaR forecasts between conditional and unconditional models. Similar studies were already performed in i.a. (Kuester et al. 2006; Baran and Witzany 2011; Choi and Min 2011; Just 2014) but the set of considered models was different than in this paper. We take advantage of following unconditional distributions: Gaussian, alpha-stable, Normal Inverse Gaussian (NIG) and Generalized Pareto (GP) and conditional models: Exponentially Weighted Moving Average (EWMA), GARCH with Gaussian and Student's t innovations and conditional Extreme Value Theory (GARCH-EVT). Estimations are based on various markets including 5 stock indices, 4 exchange rates and 4 commodity futures from the period 2000 – June 2019. We do calculations of VaR for long and short investor position.

The remainder of this paper is organized as follows. Section 2 briefly summarizes different approaches to VaR measurement. Section 3 examines methods for testing the accuracy of VaR forecasts. In section 4 the data used in empirical study and the results of our research are described. Concluding remarks are provided in the final section.

## 2. Methodology

### 2.1. Unconditional Value at Risk

VaR for a long position is a minus quantile of the loss distribution:

$$VaR_{\alpha} = -F^{-1}(\alpha), \quad (2)$$

where  $F^{-1}$  is the inverse of cumulative distribution function of returns,  $F$ . For short position it is a  $1 - \alpha$  quantile of the distribution:

$$VaR_{1-\alpha} = F^{-1}(1 - \alpha). \quad (3)$$

We briefly characterized the distributions which are used in our studies.

*Gaussian (normal) distribution* is characterized by only two parameters, mean,  $\mu \in \mathbb{R}$  and standard deviation,  $\sigma > 0$ . The probability density function is of the form:

$$f_{NORM}(x) = \frac{1}{\sqrt{2\pi}\sigma} \exp\left\{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right\}. \quad (4)$$

A lot of well-known desirable properties of the normal distribution make it the most useful distribution in finance. However, its tails are too thin to precisely measure a quantile of empirical distribution of returns. The tails decay very quickly (faster than exponentially), but it is still in use in practice to measure VaR. In this study it is used rather as a benchmark only.

*Alpha-stable distributions* are a broad family of probability distributions which can capture skewness and heavy tails. Alpha-stable distributions contain the Cauchy, Gaussian and L evy distributions. The class was introduced by Paul L evy in 1924 (L evy 1924). It was the first alternative to Gaussian distribution in finance (Mandelbrot 1963), and now is widespread in risk management, forecasting and econometrical analysis (Bradley and Taqqu 2003; Kabasinkas et al. 2009; Nolan 2009; Rachev et al. 2009). In the general case, the analytic form of distribution function does not exist, therefore it is defined by characteristic function:

$$\mathbb{E}[\exp(itX)] = \begin{cases} \exp\left(-c^\alpha |t|^\alpha \left(1 - i\beta \operatorname{sign}(t) t g\left(\frac{\pi\alpha}{2}\right)\right) + it\tau\right), & \alpha \neq 1, \\ \exp\left(-c|t| \left(1 + i\beta \frac{2}{\pi} \operatorname{sign}(t) \log(|t|)\right) + it\tau\right), & \alpha = 1. \end{cases} \quad (5)$$

The stable distribution is defined by four parameters. The most important parameter  $\alpha \in (0,2]$  is called stability index, parameter  $\beta \in [-1,1]$  is a measure of skewness,  $\tau \in \mathbb{R}$  is a position and  $c > 0$  is a scale parameter. Parameter  $\alpha$  is responsible for the thickness of the tail. The lower its value is, the thicker the tail is. For  $\alpha \in (0,2)$  the second moment of the distribution does not exist, but for  $\alpha = 2$  it is obtained the Gaussian distribution as a limit case. Alpha-stable family of distributions is closed under linear transformations, which means that the linear combination of random variables with alpha-stable distribution with the same index of stability  $\alpha$ , also has alpha stable distribution with that index.

*Normal Inverse Gaussian (NIG) distribution* is a member of the broader class of distributions called generalized hyperbolic (GH) introduced in (Barndorff-Nielsen 1977). This distribution is widely applied in financial economics for modeling unconditional and conditional return distribution (Haas and Pigorsch 2009). Log density of NIG is concave in an interval around zero and convex in the tails. It is a typical property of financial returns which exhibits tail behavior that is heavier than log-linear (Barndorff-Nielsen 1997). The density of the NIG distribution is given by

$$f_{NIG}(x) = \frac{\alpha \delta K_1(\alpha \sqrt{\delta^2 + (x-\mu)^2})}{\pi \sqrt{\delta^2 + (x-\mu)^2}} \exp\left(\delta \sqrt{\alpha^2 - \beta^2} + \beta(x - \mu)\right), \quad (6)$$

where:  $\alpha$  and  $\beta$  are shape parameters fulfilling condition  $0 < |\beta| \leq \alpha$ , and  $\mu \in \mathbb{R}$ ,  $\delta > 0$  are respectively position and scale parameters.  $K_1$  is modified Bessel function of the third kind with index equal to one.

*Generalized Pareto (GP) distribution* is one of two key distributions of Extreme Value Theory. The role of GP distribution in EVT is as a natural model for the excess distribution over high threshold. This is called Peaks over Threshold (POT) approach and it is based on Pickands-Balkema-de Haan Theorem (Balkema and de Haan 1974). For high threshold  $u$ , the conditional distribution function:

$$F_u(x) = P(X - u \leq x | X > u) = \frac{F(x+u) - F(u)}{1 - F(u)}, \quad (7)$$

converges to a generalized Pareto distribution. GP distribution is as follows

$$G_{\xi,\beta}(x) = \begin{cases} 1 - \left(1 + \xi \frac{x}{\beta}\right)^{-\frac{1}{\xi}}, & \xi \neq 0, \\ 1 - \exp\left(-\frac{x}{\beta}\right), & \xi = 0, \end{cases} \quad (8)$$

where:  $\beta > 0$ ,  $x \geq 0$  for  $\xi \geq 0$  and  $0 \leq x \leq -\beta/\xi$  for  $\xi < 0$ . The shape parameter,  $\xi$  divides distributions into three classes. Heavy tail distributions (e.g. alpha-stable, Student's  $t$ ) have  $\xi > 0$  (Fréchet domain of attraction). Thin tail distributions (e.g. Gaussian, log-normal) have  $\xi = 0$  (Gumbel domain of attraction). Distributions with finite right endpoint have  $\xi < 0$  (Weibull domain of attraction). The unconditional cumulative distribution function of returns one obtain rearranging (7)–(8):

$$F(x) = (1 - F(u))G_{\xi,\beta}(x)(x - u) + F(u), \quad x > u. \quad (9)$$

Replacing  $F(u)$  by  $\hat{F}(u) = 1 - N_u/n$ , where  $N_u$  is a number of exceedances over threshold  $u$  and  $n$  is number of returns we obtain:

$$\hat{F}(u) = 1 - \frac{N_u}{n} \left(1 + \xi \frac{(x-u)}{\beta}\right)^{-\frac{1}{\xi}}. \quad (10)$$

VaR for short position (right tail) is easy obtainable by inverting the above equation:

$$\text{VaR}_{1-\alpha} = u + \frac{\beta}{\xi} \left(\left(\frac{n}{N_u} \alpha\right)^{-\xi} - 1\right). \quad (11)$$

## 2.2. Conditional Value at Risk

We assume following process of returns:

$$r_t = \sigma_t \varepsilon_t, \quad \varepsilon_t \sim i.i.d. (0,1), \quad (12)$$

where  $\sigma_t$  is conditional volatility and the innovations  $\varepsilon_t$  have distribution  $F$ . Conditional VaR computed for long position is as follows:

$$VaR_\alpha = -\sigma_t(1)F^{-1}(\alpha), \quad (13)$$

where  $F^{-1}$  is the inverse of cumulative distribution function  $F$  and  $\sigma_t(1)$  is one step ahead forecast of conditional standard deviation. For short position it is equal to:

$$VaR_{1-\alpha} = \sigma_t(1)F^{-1}(1-\alpha). \quad (14)$$

We briefly characterized three such models which will be used in our study.

*GARCH model.* There is a broad family of Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models but the most popular is GARCH(1,1) (Bollerslev 1986):

$$\sigma_t^2 = \omega + \alpha r_{t-1}^2 + \beta \sigma_{t-1}^2, \quad (15)$$

where:  $\omega, \alpha, \beta > 0, \alpha + \beta < 1$ .

The parameters  $\alpha$  and  $\beta$  represent the adjustments to past market shocks and volatility respectively.

*Exponentially Weighted Moving Average (EWMA)* volatility model takes into account the property that the influence of any observation in financial time-series declines over time at the stable rate  $\lambda > 0$ . The model was adopted in 1994 by U.S. investment bank JP Morgan in RiskMetrics methodology. The variability in this model are determined by formula:

$$\sigma_t^2 = (1 - \lambda)r_{t-1}^2 + \lambda\sigma_{t-1}^2, \quad (16)$$

where  $0 < \lambda < 1$ .

Parameter  $\lambda$  is not estimated, but it is taken at the level of 0.94 for the daily data, and at the level of 0.97 for monthly data. It determines the ease use of this method in practice. In fact EWMA model belongs to the family of GARCH models called IGARCH (1,1).

*Conditional EVT (GARCH-EVT)* model is a concept of McNeil and Frey (2000) to VaR modeling by extending the EVT framework to dependent time-series. In this model, we fit the GP distribution parameters to standardized residuals  $e_t$  of GARCH model and then calculate VaR for short position as follows:

$$VaR_{1-\alpha} = \sigma_t(1)VaR_{1-\alpha}(e_t), \quad (17)$$

where:  $\sigma_t(1)$  is one step ahead forecast of conditional standard deviation in GARCH model and  $VaR_{1-\alpha}(e_t)$  is calculated from (11) but for the standardized residuals  $e_t$  of GARCH model.

## 3. Backtesting Methods

Backtesting procedure performs the comparison of Value at Risk estimations to actual losses of the considered assets. The accuracy of the model is assessed here on the basis of the number of returns exceeding VaR. Calculating the VaR at a tolerance level  $\alpha$ , it is required, that the percentage of the VaR exceeded by empirical returns to the all ones in the sample would equal to  $\alpha$ . If exceedances' percentage is higher than assumed, this model underestimates the risk, otherwise the VaR model is too conservative, and the actual risk is lower than the model shows. The most used backtesting tool is the Kupiec's test (Kupiec 1995) known as the proportion of failures test. This test verifies if the actual number of VaR exceedances is equal to  $\alpha$ . The test statistic is defined as follows:

$$LR_{UC} = 2 \left( \log \left( \left( \frac{T_1}{T_0 + T_1} \right)^{T_1} \left( 1 - \frac{T_1}{T_0 + T_1} \right)^{T_0} \right) - \log(\alpha^{T_1} (1 - \alpha)^{T_0}) \right), \quad (18)$$

where:  $T_1$ – the number of VaR exceedances,  $T_0$ – the number of unexceeded VaR. Under the true null hypothesis  $LR_{UC} \sim \chi^2(1)$ .



Christoffersen's test (Christoffersen 1998) is more sophisticated statistical test and aside from the number of exceptions additionally checks independence of VaR exceedances. More precisely it verifies if the current exception is independent on the exception appearance on the previous day. The test statistic is defined as follows:

$$LR_{CC} = 2\log\left(\left(\frac{T_{01}}{T_{01}+T_{00}}\right)^{T_{01}}\left(1 - \frac{T_{01}}{T_{01}+T_{00}}\right)^{T_{00}}\left(\frac{T_{11}}{T_{10}+T_{11}}\right)^{T_{11}}\left(1 - \frac{T_{11}}{T_{10}+T_{11}}\right)^{T_{10}}\right) - 2\log(\alpha^{T_{01}+T_{11}}(1 - \alpha)^{T_{00}+T_{10}}), \quad (19)$$

where:  $T_{ij}$  – the number of days when exception  $j$  occurred assuming that exception  $i$  occurred on the previous day (1 if violation occurs, 0 if no violation occurs). Under the true null hypothesis  $LR_{CC} \sim \chi^2(2)$ .

The Christoffersen and Pelletier's test analyses if the number of days between exceedances is independent over time (Christoffersen and Pelletier 2004). Under the null hypothesis the duration of time between VaR violations should have no memory and mean duration of  $1/\alpha$ . The test is based on the Weibull distribution, which is the memory free distribution. Here the Weibull distribution with parameter  $b = 1$  is used. The distribution is of the form:

$$f(d) = a^b b d^{b-1} \exp\{-\alpha d^b\}, \quad (20)$$

where  $d$  is the number of days between two violations of VaR. Under the null hypothesis of independence the likelihood is as follows:

$$L(\alpha) = \prod_{t=1}^{T_1-1} (\alpha \exp(-\alpha d_t)), \quad (21)$$

where  $T_1$  is the number of days in which a violation is occurred. The likelihood ratio test statistic is thus:

$$LR_{UD} = 2(\log L(\hat{\alpha}) - \log L(\alpha)). \quad (22)$$

Under the true null hypothesis  $LR_{UD} \sim \chi^2(1)$ . We refer to (Christoffersen and Pelletier 2004) for details of the test.

The loss function is a goodness-of-fit measure for VaR calculation. The loss function for a given  $\alpha$  is defined as follows (Gonzales-Rivera et al. 2004):

$$Q = P^{-1} \sum_{t=R}^T (\alpha - I_{t+1}(\alpha))(r_{t+1} + VaR_{\alpha}(r_t)), \quad (23)$$

where:  $I_{t+1}(\alpha) = 1$  for  $r_{t+1} < -VaR_{\alpha}(r_t)$  and  $I_{t+1}(\alpha) = 0$  otherwise,  $P$  – the prediction period,  $R$  – the estimation period. A lower  $Q$  value means a better goodness of fit.

#### 4. Results and Discussion

To test the forecasting performance of examined VaR models we selected 4 currencies, 5 stock indices and 4 commodities: USD/EUR, USD/GBP, USD/JPY, USD/PLN, S&P500 (SPX), FTSE100 (UKX), NIKKEI225 (NKX), ATHEX COMP (ATX), WIG20, GOLD (GC.F), SILVER (SI.F), CRUDE OIL (CL.F), NATURAL GAS (NG.F). The data comprises of daily price levels of the chosen assets from the beginning of 2000 up to 30th June, 2019. The data set was obtained from the financial stock news website (stooq.pl). We use log-returns (as a percentage) in our calculations. We examine the VaR forecasts at two significance levels, i.e. 1% and 5% for both the long and the short investor position. For the sake of brevity we present the results only for 5% VaR in the tables 1–8. Results for 1% VaR are available from the authors on the request. For all considered models, we allow the model parameters to change over time. Using rolling windows of size 500 we daily update the model parameters estimates and calculate VaR forecasts for the next trading day. We calculate VaRs using the following unconditional models: Gaussian distribution (NORM), stable distribution (STAB), Normal Inverse Gaussian distribution (NIG) and Generalized Pareto distribution (GP) assuming arbitrary threshold level of 90% (i.e. the largest 10% of positive and negative returns are considered as the extreme observations). We also use conditional models like: EWMA, GARCH with Gaussian (GARCH-NORM) and Student's  $t$  (GARCH- $t$ ) innovations and McNail and Frey GARCH-EVT model with Gaussian innovations – assuming the threshold in the same way as in the unconditional model.

Echaust (2018) and Echaust and Just (2020) considered GARCH-EVT model with optimal tail selection and updated the optimal tail fraction for each moving window of observations. They did not find the improvement of VaR forecasts accuracy with reference to a constant threshold approach. In order to verify the effectiveness of examined models, the expected ( $ET$ ) and the actual ( $T_1$ ) number of VaR exceedances are determined and Kupiec's, Christoffersen's and Christoffersen and Pelletier's tests are applied to verify a correctness of models. Additionally, the tests are supplemented by the loss function.

Assessing the quality of the estimated VaRs for the analyzed assets, based on the Kupiec's test it can be concluded that the worst results are obtained for the unconditional model with a normal distribution. Especially for 1% VaR the Gaussian distribution has too thin tails and too many exceedances of VaR appear. Such a situation takes place in 11 out of 13 analyzed assets for both left and right tails (significance level of 5%). It is possible to get an improvement of the results using NIG or GP distributions, which allow to capture the fat tails property of the empirical distribution. They measure the number of exceedances very accurately for 5% VaR but for 1% VaR the models fail in 4–5 out of 13 cases. In these cases, the number of VaR's exceedances, estimated by using unconditional models, exceeds the acceptable level. It means, that VaRs determined by using these methods are underestimated. Since it is not possible to estimate the stable distribution parameters for each window of observation, therefore these results are placed in the table 8 only for two assets i.e. SPX and SLF. As is typical for this distribution, unlike the other unconditional models, this model overestimates the high quantiles (1% and 99% here). The accuracy of conditional models vary depending on the type of model which is used to measure the VaR. EWMA model produces VaR forecasts seriously inaccurate and the number of exceedances is much higher than the expected level. For the tolerance level of 1% the model generates the worst VaR forecasts between all considered models (except the unconditional model with a normal distribution). The GARCH models perform much better, but surprisingly they both are outperformed by unconditional NIG and GP distributions for 5% VaR. The improvement of the quality of VaR estimations is achieved for the GARCH-EVT model. This is only one model that produces accurate VaR forecasts for both significance levels and for all considered assets.

The Christoffersen's and Christoffersen-Pelletier's tests focus on independence of VaR exceedances instead of their number only. Since unconditional models do not account for volatility clustering none of them is able to produce i.i.d. VaR violations. In almost all considered cases, we reject the null hypothesis, which states that the VaR exceedances are independent over time. The exception is the Christoffersen's test which fails to reject independence in some cases for each distribution. The NIG and GP distributions perform the best between unconditional models and they seem to be good models in 4 out of 13 for left tail and in 6 out of 13 cases for 5% VaR, and in half of cases for 1% VaR. Conditional models perform significantly better. The volatility models, GARCH and GARCH-EVT, in most of the analyzed cases, can capture stylized facts about financial time series like volatility clustering and leptokurtosis, as well as the skewness of the distribution (GARCH-EVT). The worst model is EWMA which fails in almost half of the cases. The GARCH-EVT model occurs to be the most preferable for both considered tolerance levels and for both the right and the left tails. For this model the Christoffersen's test rejects the null hypothesis only once for the left and the right tail in the 5% VaR case and twice for the left tail in the 1% VaR case. The Christoffersen-Pelletier's test indicates the dependence of the number of days between following exceedances two times for the left tail and five times for the right one in the 5% VaR case, and only once for the left tail in the 1% VaR case.

Loss function achieves approximately the same values for all conditional models and the same for all unconditional models. However, the values obtained from conditional methods are lower than those from unconditional models, implying that they offer higher accuracy than unconditional models.

**Table 1.** Backtesting VaR estimation under normal distribution.

NORM		Lower tail, VaR 0.05					Upper tail, VaR 0.95				
Asset	ET	T1	UC	CC	UD	Loss	T1	UC	CC	UD	Loss
USD/EUR	227	207	2.07	9.03*	16.25**	0.066	219	0.37	6.58*	36.08**	0.068
USD/GBP	227	214	0.87	4.20	17.83**	0.061	232	0.09	12.82**	25.88**	0.068
USD/JPY	227	209	1.69	8.28*	32.65**	0.073	199	4.01*	7.05*	11.65**	0.068
USD/PLN	225	190	6.15*	16.46**	27.02**	0.09	240	0.98	22.56**	42.12**	0.098
SPX	220	248	3.58	29.81**	93.12**	0.143	192	3.94*	10.06**	70.86**	0.128
UKX	221	219	0.02	26.50**	81.23**	0.137	196	3.14	10.11**	58.02**	0.129
NKX	214	206	0.32	10.98**	61.20**	0.18	165	12.80**	15.85**	39.77**	0.156
ATH	216	197	1.88	23.94**	59.30**	0.21	166	13.36**	19.22**	31.39**	0.197
WIG20	218	211	0.31	35.06**	53.08**	0.162	205	0.96	2.20	15.03**	0.151
GC.F	222	233	0.56	7.76*	8.84**	0.134	190	5.12*	5.79	7.17**	0.117
SLF	222	221	0.01	11.38**	6.41*	0.241	188	5.80*	5.80	18.97**	0.198
CL.F	222	240	1.48	11.57**	44.42**	0.261	213	0.40	7.20*	39.95**	0.241
NG.F	222	159	20.83**	23.73**	33.81**	0.34	191	4.79*	7.41*	43.65**	0.381

Note: ET (T1) – expected (actual) number of VaR violations, UC – Kupiec's test statistic, CC – Christoffersen's test statistic, UD – Christoffersen and Pelletier's test statistic, Loss – loss function Q described as in Gonzalez-Rivera et al. (2004), p-value<0.01 (\*\*), 0.01<p-value<0.05 (\*).

**Table 2.** Backtesting VaR estimation under NIG distribution.

NIG		Lower tail, VaR 0.05					Upper tail, VaR 0.95				
Asset	ET	T1	UC	CC	UD	Loss	T1	UC	CC	UD	Loss
USD/EUR	227	218	0.45	5.53	13.02**	0.067	224	0.07	5.44	34.05**	0.067
USD/GBP	227	245	1.37	3.92	14.47**	0.061	237	0.40	11.87**	20.97**	0.068
USD/JPY	227	233	0.12	6.53*	27.10**	0.073	223	0.11	5.64	19.76**	0.068
USD/PLN	225	224	0.01	14.61**	23.85**	0.091	237	0.62	19.09**	41.92**	0.098
SPX	220	246	3.10	32.42**	96.40**	0.142	237	1.33	6.41*	86.95**	0.129
UKX	221	225	0.07	28.96**	74.77**	0.136	224	0.04	6.14*	54.62**	0.129
NKX	214	208	0.18	10.36**	59.57**	0.18	197	1.47	7.67*	35.14**	0.155
ATH	216	204	0.76	30.09**	55.77**	0.208	200	1.33	15.75**	24.50**	0.196
WIG20	218	212	0.24	34.51**	53.67**	0.162	234	1.07	1.62	11.13**	0.152
GC.F	222	230	0.29	3.33	7.10**	0.133	226	0.07	1.38	6.02*	0.117
SLF	222	222	0.00	14.73**	5.69*	0.241	243	2.01	2.25	12.23**	0.196
CL.F	222	238	1.17	11.72**	47.63**	0.26	235	0.78	12.05**	38.56**	0.242
NG.F	222	205	1.41	3.52	24.90**	0.335	203	1.77	5.08	37.88**	0.381

Note: ET (T1) – expected (actual) number of VaR violations, UC – Kupiec's test statistic, CC – Christoffersen's test statistic, UD – Christoffersen and Pelletier's test statistic, Loss – loss function Q described as in Gonzalez-Rivera et al. (2004), p-value<0.01 (\*\*), 0.01<p-value<0.05 (\*).

**Table 3.** Backtesting VaR estimation under GP distribution.

GP		Lower tail, VaR 0.05					Upper tail, VaR 0.95				
Asset	ET	T1	UC	CC	UD	Loss	T1	UC	CC	UD	Loss
USD/EUR	227	210	1.51	7.92*	14.53**	0.067	215	0.78	5.09	36.27**	0.068
USD/GBP	227	236	0.32	0.97	10.88**	0.061	230	0.03	15.12**	26.17**	0.068
USD/JPY	227	230	0.02	6.97*	19.97**	0.072	232	0.08	3.23	15.29**	0.068
USD/PLN	225	220	0.14	15.90**	29.76**	0.091	233	0.27	12.46**	38.01**	0.097
SPX	220	225	0.11	33.86**	102.02**	0.142	228	0.30	6.90*	82.63**	0.129
UKX	221	223	0.02	27.29**	80.46**	0.137	220	0.01	8.28*	55.97**	0.130
NKX	214	218	0.08	5.32	42.84**	0.179	202	0.73	7.45*	37.97**	0.155
ATH	216	205	0.64	26.97**	61.09**	0.208	209	0.27	18.14**	30.61**	0.197
WIG20	218	219	0.00	36.36**	51.94**	0.163	211	0.31	1.14	15.12**	0.153
GC.F	222	221	0.01	4.22	7.78**	0.133	225	0.04	0.24	7.67**	0.116
SLF	222	226	0.07	17.51**	7.02**	0.241	235	0.78	0.99	12.86**	0.197
CL.F	222	237	1.03	10.28**	41.57**	0.259	232	0.46	7.86*	32.11**	0.241
NG.F	222	221	0.01	0.85	22.49**	0.336	215	0.24	3.13	43.10**	0.380

Note: ET (T1) – expected (actual) number of VaR violations, UC – Kupiec's test statistic, CC – Christoffersen's test statistic, UD – Christoffersen and Pelletier's test statistic, Loss – loss function Q described as in Gonzalez-Rivera et al. (2004), p-value<0.01 (\*\*), 0.01<p-value<0.05 (\*).

**Table 4.** Backtesting VaR estimation under EWMA model.

EWMA		Lower tail, VaR 0.05					Upper tail, VaR 0.95				
Asset	ET	T1	UC	CC	UD	Loss	T1	UC	CC	UD	Loss
USD/EUR	227	262	5.15*	5.21	8.13**	0.062	250	2.20	2.34	1.67	0.062
USD/GBP	227	239	0.59	1.21	5.42*	0.058	263	5.53*	6.32*	3.59	0.062
USD/JPY	227	234	0.17	0.26	0.12	0.068	218	0.45	1.13	3.61	0.065
USD/PLN	225	224	0.01	0.77	4.57*	0.082	264	6.63*	12.34**	0.02	0.089
SPX	220	246	3.10	3.22	0.99	0.12	226	0.17	5.37	13.38**	0.103
UKX	221	277	13.77**	26.89**	0.35	0.118	219	0.02	8.60*	16.84**	0.104
NKX	214	248	5.41*	5.61	1.24	0.161	221	0.24	2.92	2.74	0.136
ATH	216	248	4.66*	21.97**	9.71**	0.192	217	0.00	2.86	1.10	0.182
WIG20	218	233	0.93	5.40	4.93*	0.149	242	2.47	2.48	16.20**	0.142
GC.F	222	248	3.07	3.36	4.12*	0.126	219	0.05	6.15*	13.73**	0.112
SLF	222	258	5.82*	6.11*	6.60*	0.226	205	1.42	4.17	0.49	0.186
CL.F	222	258	5.82*	8.27*	0.01	0.234	216	0.18	5.88	16.12**	0.21
NG.F	222	218	0.08	0.90	2.49	0.312	268	9.42**	10.17**	5.05*	0.364

Note: ET (T1) – expected (actual) number of VaR violations, UC – Kupiec's test statistic, CC – Christoffersen's test statistic, UD – Christoffersen and Pelletier's test statistic, Loss – loss function Q described as in Gonzalez-Rivera et al. (2004), p-value<0.01 (\*\*), 0.01<p-value<0.05 (\*).

**Table 5.** Backtesting VaR estimation under GARCH model with Gaussian innovations.

GARCH -NORM		Lower tail, VaR 0.05					Upper tail, VaR 0.95				
Asset	ET	T1	UC	CC	UD	Loss	T1	UC	CC	UD	Loss
USD/EUR	227	216	0.66	0.72	2.38	0.062	208	1.87	2.12	0.57	0.063
USD/GBP	227	215	0.75	1.29	2.11	0.058	243	1.07	1.07	0.49	0.062
USD/JPY	227	211	1.34	1.72	0.06	0.069	196	4.91*	6.68*	5.46*	0.065
USD/PLN	225	189	6.52*	6.52*	1.48	0.082	237	0.62	2.29	0.03	0.089
SPX	220	239	1.66	1.66	0.01	0.119	205	1.12	3.96	14.09**	0.103
UKX	221	252	4.33*	5.30	0.83	0.118	194	3.67	11.36**	13.56**	0.103
NKX	214	229	1.08	1.22	0.52	0.16	184	4.65*	4.65	2.55	0.134
ATH	216	203	0.89	7.62*	4.73*	0.19	191	3.25	4.10	1.31	0.182
WIG20	218	203	1.25	6.79*	6.09*	0.149	226	0.24	1.63	10.00**	0.142
GC.F	222	219	0.05	1.72	3.31	0.125	199	2.62	6.30*	1.63	0.112
SLF	222	237	1.03	3.30	1.62	0.229	181	8.52**	12.10**	0.01	0.187
CL.F	222	231	0.37	0.37	0.29	0.234	185	6.90**	7.34*	6.21*	0.211
NG.F	222	187	6.14*	6.67*	2.03	0.313	235	0.78	1.35	2.31	0.363

Note: ET (T1) – expected (actual) number of VaR violations, UC – Kupiec's test statistic, CC – Christoffersen's test statistic, UD – Christoffersen and Pelletier's test statistic, Loss – loss function Q described as in Gonzalez-Rivera et al. (2004), p-value<0.01 (\*\*), 0.01<p-value<0.05 (\*).

**Table 6.** Backtesting VaR estimation under GARCH model with Student's *t* innovations.

GARCH- <i>t</i>		Lower tail, VaR 0.05					Upper tail, VaR 0.95				
Asset	ET	T1	UC	CC	UD	Loss	T1	UC	CC	UD	Loss
USD/EUR	227	225	0.04	0.38	1.90	0.062	205	2.49	2.50	0.11	0.063
USD/GBP	227	219	0.35	0.61	1.18	0.058	238	0.49	0.70	0.05	0.062
USD/JPY	227	224	0.07	0.18	0.20	0.068	208	1.87	3.48	2.85	0.065
USD/PLN	225	199	3.37	3.55	0.92	0.082	244	1.58	5.01	0.10	0.089
SPX	220	247	3.34	3.40	0.29	0.119	212	0.32	3.87	17.65**	0.103
UKX	221	254	4.90*	5.74	1.16	0.118	202	1.81	10.69**	14.12**	0.103
NKX	214	232	1.54	1.77	1.31	0.161	188	3.47	3.85	2.23	0.134
ATH	216	219	0.03	6.60*	3.21	0.19	196	2.08	7.70*	1.97	0.181
WIG20	218	210	0.39	10.64**	7.11**	0.15	238	1.70	3.15	13.80**	0.141
GC.F	222	239	1.32	2.09	3.01	0.125	220	0.02	6.26*	4.30*	0.111
SLF	222	259	6.14*	9.30**	2.90	0.228	209	0.83	2.72	0.43	0.185
CL.F	222	235	0.78	0.99	0.18	0.234	187	6.16*	6.68*	4.97*	0.211
NG.F	222	203	1.77	3.21	0.19	0.313	251	3.82	4.22	2.05	0.362

Note: ET (T1) – expected (actual) number of VaR violations, UC – Kupiec's test statistic, CC – Christoffersen's test statistic, UD – Christoffersen and Pelletier's test statistic, Loss – loss function Q described as in Gonzalez-Rivera et al. (2004), p-value<0.01 (\*\*), 0.01<p-value<0.05 (\*).

**Table 7.** Backtesting VaR estimation under GARCH-EVT model.

GARCH-EVT		Lower tail, VaR 0.05					Upper tail, VaR 0.95				
Asset	ET	T1	UC	CC	UD	Loss	T1	UC	CC	UD	Loss
USD/EUR	227	209	1.69	1.91	0.88	0.062	218	0.45	0.68	1.12	0.063
USD/GBP	227	228	0.00	1.26	4.71*	0.058	221	0.20	0.21	0.30	0.062
USD/JPY	227	228	0.00	0.60	0.03	0.069	220	0.29	2.89	3.75	0.065
USD/PLN	225	210	1.13	2.19	0.23	0.082	226	0.00	0.65	0.04	0.089
SPX	220	223	0.04	0.71	0.21	0.119	217	0.05	4.16	12.44**	0.104
UKX	221	226	0.11	1.83	0.34	0.119	234	0.77	11.83**	17.08**	0.104
NKX	214	220	0.17	0.73	1.19	0.16	205	0.41	0.49	4.13*	0.134
ATH	216	210	0.20	8.55*	2.28	0.19	222	0.15	0.75	3.11	0.182
WIG20	218	224	0.12	4.81	4.13*	0.15	220	0.01	1.84	20.65**	0.142
GC.F	222	222	0.00	3.07	3.72	0.126	217	0.12	4.12	3.07	0.111
SLF	222	224	0.02	1.96	1.64	0.229	214	0.32	5.76	0.95	0.188
CL.F	222	227	0.11	0.29	0.19	0.234	210	0.71	1.15	5.43*	0.211
NG.F	222	220	0.02	0.41	1.04	0.312	229	0.23	1.03	2.62	0.365

Note: ET (T1) – expected (actual) number of VaR violations, UC – Kupiec's test statistic, CC – Christoffersen's test statistic, UD – Christoffersen and Pelletier's test statistic, Loss – loss function Q described as in Gonzalez-Rivera et al. (2004), p-value<0.01 (\*\*), 0.01<p-value<0.05 (\*).

**Table 8.** Backtesting VaR estimation under stable distribution.

STAB		Lower tail, VaR 0.05					Upper tail, VaR 0.95				
Asset	ET	T1	UC	CC	UD	Loss	T1	UC	CC	UD	Loss
SPX	220	229	0.37	29.78**	104.63**	0.142	237	1.33	8.93**	81.71**	0.130
SLF	222	227	0.11	19.28**	8.56**	0.242	238	1.17	1.18	11.13**	0.197

Note: ET (T1) – expected (actual) number of VaR violations, UC – Kupiec's test statistic, CC – Christoffersen's test statistic, UD – Christoffersen and Pelletier's test statistic, Loss – loss function Q described as in Gonzalez-Rivera et al. (2004), p-value<0.01 (\*\*), 0.01<p-value<0.05 (\*).

## 5. Conclusions

The aim of this paper has been to evaluate how well unconditional and conditional models perform in estimating and forecasting a VaR measure. We employ four unconditional models i.e. Gaussian, NIG, GP, and stable distributions and four conditional models i.e. EWMA, GARCH with Gaussian and Student's *t* innovations and GARCH-EVT models. Definitely worse VaR estimations are obtained for unconditional models, and especially poor for the Gaussian distribution. An improvement of VaR accuracy is obtained for VaR calculated from NIG and GP distributions, which can better model extreme returns. However, these estimations are still not good. We have shown that unconditional models usually underestimate the VaR for a small tolerance VaR level (1%). Even if they provide the VaR estimates, for which the number of their exceedances by the empirical returns is in line with the assumed level, the exceedances are not independent over time. They provide the stable estimates of model parameters and do not update quickly when the volatility changes. The majority of VaR exceedances occurred during periods of high volatility, when VaR values were estimated based on periods of low volatility. However, in periods of low volatility, they occurred after periods of high volatility and the VaRs have not been exceeded. Conditional models are deprived of this defect. The clustering of returns volatility is well captured by conditional models like GARCH-*t* and GARCH-EVT. Especially the latter model should be distinguished because of good VaR estimations regardless of considered assets, the level of tolerance and investor position (long and short).

The presented results concern the verification of VaR models in a very short, one-day time horizon. When we analyze the accuracy of VaR forecasts in a longer period of time e.g. 10 days, these results may differ significantly from those ones presented in this work. This problem will be considered in the authors' future work.

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# Equilibrium Searching in Supply Chains by Biform Games

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**Abstract:** Supply chain management is a discipline that has met with great interest in both practical applications and theoretical development. The supply chain consists of independent units that cooperate and compete in different situations. Finding balance in supply chains is a difficult task. The paper proposes a model framework that captures the existence of multiple units with different interests and preferences, which are evaluated by multiple evaluation criteria. The procedure is based on biform games that incorporate cooperative and non-cooperative procedures. The authors' contribution is the division of biform games into sequential and simultaneous forms. Sequential biform games gradually apply cooperative and subsequently non-cooperative techniques. Simultaneous shape contemplates the simultaneous use of cooperative and non-cooperative techniques. The search for equilibrium is based on negotiating the aspiration values of the evaluation criteria. A supply chain equilibrium is when non-empty intersection of these values is achieved.

**Keywords:** supply chain; biform game; equilibrium

**JEL Classification:** C70

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## 1. Introduction

Game theory is a discipline that analyzes situations with conflicting interests of the participants. Such problems often arise and affect the behavior of participants in economic situations. The classic work of John von Neumann and Oskar Morgenstern (1944) has already formulated basic models of game theory for economic decision-making. Game theory has developed considerably and a considerable amount of literature has been published. Kreps (1991) and Myerson (1997) provide an overview of basic models, concepts, and practices in game theory. Models of game theory analyze conflict situations in which players have their interests and it is necessary to seek a balanced solution. Classical game theory is divided into cooperative non-cooperative concepts. Nash equilibrium is a classic concept in non-cooperative theory, when this situation means that when any player withdraws from his equilibrium position while maintaining the positions of other players, he cannot improve his winnings. The cooperative game theory analyzes the possible common winnings of the players, the conditions under which they are formed, how the coalitions of players are formed, and how they redistribute the winnings. Also included is an analysis of the stability of coalitions of players and their winnings. Brandenburger and Stuart (2007) suggest biform games as a connection of non-cooperative and cooperative games.

Supply chain management is a discipline that has met with great interest in both practical applications and theoretical development (Tayur et al. 2012). The supply chain consists of independent units that cooperate and compete in different situations. In recent years, game theory has provided a number of models and techniques for supply chain management analysis. Cachon and Netessine (2004) provide an excellent overview of the concepts and practices of non-cooperative game theory for supply chain analysis. This concept forms allocation mechanisms analogously to the classical market environment.

Nagarajan and Sošić (2008), on the other hand, provide an overview of existing literature on the use of cooperative game models and practices in supply chain management. The authors focused mainly on the achievable common outputs, their redistribution, formation and stability of coalitions.

Brandenburger and Nalebuff (2011) introduce the concept of co-opetition, which captures the fact that collaboration is applicable in some cases, while competition is more appropriate in others. The authors propose biform games to explain and justify the proposed concept. Okura and Carfi (2014) analyze how cooperative studies can be linked to game theory models and procedures.

The paper proposes a modeling framework for equilibrium searching in supply chains based on biform games. The authors' contribution is the division of biform games into sequential and simultaneous forms. Sequential shape gradually applies cooperative and subsequently non-cooperative techniques. Simultaneous shape contemplates the simultaneous use of cooperative and non-cooperative techniques. The search for equilibrium is based on negotiating the aspiration values of the evaluation criteria. A supply chain equilibrium is found when non-empty intersection of these values is achieved.

The rest of the paper is arranged as follows. The elements of supply chains are summarized in Section 2. Section 3 reports on sequential biform games in supply chain analyses. The practices of simultaneous biform games are described in Section 4. The discussion and the conclusions are presented in Section 5.

## 2. Supply Chain

A supply chain is defined as a dynamic complex network structure of units, resources, activities, information and technologies linked to meet demand and move a product from the initial supplier to the final consumer (Fiala 2005).

The supply chain is modeled as a network system with clusters of:

- suppliers,
- manufacturers,
- distributors,
- retailers,
- customers,

where

- material,
- information,
- financial,
- and decision

flows connect units in the supply chain. The flows progress in both directions. Decision flows are considered as a sequence of decisions between supply chain units.

Supply chain management is a collection of models, tools and techniques that are used to manage these systems throughout the life cycle. The supply chain management consists of four successive phases:

- design,
- control,
- performance evaluation,
- and performance improvement.

These phases repeatedly alternate during the dynamic development of the supply chain and the environment in which the chain is formed. Supply chain performance is evaluated by more evaluation criteria:

- economic,
- social,
- environmental,
- and others.

Models of game theory are very useful in analyzing and managing supply chains due to the inclusion of a larger number of decision-making units that have conflicting but also some common

interests. The proposed biform game models prove to be a suitable tool for finding an equilibrium in a network system, where competitive and cooperative processes between the units of the system take place. The model is enriched by the introduction of multiple evaluation criteria to measure supply chain performance. The search for an equilibrium in supply chains is modeled using negotiation techniques under pressure. Negotiation brings the exchange of information, specifying material flows, reducing inefficiencies and, leads to a better functioning of supply chains according to evaluation criteria, and hence there is a performance improvement of supply chains.

### 3. Sequential Biform Game

The sequential biform game is composed from two stages. In the first stage, players compete and use instruments of non-cooperative games. In the second stage, players cooperate and the tools of cooperative games are used.

In the first stage, the concept of Nash equilibrium is applied. Nash equilibrium is a set of equilibrium strategies, from which no player can improve his payout that departs from his equilibrium strategy, and other players remain with their equilibrium strategies.

A non-cooperative game in the normal form is given by this formula

$$\{N = \{1, 2, \dots, n\}; X_1, X_2, \dots, X_n; \pi_1(x_1, x_2, \dots, x_n), \pi_2(x_1, x_2, \dots, x_n), \dots, \pi_n(x_1, x_2, \dots, x_n)\}, \quad (1)$$

where  $N$  is a set of  $n$  players;  $X_i, i = 1, 2, \dots, n$ , is a set of strategies for player  $i$ ;  $\pi_i(x_1, x_2, \dots, x_n), i = 1, 2, \dots, n$ , is a player's  $i$  payout function, defined on  $n$  sets  $X_i, i = 1, 2, \dots, n$ .

Strategies of all players than player  $i$  are defined by a vector

$$\mathbf{x}_{-i} = (x_1, \dots, x_{i-1}, x_{i+1}, \dots, x_n). \quad (2)$$

A vector of strategies  $(x_1^0, x_2^0, \dots, x_n^0)$  is Nash equilibrium if the following conditions are satisfied

$$x_i^0(\mathbf{x}_{-i}^0) = \operatorname{argmax}_{x_i} \pi_i(x_i, \mathbf{x}_{-i}), i = 1, 2, \dots, n. \quad (3)$$

In second stage, a cooperative game approach is used to get the maximal common output and to distribute this output to individual players. Shapley values (8) can be used for distribution of this output total.

The maximal common output is reached if the next problem is solved

$$\mathbf{x}^0 = \operatorname{argmax}_{\mathbf{x}} \sum_{i=1}^n \pi_i(x_i). \quad (4)$$

The game in the characteristic function form is advantageous for modeling and solving cooperative games. The characteristic function  $v(S)$  is introduced for all subsets  $S \subseteq N$  (i.e. for all coalition) and defines values  $v(S)$  by following formulas:

$$v(\emptyset) = 0, v(S_1 \cup S_2) \geq v(S_1) + v(S_2), \quad (5)$$

where  $S_1, S_2$  are disjoint subsets of the set of all players  $N$ . A cooperative game with set  $N$  of all players in the characteristic function form is defined as the pair  $(N, v)$ .

Shapley (1953) introduced a specific allocation rule that has positive characteristics in terms of equilibrium and fairness of distribution. Shapley vector is defined as

$$\mathbf{h} = (h_1, h_2, \dots, h_n), \quad (6)$$

where the elements of the vector mean the average marginal contribution of the  $i$ -th player to all coalitions in which he may appear as a participant. A contribution of the player  $i$  to the coalition  $S$  is designed by the difference:

$$v(S) - v(S - \{i\}). \quad (7)$$

Shapley value for the player  $i$  is designed as a weighted sum of marginal contributions by the formula:

$$h_i = \sum_S \left\{ \frac{(|S|-1)!(n-|S|)!}{n!} [v(S) - v(S - \{i\})] \right\}, \quad (8)$$

where the number of coalition participants is denoted by the symbol  $|S|$  and summarizing takes place across all coalitions where  $i \in S$ .

It is useful to link these two stages together. Confidence indices  $0 \leq \alpha^i \leq 1$ , for all  $i = 1, 2, \dots, n$ , are presented to create the connection between the non-cooperative and cooperative stages.

#### 4. Simultaneous Biform Games

The simultaneous biform game is composed from one stage where a mix of approaches for cooperative and non-cooperative games is used together. Multi-round negotiations are in the progress in the one-stage model. The specific combination of these approaches varies depending on the situation of the problem. The problem needs to be analyzed, especially in terms of which players can cooperate and to what extent. There are two specific extreme cases. A classical cooperative model (4) can be used if all players can fully collaborate. The subsequent distribution of the output is based on the Shapley values (8). A classical non-cooperative model (3) can be used if no one can cooperate even in a partial extent.

The general simultaneous biform game model is based on multi-round negotiations with multiple evaluation criteria (Fiala 1999). The concept of negotiation under pressure goes out from the fact that each player is exposed to different internal and external pressures. The extent of cooperation is created by the set of constraints that arise dynamically according to pressures. The effects of pressures are transformed into the constraints of the model.

##### 4.1. Negotiation model

The general negotiation model supposes  $n$  players. A strategy space for the negotiation process is denoted as  $X$ . Strategies are vectors  $\mathbf{x} \in X$ , whose components express the parameter values of the strategy. A consensus strategy  $\mathbf{x}^*$  is an element of the strategy space  $X$ . The classical game concepts are based on a fixed structure of the game and sets of strategies are fixed also. In the proposed model, sets of strategies and evaluations of strategies are considered as dynamic  $X_i(t)$ ,  $i = 1, 2, \dots, n$ . Changes take place in the discrete time points  $t = 0, 1, 2, \dots, T$ .

Each player evaluates strategies by multiple evaluation criteria and assesses the strategies according to the target values. We denote  $f^1(\mathbf{x})$ ,  $f^2(\mathbf{x})$ , ...,  $f^n(\mathbf{x})$  multiple evaluation criteria functions that depict the strategy  $\mathbf{x}$  into the vectors of target values  $\mathbf{y}^1$ ,  $\mathbf{y}^2$ , ...,  $\mathbf{y}^n$  of the target spaces of the players  $Y^1$ ,  $Y^2$ , ...,  $Y^n$ . All players want to optimize the values of their multiple evaluation criteria functions. Number of criteria may be different for each player.

A dynamic model represents negotiation process, where individual time moments  $t = 0, 1, 2, \dots, T$  capture multi-round negotiation. The dynamic formulation of the problem captures the level of agreement or disagreement between the players. Reformulation of problems can be taken as searching for consensus through the exchange of information among players. At the time  $T$  the process is finalized by determining the trajectory to reach consensus. Dynamic negotiation process can be modeled as a progressive adjustment of the negotiating space until a one-element negotiating space is achieved.

A set of acceptable strategies is formulated for each player, where the strategies are acceptable with respect to specified aspiration levels. The aspiration levels  $\mathbf{b}^i(t)$ ,  $i = 1, 2, \dots, n$ ,  $t = 1, 2, \dots, T$ , correspond to opportunities for added values. At the start of the negotiations ( $t = 0$ ) the set of acceptable strategies for player  $i = 1, 2, \dots, n$ , has the form

$$X_i(0) = \{\mathbf{x}; \mathbf{x} \in X, f^i(\mathbf{x}) \leq \mathbf{b}^i(0)\}, i = 1, 2, \dots, n. \quad (9)$$

Then the negotiation space at the start of the negotiations ( $t = 0$ ) is defined as an intersection of sets of the acceptable strategies of all players in negotiations

$$X_0(0) = \bigcap_{i=1}^n X_i(0) \quad (10)$$

Next negotiations take place over time periods  $t = 1, 2, \dots, T$ . The negotiation process should be directed to a consensus strategy, to reach one-element negotiating space  $X_0(t)$ .

#### 4.2. Concept of pressure

This concept of negotiation under pressure comes from the fact that each player decides under pressure subject to objective context with a set of internal and external pressures (Fiala 1999). A player is under pressure, if he wants to achieve a consensus in a time limit or in a situation where other players influence his behavior. The pressure affects decisions through a set of constraints that must be met. Thereafter, the pressure effects are shown in modifications of the set of constraints of the negotiation model. This will lead to a modification of the set of acceptable decisions for players and a modification of the negotiating space and may be directed to a consensus

Changes in aspiration levels for criteria functions due to the effects of pressures taking place at time periods  $t = 1, 2, \dots, T$ , also modify the set of acceptable strategies

$$X_i(t) = \{\mathbf{x}; \mathbf{x} \in X, \mathbf{f}^i(\mathbf{x}) \leq \mathbf{b}^i(t)\}, i = 1, 2, \dots, n. \quad (11)$$

These changes are characterized by the following formula

$$\mathbf{b}^i(t) = \mathbf{b}^i(t - 1) + \mathbf{p}^i(t). \quad (12)$$

Vector  $\mathbf{p}^i(t)$  characterizes the adjustments of aspiration levels for the player  $i$  at time  $t$  in comparison with aspiration levels at time  $t - 1$ . Vector  $\mathbf{p}(t)$  describes the adjustments of all aspiration levels for all players at time  $t$ . So called trajectory of pressures is a continuous vector function  $\mathbf{p}(t)$  defined on the interval  $[0, T]$  that is created by connection of vectors  $\mathbf{p}(0), \mathbf{p}(1), \dots, \mathbf{p}(T)$ . The trajectory of pressures captures tactics of players in achieving the consensus, an equilibrium in supply chain.

### 5. Discussion and Conclusions

This paper proposes a general framework for equilibrium searching in supply chains. The problem-solving framework uses the network system with multiple units in and multiple evaluation criteria to structure the problem. Biform games are the basis of the process, combining cooperative and non-cooperative game instruments. The authors propose to classify biform games into sequential and simultaneous forms. The simultaneous form uses pressure negotiation concepts to achieve an equilibrium. The search for equilibrium is based on negotiating aspiration values of multiple evaluation criteria. The framework is flexible enough and allows an additional refinement of the supply chain equilibrium process, to extend the set of chain units by new and atypical units, to add additional evaluation criteria, and to include other solution concepts and approaches.

Standard multi-criteria decision techniques or state space searches using heuristic distance information from ideal criteria values can be used to search for criteria aspiration levels. The approach can also be enriched with multi-criteria De Novo optimization, where resource constraints in the chains are variable and the overall constraint is only a budget. New units (start-ups) can be included in the process of an equilibrium searching. The concept of co-opetition can bring new views into the analysis of supply chains, including adding new members such as competitors and complementors (competitors that create added value).

The model framework is open to complement other tools. Allocation mechanisms for the distribution of outputs can use other instruments, not only Shapley values, but also contracts (Fiala 2016a) and auctions (Fiala 2016b). Graph theory tools can be used to capture the complex structure of a modeled system with an environment in which units (nodes) formulate relations (edges) and flows to satisfy overall demand throughout the supply chain. The interconnection of these models and methods provides a suitable instrument for thorough supply chain analysis.

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# The Opinion of Young Polish Consumers on the Innovative Payment Methods – Results of the Research

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**Abstract:** In the world that is undergoing a constant changing process, it is inevitable that the market of payment instruments would remain the same. Young Polish consumers are those who are addressed the most when new payment methods are being introduced. That is why the objective of this work was to examine their attitude towards innovative payment methods. The research was done through a human research survey, where each respondent was given a questionnaire with single and multiple-choice questions. The aim was to determine the main factors that would influence their choice regarding the payment method. It was found that it is conditioned by the place of residence and education level. Furthermore, it was shown that, regarding gender, men know more about innovative payment methods than women and are more likely to use them actively. Apart from that, it was concluded that the main three factors when choosing the most preferred way of payment are convenience, time and ease of use. Moreover, the research showed that cost is not a driving force when that decision is being made.

**Keywords:** innovative payment methods; cashless payment instruments; attitude towards payments

**JEL Classification:** E4; O3; D71

## 1. Introduction

The 21st century is probably one of the most dynamically developing era in terms of technological advancements. This phenomenon can be seen especially on the mobile phones market. The newest smartphone with its new features will no longer catch anyone's attention in five years. Because of these rapid changes the way people think is being adjusted to the new reality. It is since information is easily attainable and spread very quickly. People are not used to wait anymore; they require the fulfillment of their needs ad hoc. Even the most basic daily activities are done accompanied by advanced technological appliances. The interest in using the newest possible technologies can be explicitly seen among young Polish consumers, and this also applies when they choose the payment method. In order to fulfill these new needs, various ways of payment are being created. One of the greatest inventions of the past ten years are mobile payments which can be done through a portable electronic device using mobile wallets or payment applications.

A lot of research in the scope of innovative payment methods can be found in the literature review. One of the researchers, M. Sołtysiak, examined the necessity of having new and innovative developments in the fields of payment and banking (Sołtysiak 2015). His aim was also to extract the essential factors that contribute to the decision-making process when the payment method is being chosen. The results of the findings lead to a conclusion that young Polish consumers are eager to have a bank account and would choose payment methods that are convenient and easy to use. An interesting study was also done by M. Kapler who analyzed buyer decision process among Polish consumers. In her work she was concentrated on finding the reasons for choosing a given payment method. As noted by Kapler (2014), the most important factors when deciding on the payment instrument were cost, speed of the transaction, ease of use and loyalty programs offered. Another finding of this research was that people are prone to choosing cash instead of cashless methods of payment. The reason for this is that consumers have certain payment habits and that not all POS in Poland offer the possibility of using cashless instruments. M. Grzywińska-Rapca and M. Grzybowska-

Brzezińska also examined the factors influencing the choice of the method of payment. The results showed the contrast between the majority of the society and young Polish consumers. The former was less willing to use cheap bank accounts, instant money transfers and managing their finances without leaving home. On the other hand, young Polish consumers are eagerly using cashless payment methods (Grzywińska-Rapca and Grzybowska-Brzezińska 2015).

The main aim of the work is to determine the attitude of the young Polish consumers towards the innovative payment methods. The hypothesis is that the main factors determining the decision when young Polish consumers choose one of the innovative payment methods are time, convenience and ease of use. In order to prove the hypothesis and accomplish the aim of the work, a survey was conducted.

## 2. The Characteristic of Innovative Payment Methods in Poland

In recent years methods of payment in Poland were being constantly developed. Except for the emergence of newer payment cards, such as proximity cards, other cashless ways of paying appeared on the market. The ones that gained the biggest popularity are Blik, PeoPay, Apple Pay and Google Pay.

Blik is a method based on generating single-use six-digit codes that are given through the bank application. The code lasts for two minutes during which it has to be given to the shop assistant or typed on the screen of the computer in the shop. Blik can be used at the stationary POS, on the Internet, but also this method enables a consumer to withdraw cash, make a transfer and issue a check. It is an easy way of payment when P2P (“person to person”) transactions are being paid because it is not necessary to use the bank account number in order for the money to reach its destination. The only thing that needs to be done is typing somebody’s telephone number and the Blik code.

Google Pay and Apple Pay are the methods that are based on HCE and NFC technologies. NFC (Near Field Communication) enables an exchange of radio waves in the distance of 20 cm. It merges contactless and mobile payments together. It means that a mobile phone equipped with NFC technology can be a substitute for the basic proximity card. All that needs to be done is moving the mobile closer to the payment terminal, and if the amount of money is greater than 50 zł, additional PIN authorization is required. A necessary condition for NFC to function properly is having a virtual paying card provided by the bank, which is embedded into a SIM card. Later on, HCE (Host Card Emulation) appeared on the market. It uses NFC technology and a data cloud instead of the SIM card. A lot of mobile applications were created in order to allow customers to use HCE. The most popular one on the international market are Google Pay and Apple Pay. They can also be used in Poland, even though one of the Polish banks created one of such financial instruments on its own, and it is called PeoPay.

Table 1. shows the popularity of the innovative payment’s methods in Poland. The unit used to display the quantity of paying cards and HCE/NFC technologies is the quantity of cards issued; when it comes to Blik and PeoPay it was the number of users. In all of the cases the upward trend can be seen. Because of the lack of data concerning the number of Polish clients for each Apple Pay and Google Pay, the table summarizes all the cards issued that use NFC and HCE technology.

**Table 1.** The Characteristic of Innovative Payment Methods.

Innovative payment method	Quantity		
	2015	2016	2017
Paying card	35,209,043	36,874,489	39,095,880
Blik	1,400,000	3,100,000	6,100,000
PeoPay	509,200	672,300	938,200
HCE, NFC Technologies (Google Pay, Apple Pay)	-	233,372	857,810



### 3. Methodology

The survey's aim was to provide data about the main factors determining the decision when young Polish consumers choose one of the innovative payment methods. It was conducted with one of the most popular diagnostic methods – diagnostic poll method. It took a form of a human research survey and normally its aim is to show the attitude of a given group of people towards a certain problem.

In order to convey the human research survey a questionnaire consisting of 19 closed questions was made. They included both single and multiple-choice questions. The survey was supposed to be conveyed among young Polish consumers aged between 18 and 25, on different levels of education, living in distinct places in Poland. Such representative group is characterized by the ability of quick adaptation to changes, the urge to look for novelties and the willingness to rely on inventions that save time and effort. The aim of the survey was to identify paying preferences of the young Polish consumers. The hypothesis stated in the work was that the main factors determining the decision when young Polish consumers choose one of the innovative payment methods are time, convenience and ease of use.

In order to determine the significance of the differences in the distribution of two nominal variables, Chi- squared test of independence was done.

The formula used in the test is as follows:

$$\chi^2 = \sum_{i=1}^n \frac{(O_i - E_i)^2}{E_i} \quad (1)$$

Where:

$\chi^2$  – Chi-Square test of independence

$O_i$  – Observed value of two nominal variables

$E_i$  – Expected value of two nominal variables

The formula used to count the expected value of two nominal variables:

$$E_i = \frac{(\text{sum of the } k_{th} \text{ row})(\text{sum of the } i_{th} \text{ column})}{(\text{total number})} \quad (2)$$

The test served to examine the correlation between sociodemographic data and the answers to the questions in the questionnaire. Only statistically significant correlations were included in the work.

In order to determine the correlation between the variables, Spearman's rank correlation coefficient was used. The values of the coefficient vary between +1 (strong positive correlation; along with the increase of the first variable the other also increases) and -1 (strong negative correlation; along with the increase of the first variable the other also decreases). When the coefficient equals to 0 then there is no correlation between the variables.

The statistical significance of all tests indicated is judged at the  $p = 0.05$  significance level. Analyses were done using SPSS Statistics.

### 4. Results

#### 4.1. Sociodemographic analysis

The questionnaire was filled in by 514 respondents. Majority of them were women (79.8%), whereas men constituted for 20.2% of the group. Most of the respondents were at the secondary education level (54.1%) or had a bachelor's or engineer's degree (41.2%). Some people were at the basic education level (1.4%), vocational education level (0.4%) or had a master's degree (2.9%). Nearly half of the representative group lived in cities with more than 200,000 inhabitants (49.6%); a lot of respondents lived in the country (23.0%); the rest of the group occupied cities with less than 20,000 inhabitants (6.0%), between 20,000 and 100,000 inhabitants (13.6%), and between 100,000 and 200,000 inhabitants (7.8%). The majority of the group was still at school or university, whereas 48.1% studied

and did not work, 43.8% studied and worked, 7.2% solely worked and 1.0% of the representative group was unemployed.

#### 4.2. Innovative Payment Methods in Poland

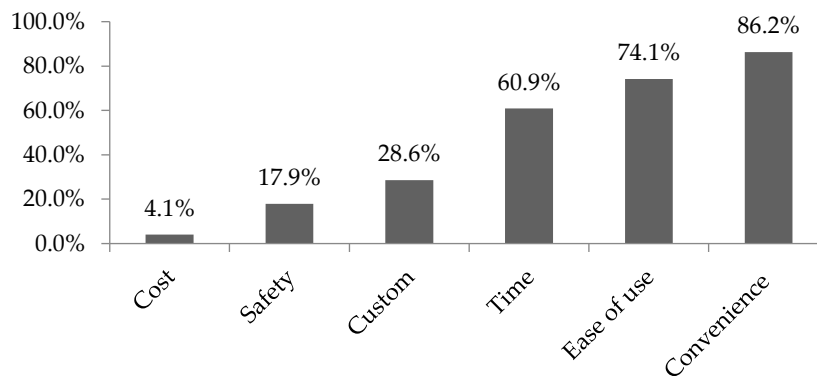
Vast majority of the respondents preferred paying by card (83.7%) and only 16.3% of the group would choose cash.

**Table 2.** Paying preferences among the representative group based on their place of residence.

		Place of residence			
		Country and cities (less than 20k inhabitants)	Cities (less than 200k inhabitants)	Cities (more than 200k inhabitants)	
Preferred payment method	Cash	Number of people	36	19	29
		% of people	24.2%	17.3%	11.4%
	Paying card	Number of people	113	91	226
		% of people	75.8%	82.7%	88.6%
Chi-squared test of independence		$\chi^2 = 11.34; p = 0.003$			

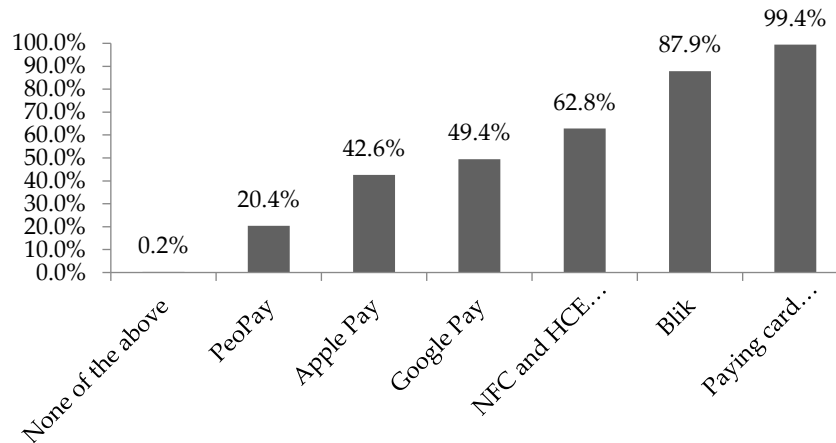
Paying by card was most often preferred by citizens of large (89%) and medium (83%) cities, whereas inhabitants of the country and small cities (76%) less often chose paying cards. The differences are statistically significant ( $p = 0.003$ ) (Tab. 2).

The most important factors influencing the choice of the payment method were convenience (86%), ease of use (74%) and time (61%). Less significant factors were custom (29%), safety (18%) and cost (4%) (Fig. 1).



**Figure 1.** Factors determining the choice of a given payment method (multiple choice question).

The best-known cashless payment methods were paying card (99%), Blik (88%), NFC and HCE technologies (63%), Google Pay (49%) and Apple Pay (43%). Less popular was PeoPay (20%). Only 0.2% of the respondents knew none of the above.



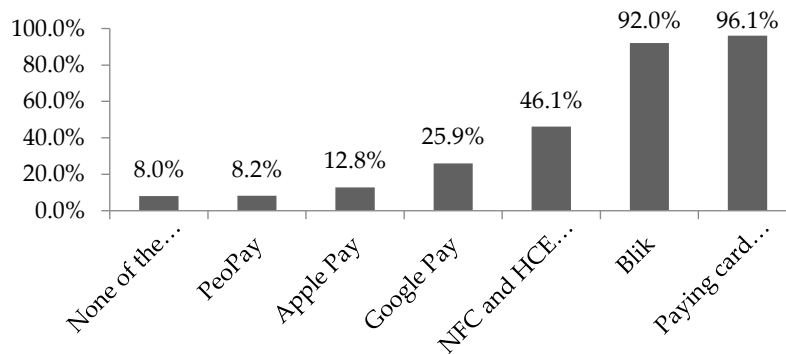
**Figure 2.** Payment methods known among the respondents (multiple choice question).

**Table 3.** Known payment methods based on gender.

			Gender	
			Female	Male
Known payment method	Paying card	Number of people	407	104
		% of people	99.3%	100.0%
	NFC and HCE technologies	Number of people	240	83
		% of people	58.5%	79.8%
	Blik	Number of people	363	89
		% of people	88.5%	85.6%
	Apple Pay	Number of people	160	59
		% of people	39.0%	56.7%
	PeoPay	Number of people	76	29
		% of people	18.5%	27.9%
	Google Pay	Number of people	186	68
		% of people	45.4%	65.4%
	None of the above	Number of people	1	0
		% of people	0.2%	0.0%
Chi-squared test of independence			$\chi^2 = 46.17; p < 0.001$	

Both women and men were similar in their knowledge about paying cards and Blik. But it was men who more often knew such cashless payment methods as NFC and HCE technologies, Apple Pay, Google Pay and PeoPay. Chi-squared test of independence shows that given differences are statistically significant ( $p < 0.001$ ) (Tab. 3).

The representative group most often used such methods of payment as paying card (96%) and cash (92%). Less respondents chose Blik (46%), NFC and HCE technologies (26%). Even less often Apple Pay (13%), Google Pay (8%) and PeoPay (8%) were used (Fig. 3).



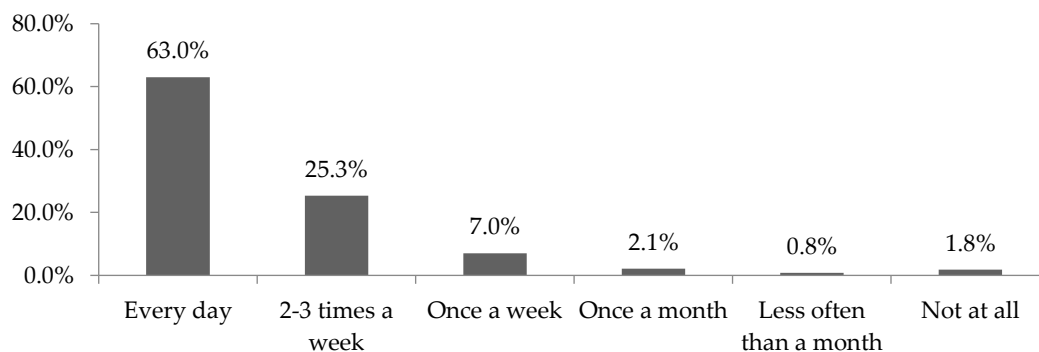
**Figure 3.** Used payment methods among the respondents (multiple choice question).

**Table 4.** Used payment methods based on gender.

			Gender		
			Female	Male	
Used payment method	Cash	Number of people	382	91	
		% of people	93.2%	87.5%	
	Paying card	Number of people	393	101	
		% of people	95.9%	97.1%	
	NFC and HCE technologies	Number of people	96	37	
		% of people	23.4%	35.6%	
	Blik	Number of people	189	48	
		% of people	46.1%	46.2%	
	Apple Pay	Number of people	51	15	
		% of people	12.4%	14.4%	
	PeoPay	Number of people	36	5	
		% of people	8.8%	4.8%	
	Google Pay	Number of people	25	17	
		% of people	6.1%	16.3%	
	None of the above	Number of people	0	0	
		% of people	0.0%	0.0%	
	Chi-squared test of independence			$\chi^2 = 24.07; p = 0.001$	

Women used cash, paying card, Blik and Apple Pay as often as men. Men chose NFC and HCE technologies and Google Pay more often than women. On the other hand, women used PeoPay more than men. Chi-squared test of independence shows that given differences are statistically significant ( $p = 0.001$ ) (Tab. 4).

More than a half of the respondents used cashless payment methods every day (63%). Other people in the representative group used them 2-3 times a week (25%), once a week (7%), once a month (2%) or less often than a month (1%). Only 2% of the respondents did not use cashless methods of payment at all (Fig. 4).



**Figure 4.** Frequency of use of cashless payment methods.

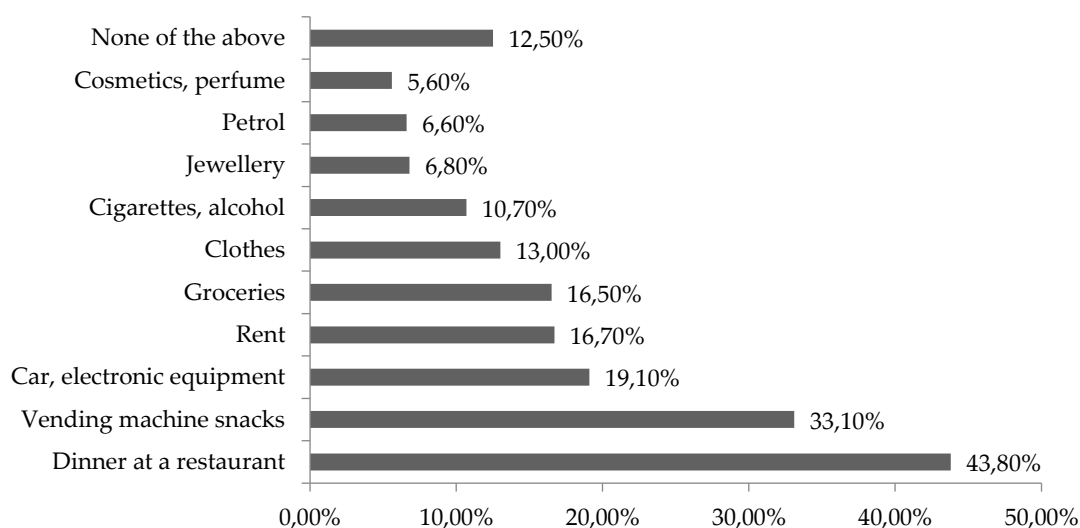
**Table 5.** Values of Spearman's rank correlation coefficient. The relationship between the place of residence and the frequency of use of cashless payment methods.

	Frequency of use of cashless payment methods	
Place of residence	Spearman's rank correlation coefficient	-0.21
	Significance (both-sided)	<0.001

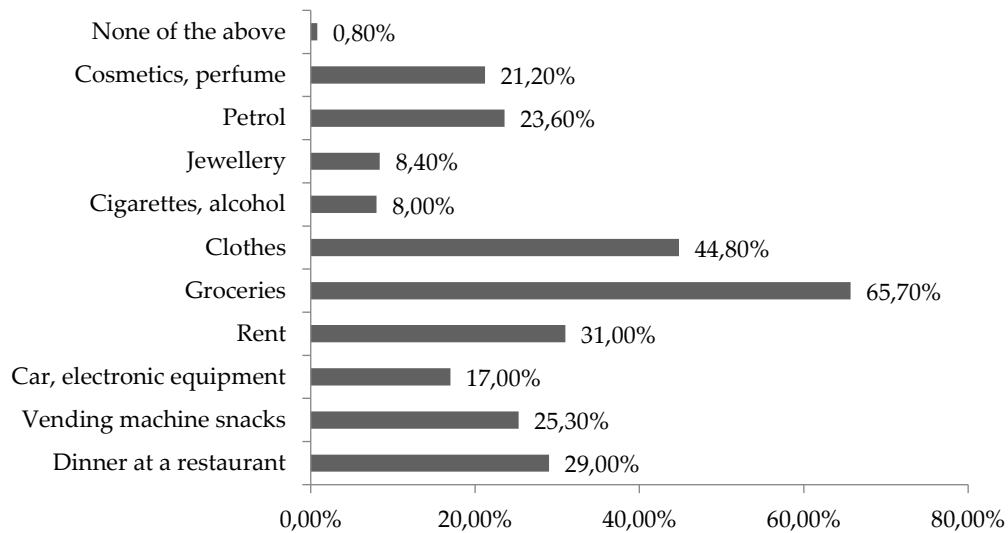
The analysis of the correlation using Spearman's rank correlation coefficient shows statistically significant relationship between the place of residence and the frequency of use of cashless payment methods. The respondents living in large cities more often used cashless payment methods than citizens of smaller cities ( $p < 0.001$ ) (Tab. 5).

Goods that were most likely purchased with cash were: dinner at a restaurant (44%) and vending machine snacks (33%). Less often cash was used to buy a car and electronic equipment (19%), and rent (17%). Seldom people paid with cash for groceries (17%), clothes (13%), cigarettes and alcohol (11%), jewellery (7%), petrol (7%), and cosmetics and perfume (6%) (Fig. 5).

Goods that were most likely purchased with paying card were: groceries (66%), and clothes (45%). Less often paying card was used to pay the rent (31%), dinner at a restaurant (29%), vending machine snacks (25%), petrol (25%), cosmetics and perfume (21%), or car and electronic equipment (17%). Seldom people paid with paying card for jewellery (8%), or cigarettes and alcohol (8%) (Fig. 6).

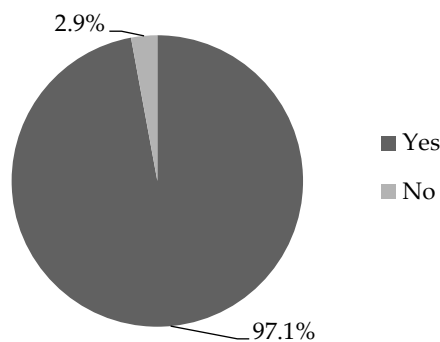


**Figure 5.** Goods most likely paid with cash (multiple choice question).



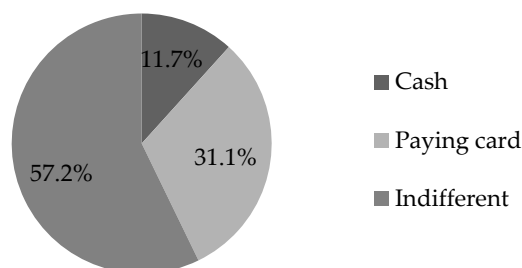
**Figure 6.** Goods most likely paid with paying card (multiple choice question).

Almost everyone in the representative group agrees that growing popularity of the Internet influences the frequency of use of cashless payment methods (97%) (Fig. 7).



**Figure 7.** Is the growing popularity of the Internet influence the frequency of use of cashless payment methods?

The majority of the representative group (57%) claimed that cash and paying card were indifferent to each other in terms of their cost. 31% of the respondents reckoned that paying card was more expensive than cash, while 12% had the opposite opinion (Fig. 8).



**Figure 8.** The most expensive payment methods.

**Table 6.** The most expensive payment methods based on gender.

			Gender	
			Female	Male
The most expensive payment methods	Cash	Number of people	41	19
		% of people	10.0%	18.3%
	Paying card	Number of people	127	33
		% of people	31.0%	31.7%
	Indifferent	Number of people	242	52
		% of people	59.0%	50.0%
Chi-squared test of independence			$\chi^2 = 6.06; p < 0.048$	

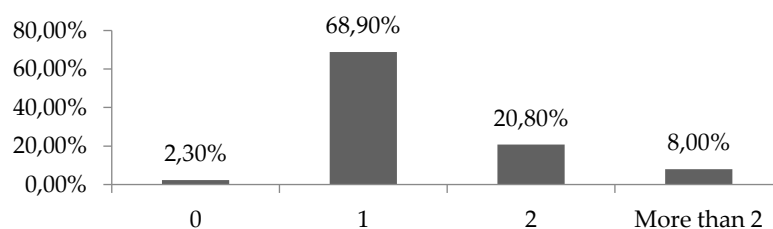
Men more often than women claimed that cash was more expensive. More women thought that cash and paying card were indifferent to each other. The differences between genders are statistically significant ( $p = 0.004$ ) (Tab. 6).

**Table 7.** The most expensive payment methods based on place of residence.

			Place of residence		
			Country and cities (less than 20k inhabitants)	Cities (less than 200k inhabitants)	Cities (more than 200k inhabitants)
The most expensive payment methods	Cash	Number of people	14	15	31
		% of people	9.4%	13.6%	12.2%
	Paying card	Number of people	62	29	69
		% of people	41.6%	26.4%	27.1%
	Indifferent	Number of people	73	66	155
		% of people	49.0%	60.0%	60.8%
Chi-squared test of independence			$\chi^2 = 10.97; p < 0.027$		

The citizens of medium and large cities more often claimed that these two payment methods were indifferent to each other, whereas people living in the country and in small cities thought that paying card was more expensive (42%). The differences between the groups are statistically significant ( $p = 0.027$ ) (Tab. 7.)

The majority of the respondents had only one paying card (69%), while 21% of the representative group had two paying cards or more (8%) (Fig. 9).



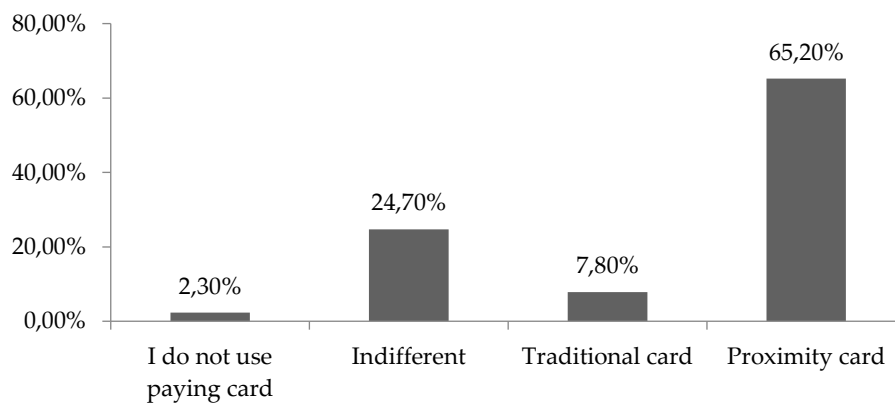
**Figure 9.** The number of paying cards in possession.

**Table 8.** The number of paying cards in possession based on the education level and place of residence.

		The number of paying cards in possession
Education level	Spearman's rank correlation coefficient	0.16
	Significance (both-sided)	<0.001
	Spearman's rank correlation coefficient	0.15
Place of residence	Significance (both-sided)	0.001

The analysis of the correlation using Spearman's rank correlation coefficient shows statistically significant relationship between the education level ( $p < 0.001$ ), place of residence ( $p = 0.001$ ) and the number of paying cards in possession. The respondents with higher education level, living in large cities were more likely to have a few paying cards (Tab. 8).

The most preferred type of paying card was the proximity card (65%). Only 8% would rather choose the traditional card, and 25% of the representative group were indifferent to two options.



**Figure 10.** Preferred paying card.

## 5. Discussion

According to the findings of the survey young Polish consumers know a lot about innovative payment methods and prefer them over cash. M. Grzywińska-Rapca and M. Grzybowska-Brzezińska came to the same conclusion. Moreover, the survey showed that there is statistically significant relationship between place of residence, education level and the payment method that would be chosen. The reason for that may be that in larger cities more shops offer the possibility of cashless payments. Apart from that, more educated people are usually more eager to expand their knowledge in various fields. Thus, they would be more likely to look for newer and more innovative methods of payment. It is similar in the case of the number of possessed paying cards (Fig. 9). More educated people living in larger cities would have more paying cards. This is another proof that the level of education and place of residence have an influence on the choice of the payment method. Furthermore, the survey indicates that men know more methods of payment and use them more actively than women. It can be because men are usually more interested in technological novelties than women. It needs to be highlighted that in some cases even though people knew some payment method, they did not necessarily use it. A good example is Blik because 87.9% of the representative group knew this payment method and only 46.1% used it actively.

When purchasing a certain basket of goods, i.e. dinner at a restaurant, groceries, clothes, petrol, cosmetics and perfume, the respondents had preferences towards either cash or cashless payments (Fig. 5 and 6). When they were paying for the rest of the goods stated in the research, the respondents were indifferent to which payment method they would choose. The reason for that might be that people usually share a bill at the restaurant, and cash is an easier way of splitting the amount of money that has to be paid. Thus, the conclusion can be drawn that convenience is an important factor when choosing the payment method. On the other hand, the respondents were more likely to pay with



paying card for groceries, clothes, petrol, cosmetics and perfume. All of these goods are products used on a daily basis, so it is probable that people buy them when they are in a rush, just after they leave school or work. They would like to save as much time as possible and paying card seems to be the most suitable way of paying to fulfill that need. As seen in Fig. 9, proximity cards are the most preferred ones. It is obviously a quicker way of purchasing because there is no need for counting money and waiting for a change. Hence, it is possible to draw a conclusion that time is another significant factor when the payment method is being chosen. As opposed to that finding, M. Kapler claims in her work that the society perceives cashless payment methods more time consuming. Nevertheless, her conclusion also supports the idea that time is a significant factor in deciding upon the method of payment.

Cost is not a factor that would influence the choice of the payment method among young Polish consumers (Fig. 8). However, it has to be pointed out that the inhabitants of the country and smaller cities perceived paying card to be more expensive. That finding supports the conclusion that place of residence may influence the choice of payment method. Moreover, one could state that cost would be a significant factor when the inhabitant of the country or a small city chooses the method of payment.

## 6. Conclusion

All in all, above findings confirm the hypothesis of the work that the main factors determining the decision when young Polish consumers choose one of the innovative payment methods are time, convenience and ease of use (Fig. 1). To the same conclusion came M. Sołtysiak in his work, when he stated that convenience is important for young Polish consumers. The only limitation to the research was lack of data about the use of certain payment methods in Poland (Apple Pay and Google Pay). Nevertheless, in the days to come it is possible that more information would be gathered, and other researchers would be able to examine this topic even more deeply.

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# The Impact of Changes in Industrial Robots Supply on the Level of Employment in Selected European Countries

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**Abstract:** Europe is a region with the highest density of robots in industry. The aim of the article is to analyse the dynamics of annual robots supplies in five selected European countries and to identify a connection between the supplies and changes in employment. The one-way analysis of variance used in the study allowed concluding that the average increase of industrial robots supplies in Germany, Italy, France, Spain as well as in Great Britain differed significantly in particular years and depended primarily on the economic situation. A positive correlation between the supplies and annual changes in employment was observed, which may result from the fact that the robots are substitutes for tasks performed in given professions but they do not replace them completely.

**Keywords:** robots; industrial robots; employment

**JEL Classification:** J21; J24

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## 1. Introduction

At the threshold of the third decade of the twenty-first century we are trying to consider the borders of automation and robotisation of business processes more frequently. Due to the automation of business processes we obtained a possibility of replacing work performed by a man by machine work, computer or its software work. On the other hand, defining the issues of robotisation of the business processes it may be observed that for its implementation in an automation process a programming robot is used. Therefore, although the terms robotisation and automation of processes are commonly alternatively used, it should be taken into account that robotisation is a part of automation or its special type. There are also cases of using robots that cannot be defined as automation.

The industrial robots play a particular role in robotisation of business processes. It should be noticed that in 2020 Europe will be a region with the highest density of using robots in industry. In almost every industry robotisation of production became necessary and it is considered as a standard of a competitive activity. Internationalisation of industry and globalisation of economy lead to implementation of the systems of production automation and consequently to supporting the effects regarding production scale. Interestingly, at the same time with a growing use of robots an increase in total employment may be noticed.

The most important achievements in automation and robotisation of business processes studies include the results of such researchers as Davenport Thomas and Kirby Julia (2015), Autor David (2015) and Sutherland Charles (2013). The studies concerning these problems were initiated in the early seventies of the last century in response to the increasing use of robots on production lines in the sixties.

The article deals with an increase in the use of industrial robots in selected European countries, including Germany, Italy, France, Spain and Great Britain, and focuses on the dynamics of their annual supplies. The data on the scale of the robotisation of processes in these countries indicate that the number of workplaces vulnerable to replacement by robots is big enough to propose a hypothesis proving the use of this type of technology as influencing a character of workplaces in the future. The main problem to solve in the presented article was to identify an impact of the increase in the use of robots on a level of employment. Dealing with the issue in more detail, the study tries to identify the links between annual

supplies of multi-functional industrial robots and changes in employment in five selected European countries.

## 2. Methods

In the course of analytical study on the dynamics of annual industrial robots supplies in five countries, including Germany, Italy, France and Great Britain, the one-way analysis of variance was used. The data concerning the increases of supplies in the years 2009-2020 (taking into account forecast data from the years 2018-2020) were obtained from the reports of the International Federation of Robotics. Subsequently, a correlation between estimated annual multi-functional industrial robots supplies and annual changes in total employment for the years 2009-2018 was calculated. Statistics on employment were obtained from the database provided by Eurostat.

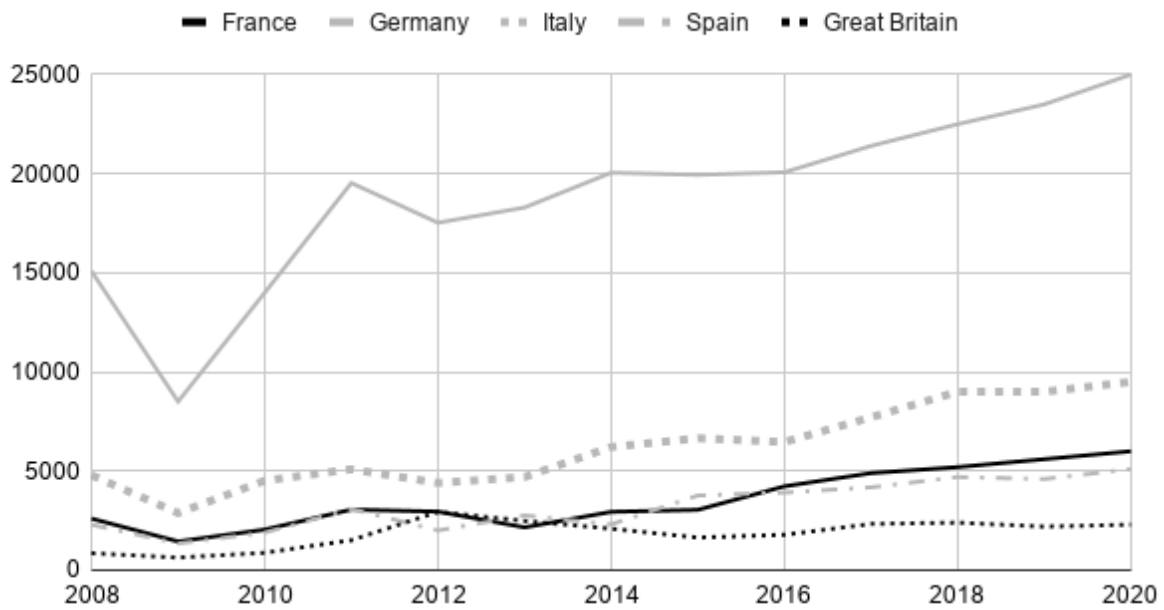
## 3. Results and Discussion

In order to carry out the analytical study we should define the term an industrial robot, which is every automatically controlled, universal robotic system programmable on at least three axes, that are fixed or mobile and can be used in industrial automation (according to ISO Standard 8373: 2012). *This means that the robot* (International Federation of Robotics 2017):

1. Performs tasks without any external commands during the process (automatically controlled);
2. Can change movements without changing the equipment (reprogrammable);
3. Is able to perform different operational activities after physical changes such as replacement of tools (universal).

From the sixties to the nineties of the last century the most of the robots and robotics were limited to an industrial use. (European Agency for Safety and Health at Work 2015) Although nowadays they are also used in other sectors, the industry is still one of their essential uses. The demand for industrial robots has started to increase significantly since 2010. The continuing tendency to automatization and technical innovations are the main reasons of this phenomenon. According to the data of the International Federation of Robotics, Europe was the second largest market of sale of industrial robots in 2018. The average annual growth rate in Europe was 10% in the years 2012-2017. The traditional industrial robots played a significant role in ensuring competitiveness of European production industry. Since the 1970s Europe has been competitive in terms of technical and trade considerations as regards robots, however they are unevenly used depending on the country. (Estolatan et al. 2018) Germany is the fifth largest robots markets in the world (after China, Japan, the Republic of Korea and the United States of America). The important market is also Italy. Whether in case of Germany or Italy it may be assumed that they have favourable solutions regarding the possibilities of automation of business processes and also institutions necessary in the robotics development<sup>6</sup>. Other countries with the significant growth of industrial robots sale are Spain, France and to a lesser degree Great Britain, however, France and Great Britain are facing the challenges that are posed by public opposition resulting from the potential of replacing human labour. The rest of West European countries, except for Austria and Portugal, also recorded an increase of sales but their position in the technological *landscape is less important*.

In recent years, the above-mentioned countries have launched the programs, aimed at development of robotics, that are often a part of the campaign for Industry 4.0. These are initiatives involving universities as well as domestic companies, mainly in a form of public-private partnerships. It is presented in figure 1 where estimated annual supplies of multi-functional industrial robots in the analysed countries, Germany, Italy, Spain, France and Great Britain, can be found. A slow but constant growth of the estimated supplies may be observed in all the countries except for Great Britain where there were slight fluctuations on their level in 2015. Germany has been an undisputed leader and in 2017 with the number 21404 it exceeded the sum of supplies acquired in other analysed countries (19,124 in total).



**Figure 1.** The estimated annual supplies of multi-functional industrial robots in selected European countries, 2008-2020 (forecasting data for the years 2018-2020), own study based on: International Federation of Robotics (2017), World Robotics Industrial Robots, <https://ifr.org/>, [accessed on 27 October 2019].

The idea of a future industrial revolution is connected with the achievements of German production both by scientists and industry analysts. (Kagermann et al. 2013) The great interest in this topic is related to an expected increase in productivity. It is worth emphasizing that Germany is not only a user but also an important engineer of industrial robots. The German robotics industry consists of about 500 companies including a few big players and a large number of small and medium-sized enterprises specializing in specific areas of use. Most of these companies are owned by stable networks, Original Equipment Manufacturers (OEMs) and leading suppliers. (GTAI 2018) In addition, Germany has a strong scientific base specialising in various sub-areas of robotics. It is estimated that 57% of German robotics is exported and the biggest export markets remain China (10%) and North America (9%). Moreover, the foreign demand is expected to grow.

Italy is another leading producer of robots in Europe. Italy has the second largest market in the region and supports industrial automation in production. The statistics show that the industry is export-oriented and the country is a significant player in the global industrial landscape. The domestic sector consists in 75% of big companies and in 25% of small and medium-sized enterprises. (Estolatan et al. 2018) Most of them is located in the north of Italy, especially in Lombardy and Piedmont. In 2016 the national plan, 'Industry 4.0' was introduced, which aimed at supporting development of the industry. This long-term strategic document ensures funds, 18 billion euro in total, for research and technological innovations.

France also has a program supporting enterprises in implementation of digital technologies and production modernisation: 'Industrie du Futur'. (European Commission 2017a) In 2008-2017 there was 88% growth in annual supplies of multi-functional industrial robots in France (from 2,605 to 4,897). The Franche-Comté region is considered to be the most vulnerable to robotisation as it is the strongest manufacturing region in the country. (Oxford Economics 2019)

The number of robots supplies in Spain was slightly smaller than statistics in France in the analysed period. The increase in the years 2008-2017 reached 82% and in the last year amounted to 4,180. The Spanish strategy of supporting robotisation is included in the strategy 'Industria Conectada 4.0'. (European Commission 2017b) It should be noted, that although the total number of industrial robots supplies in Spain is much smaller than in Germany, relatively more companies use the

industrial robots. This is a consequence of the fact that the percentage of the enterprises using robots remains low in Germany but the companies that use them do it to a greater extent. (Jäger et al. 2015)

Robotics and autonomous systems (RAS) were recognised as one of the eight technologies supporting British industrial strategy in 2012 by the British government. They are treated as a chance to restore a balance in economy as well as growth and jobs creation. The strength of Great Britain in robotics is considered a large number of experts in the research community and in business. In accordance with the assumptions of the RAS 2020 strategy this kind of base in connection with proper investment is to create ecosystem generating new products, services and business. (UK-RAS Network 2019) In the years 2008-2017 Great Britain recorded an increase in annual supplies of industrial robots at the level of 177%, however, it continues to lag behind other analysed countries.

The one-way analysis of variance of annual supplies of multi-functional industrial robots in five analysed countries allows for the conclusion that the average increases for individual years significantly differ.

**Table 1.** The one-way analysis of variance of annual supplies of multi-functional industrial robots in selected European countries, own calculations based on: International Federation of Robotics (2017), World Robotics Industrial Robots, [accessed 27 October 2019].

	<b>Df</b>	<b>Sum Sq</b>	<b>Mean Sq</b>	<b>F value</b>	<b>p value</b>
Year	11	2.744	0.24947	5.006	3.82e-05 ***

The average growth of annual supplies of robots was not stable and, as in the case of the countries with higher intensity of supplies as well as lower statistics, depended on an economic situation. There is a clearly perceived decrease in supplies after the financial crisis in 2007 and then their increase. Since 2012 a demand for industrial robots has increased due to a continuing trend towards automation and constant technical innovations of robots. In 2012 there was another drop and the sale of industrial robots in Europe fell by 6% compared to the previous year. After substantial investments of the automotive industry in 2011 the installment of robots decreased in this sector, while robots were still purchased by most of the other industries. Although in 2012 the sale of robots decreased in most of the countries, in Great Britain it increased to record levels. During the next years the sale of robots began to rise due to relaunching investment in automotive industry. In the years 2013-2018 installations of robots grew by 19% a year. The average number of robots on 10000 of employees in the manufacturing industry was 99 in 2018 in the world and 114 in Europe. Europe is a region with the highest density of robots. (International Federation of Robotics. 2017)

The development of robotics has been an area of particular interest due to its potential to improving quality of life and workplaces as well as the possible impact on employment and wages. According to the International Federation of Robotics, robots are substitutes for tasks performed in many different jobs, however, they are not replacing labour. The increase of their use has resulted in increased demand for work and has had a positive impact on wages so far. (International Federation of Robotics. 2017)

It is believed that in all analysed countries the number of workplaces vulnerable to substitution by robots is so large that we may be sure that this technology will be shaping a character and number of available workplaces in the future. (Lordan 2018)

The following table provides the correlation between estimated annual supplies of multi-functional industrial robots and annual changes in total employment in the analysed countries in the years 2009-2018. The results for all countries except for Great Britain are statistically significant. The positive correlation is noted, which may indicate a positive impact of robots supplies on employment in France, Spain, Germany and Italy.

**Table 2.** The one-way analysis of variance of annual supplies of multi-functional industrial robots in selected European countries, own calculations based on: International Federation of Robotics (2018), World Robotics Industrial Robots, [accessed: 27 October 2019].

France	Spain	Germany	Great	Italy
0.8977035 (0.001019)	0.775204 (0.01412)	0.9587835 (4.495e-05)	0.343092 (0.366)	0.7268532 (0.02652)

Dauth, Findeisen, Südekum and Wößner found no evidence that robots are responsible for the total loss of jobs in Germany but they rather influence on the structure of employment. According to their results, each robot destroys two production sites, representing 23% of the overall decrease in manufacturing industry in Germany in the years 1994-2014. However, the losses were compensated due to additional workplaces in the service sector. (Dauth et al. 2017) Similarly, Graetz and Michaels while analysing the periods of emerging from a recession since 1980s checked if they were characterized by a lower increase in employment due to technological changes. According to the results for 17 countries, including Germany, Italy, France, Spain and Great Britain, although GDP grew slower after the last recessions in case of employment, no similar change can be observed. Industries use routine tasks to a greater degree and those more vulnerable to robotisation did not experience slower increase in employment. The results suggest that technology does not has an influence on a slower increase of employment after recessions in the developed countries, except for the United States where it is particularly evident. (Graetz and Michaels 2017) Meanwhile, Backer, DeStefano, Menon and Suh have shown that there is a positive relationship between employment in international enterprises in the developed countries and investments in robots. They discovered that a negative impact is visible only in case of offshoring, that is robotics seems to decrease a need to move a part of the activity from developed economies. (Backer et al. 2018) Similarly, Carbonero, Ernst and Weber presented the evidence that the impact of robots on employment in the developed countries is not significant and what is more the robots influence on a decrease of offshoring, which is beneficial for employment of the emerging economies. (Carbonero et al. 2015) Additionally, Jäger, Moll, Som, Zanker, Kinkel and Lichtner argue that differences in use of robots cannot be linked with the level of employment and wages in the countries as a pressure factor for replacing labour by capital. There are examples that the countries with a relatively low wages, such as Spain, have higher percentage of companies using robots than countries with high wages, such as Switzerland. (Jäger et al. 2015)

At the same time, the results obtained by Chiacchio, Petropoulos and Pichler suggest that one additional robot for one thousand employees causes a decrease in employment by 0.16-0.2 percentage points. The calculations were performed with the use of the data for the countries analysed also in this article, except for Great Britain. Additionally, Finland and Sweden were taken into account. (Chiacchio et al. 2018) Comparing the employment on positions vulnerable to automation in the three decades it was stated that there is no significant evidence of continuation of automation in all the analysed countries (Germany, Italy, France, Great Britain, Spain). (Lordan 2018) This may suggest that the analysed countries reorganised work in other way than the countries with a significant employment decrease.

#### 4. Conclusions

The conducted studies, both theoretical and analytical, proved that the implementation of the increasingly modern robots is a constant and unstoppable process in the analysed countries. Robotisation of the industrial production is facilitated by a good economic situation and above all omnipresent, not only in European countries but also worldwide, production standardization. The conducted analysis of the dynamics of annual supplies of industrial robots as well as their impact on employment allowed to draw a few significant conclusions regarding the assessment of the state of robotisation and its future in Europe.

1. Robotisation of the global and European production is regarded as a continuous and necessary process both in a growth and economic development of countries in the world. This thesis is accepted by theoreticians, researchers and practitioners of the economic life.
2. During the last decade the increasing interest in industrial robots is noticeable in Europe, which remains the second largest market for their sale. This tendency is clearly visible in the statistics regarding the annual supplies of robots in the analysed European countries. This is reflected in a slow but constant increase of estimated supplies in all countries, except for Great Britain where since 2015 there have been slight fluctuations in their level.
3. The average increases in the industrial robots supplies in Europe for the individual years differed significantly in the countries with high intensity of supplies as well as with lower statistics. One-way analysis of variance of the annual supplies allows to conclude that they depended on the economic situation.
4. The conducted studies and their results proved that there was a positive correlation between estimated annual supplies of multi-functional industrial robots and annual changes in the total employment in the analysed countries in the years 2009-2018. This is confirmed by the statistically significant results for all countries except for Great Britain. This may result from the fact that robots are substitutes for tasks performed within given jobs but do not replace them completely, which means that the differences in use of robots should not be linked only with the level of employment as a pressure factor for work replacement.

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# Predicting Exchange Rates Using the Kalman Filter

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**Abstract:** The Kalman filter is one of the classical algorithms of statistical estimation theory, which finds application in many different areas, including econometrics. One of the possible problems for which the Kalman filter can be suitably employed is the exchange rate prediction. Over the course of time, various authors have investigated the possibility of using the forward rate to predict the future spot rate. In general, however, it has been shown that the accuracy of the predictions based on the assumed equality between the forward rate and the future spot rate is not very satisfactory. The paper deals with the presentation and empirical evaluation of the possibilities of using the Kalman filter in predicting the future spot rate on the basis of the forward rate. Various models for describing the relationship between these rates are presented and their predictive performance is then assessed on the exchange rate data of currency pairs EUR/CZK and USD/CZK. The results show the benefits of using the Kalman filter.

**Keywords:** Kalman filter; exchange rate prediction; forward rate; spot rate

**JEL Classification:** C13; C53

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## 1. Introduction

The relationship between the forward exchange rate and the future spot rate has been investigated by a number of authors (Engel 1996). Initially, it was assumed (Cornell 1977; Levich 1978) that the forward rate could be used as an optimal predictor for the future spot rate, i.e. that the so-called Unbiased Forward Rate Hypothesis (UFRH) holds, and the forward rate is an unbiased estimate of the future spot rate. Later, however, the views that UFRH does not hold and the forward rate is not a suitable predictor of the future spot rate began to prevail (Hansen and Hodrick 1980; Fama 1984). These views were supported by the results of many empirical studies for various currency pairs (Baillie, Lippens, and McMahon 1983; Frankel and Chinn 1993; Wesso 1999); other studies have shown that models predicting the spot rate using the forward rate do not produce better results than modeling the spot rate as a random walk (Bilson 1981; Meese and Rogoff 1983). The invalidity of the UFRH hypothesis was explained, for example, by the existence of a risk premium (Wolff 2000; Fama 1984), irrational expectations (Baillie, Lippens, and McMahon 1983) or by the influence of various external factors on the foreign exchange market (Wolff 1987). More recently, authors, in particular (Hai, Mark, and Wu 1997; Luintel and Paudyal 1998; Zivot 2000; McMillan 2005), have started to focus more closely on the cointegration relationship of the spot and forward rates, thus challenging the results of some previous studies.

(Phillips and McFarland 1997; Clarida et al. 2003) have shown that the forward rate may contain some useful information about the future spot rate. (Wolff 1987; Wesso 1999) pointed out that, according to empirical findings, the relationship between the forward rate and the future spot rate changes over time. (Wolff 1987; Barnhart and Szakmary 1991; Bonga-Bonga 2008) thus propose to construct a model with time-varying coefficients, that captures these characteristics of the relationship development and allows to achieve better predictive performance. (Wolff 2000; Bhar 2010) consider the existence of a risk premium as a time-varying unobservable variable whose inclusion in the model can explain the differences (deviations) between the forward rate and the future spot rate. The Kalman filter can be used to estimate the time-varying model coefficients and the development of the risk premium over time.

The paper deals with the presentation and empirical evaluation of the possibilities of using the Kalman filter in predicting the future spot rate on the basis of the forward rate for currency pairs EUR/CZK and USD/CZK. Section 2 is devoted to a brief introduction of the Kalman filter and various models for describing the relationship between the spot and the forward rate. In section 3, the results of empirical analysis are presented and discussed. Section 4 provides a final summary of the results.

## 2. Methodology

### 2.1. KalmanFilter

The Kalman filter is a tool which enables to estimate an unknown and unobservable state of a stochastic linear dynamic system using measurements corrupted by noise. The estimate produced by the Kalman filter is statistically optimal in some sense (for example when considering the minimization of the mean square error; see (Kalman 1960) for details).

#### *Algorithm of the Kalman filter*

Let us consider a stochastic linear dynamic system in discrete time, which is represented by the following state-space model (it is assumed here that the system has no inputs)

$$\mathbf{x}_t = \Phi_{t-1}\mathbf{x}_{t-1} + \mathbf{w}_{t-1}, \quad (1)$$

$$\mathbf{z}_t = \mathbf{H}_t\mathbf{x}_t + \mathbf{v}_t. \quad (2)$$

Equation (1), referred to as the state equation, describes the dynamics of the system, the vector  $\mathbf{x}_t \in \mathbb{R}^n$  is the (unknown) vector of the system state at time  $t$ , the matrix  $\Phi_{t-1} \in \mathbb{R}^{n \times n}$  represents the system state transition between time  $t-1$  and  $t$ . Equation (2) is called the measurement equation, the vector  $\mathbf{z}_t \in \mathbb{R}^m$  is referred to as the system output vector, the measurement vector or the observation vector, the matrix  $\mathbf{H}_t \in \mathbb{R}^{m \times n}$  describes the relationship between the system state and the measurements. Since a stochastic system is concerned, the vectors  $\mathbf{x}_t$  and  $\mathbf{z}_t$ ,  $t = 0, 1, 2, \dots$ , can be considered as random variables, and their sequences  $\{\mathbf{x}_t\}$  and  $\{\mathbf{z}_t\}$  are then random (stochastic) processes.

$\{\mathbf{w}_t\}$  and  $\{\mathbf{v}_t\}$  are random noise processes; these processes are assumed to be uncorrelated Gaussian processes with zero mean and covariance matrices  $\mathbf{Q}_t \in \mathbb{R}^{n \times n}$  resp.  $\mathbf{R}_t \in \mathbb{R}^{m \times m}$  at time  $t$  (the processes have qualities of Gaussian white noise).

Furthermore, let us assume that  $\mathbf{x}_0$  is a random variable having a Gaussian (normal) distribution with known mean  $\mathbf{x}_0$  and known covariance matrix  $\mathbf{P}_0$ . Moreover, suppose that  $\mathbf{x}_0$  and both the noises are always mutually uncorrelated. Thus, the following holds for all  $t$

$$E\langle \mathbf{w}_t \rangle = \mathbf{0},$$

$$E\langle \mathbf{v}_t \rangle = \mathbf{0},$$

$$E\langle \mathbf{w}_{t_1} \mathbf{w}_{t_2}^T \rangle = \mathbf{Q}_{t_1} \delta(t_2 - t_1),$$

$$E\langle \mathbf{v}_{t_1} \mathbf{v}_{t_2}^T \rangle = \mathbf{R}_{t_1} \delta(t_2 - t_1),$$

$$E\langle \mathbf{w}_{t_1} \mathbf{v}_{t_2}^T \rangle = \mathbf{0},$$

$$E\langle \mathbf{x}_0 \mathbf{w}_t^T \rangle = \mathbf{0},$$

$$E\langle \mathbf{x}_0 \mathbf{v}_t^T \rangle = \mathbf{0},$$

where the symbol  $\delta$  refers to the Kronecker delta

$$\delta(t) = \begin{cases} 1, & t = 0, \\ 0, & t \neq 0. \end{cases}$$

The aim of the Kalman filter is to produce an estimate of the state vector  $\mathbf{x}_t$  at time  $t$ , denoted by  $\hat{\mathbf{x}}_t$ , so that this estimate is optimal (for example with respect to minimizing the mean square error).

The algorithm of the Kalman filter is recursive; the calculation at time  $t$  consists of two main steps. Firstly, the a priori estimate  $\hat{\mathbf{x}}_{t(-)}$  at time  $t$  is computed through substituting the a posteriori

estimate from time  $t - 1$  into the deterministic part of the state equation of the model; this step is called the prediction step. Then, this estimate is adjusted by using the measurement carried out at time  $t$ , which results in obtaining the a posteriori estimate  $\hat{\mathbf{x}}_{t(+)}$  at time  $t$ ; this is the correction step.

The following relation can be written for the a priori estimate of the state vector  $\hat{\mathbf{x}}_{t(-)}$  at time  $t$ ; the uncertainty of this estimate is expressed by the a priori error covariance matrix  $\mathbf{P}_{t(-)}$

$$\begin{aligned}\hat{\mathbf{x}}_{t(-)} &= \Phi_{t-1}\hat{\mathbf{x}}_{t-1(+)}, \\ \mathbf{P}_{t(-)} &= \Phi_{t-1}\mathbf{P}_{t-1(+)}\Phi_{t-1}^T + \mathbf{Q}_{t-1}.\end{aligned}$$

Then, after obtaining the measurement  $\mathbf{z}_t$ , the a posteriori estimate of the state vector  $\hat{\mathbf{x}}_{t(+)}$  is determined by the combination of the a priori estimate and the difference between the actual and the expected value of the measurement weighted by the matrix  $\mathbf{K}_t$ ; its uncertainty is expressed by the a posteriori error covariance matrix  $\mathbf{P}_{t(+)}$

$$\begin{aligned}\hat{\mathbf{x}}_{t(+)} &= \hat{\mathbf{x}}_{t(-)} + \mathbf{K}_t[\mathbf{z}_t - \mathbf{H}_t\hat{\mathbf{x}}_{t(-)}], \\ \mathbf{P}_{t(+)} &= \mathbf{P}_{t(-)} - \mathbf{K}_t\mathbf{H}_t\mathbf{P}_{t(-)}, \\ \mathbf{K}_t &= \mathbf{P}_{t(-)}\mathbf{H}_t^T[\mathbf{H}_t\mathbf{P}_{t(-)}\mathbf{H}_t^T + \mathbf{R}_t]^{-1}.\end{aligned}$$

A detailed derivation of the given equations of the Kalman filter can be found for example in (Grewal and Andrews 2015); more detailed presentation of the algorithm, its features and its theoretical assumptions is provided for example in (Grewal and Andrews 2015; Harvey 1989; Maybeck 1979; Simon 2006); practical aspects of the implementation of the filter are discussed for example in (Maybeck 1979; Simon 2006).

## 2.2. Models of the Relationship between the Forward Rate and the Future Spot Rate

### Regression model

The relationship between the forward rate and the future spot rate can be described by a regression model

$$s_{t+k} = \alpha + \beta f_t + \varepsilon_{t+k}, \quad (3)$$

where  $s_{t+k}$  denotes the spot rate at time  $t + k$  and  $f_t$  the forward rate quoted at time  $t$  with maturity at time  $t + k$ ,  $\varepsilon_{t+k}$  are random model residuals with zero mean. The coefficients  $\alpha$  and  $\beta$  can be estimated using the ordinary least squares method. The situation where  $\alpha = 0$  and  $\beta = 1$  corresponds to the validity of the UFRH; rational expectations and neutral risk are assumed.

Considering the (generally proven) exchange rate non-stationarity, it is appropriate to pay attention to testing the possible cointegration of the spot rate and the forward rate. Proving the cointegration then determines the appropriateness of using the model.

### Time-varying coefficient regression model

(Wolff 1987; Barnhart and Szakmary 1991; Bonga-Bonga 2008) suggest that the coefficient  $\beta$  varies over time so that the time-varying relationship between the forward rate and the future spot rate can be captured. This leads to the following model, the development of the values of the coefficient  $\beta$  is modeled as a random walk (Bonga-Bonga 2008)

$$s_{t+k} = \alpha + \beta_t f_t + \varepsilon_{t+k}, \quad (4)$$

$$\beta_t = \beta_{t-1} + \varepsilon_t. \quad (5)$$

Equation (5) can be viewed as the state equation ( $\beta$  represents the estimated state variable  $x$ ) and equation (4) as the measurement equation of the state-space model to which the Kalman filter can be applied as described in Section 2.1.

### Model with time-varying risk premium

(Wolff 2000; Bhar 2010) propose the idea that empirically proven deviations between the forward and the future spot rate consist of a risk premium  $p$  and random deviations  $\varepsilon$ . They suggest the following model, risk premium development is modeled as an AR(1) process (Wolff 2000)

$$s_{t+k} = f_t + p_{t+k} + \varepsilon_{t+k}, \quad (6)$$

$$p_t = \phi p_{t-1} + \xi_t. \quad (7)$$

Equation (7) represents the state equation ( $p$  is the estimated state variable  $x$ ) and equation (6) represents the measurement equation, the Kalman filter can be used to solve the task of estimating the risk premium.

### 3. Results and Discussion

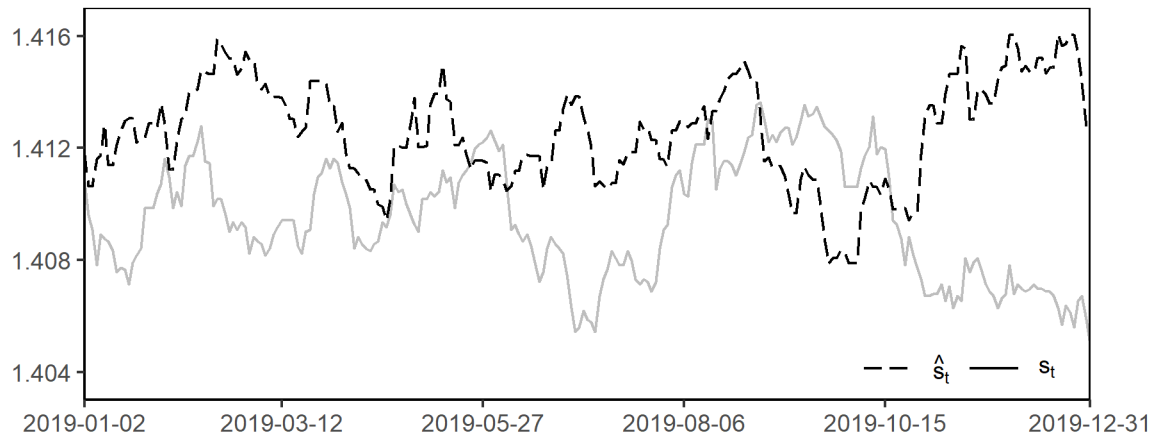
Data on spot and forward exchange rates for currency pairs EUR/CZK and USD/CZK were used for the empirical analysis. The data come from the website of the Czech National Bank. These are daily observations covering the period from 1 May 2001 to 31 December 2019, a total of 4,700 values (for each exchange rate). Forward rates are given in the form of forward points, which have been converted into exchange rate values for analysis purposes. Forward rates with a maturity of 3 months (90 days) and 6 months (180 days) are available. If in subsequent calculations the value of the exchange rate of a non-trading day was needed, it was replaced with the previous available value. All calculations were performed with the logarithms of the rates. Implementation was done using R.

By means of the augmented Dickey-Fuller unit root test, all the series of exchange rates were shown at the significance level of 5% to be non-stationary of type I(1). The Engle-Granger two-step method (Engle and Granger 1987) was used to assess the cointegration between the spot rate and the forward rate. For each pair of rates, coefficients of the regression model (3) were estimated by the ordinary least squares method. In all cases, the model residuals were stationary I(0), indicating cointegration. The relationship of cointegrated series can then be described by an error correction model, for example according to (Engle and Granger 1987) (the model is derived from the ADL(1, 1) model)

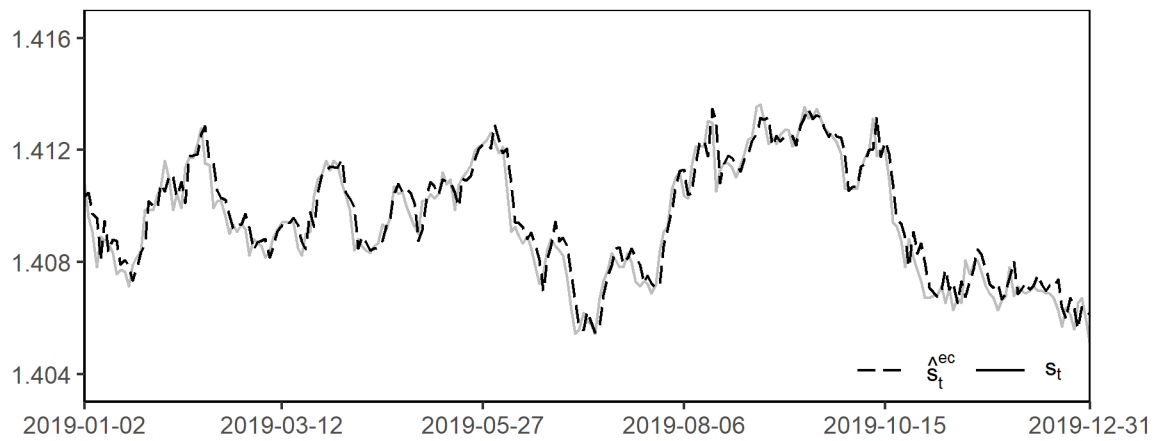
$$\Delta s_{t+k} = \alpha' + \gamma'(s_{t+k-1} - \beta' f_{t-1}) + \delta' \Delta f_t + \varepsilon'_{t+k}. \quad (8)$$

The model with time-varying coefficients and the model with time-varying risk premium were estimated using the Kalman filter. At the same time, the spot rate (one-step ahead) predictions were calculated. The residuals of all constructed models (except for the basic regression) have white noise properties.

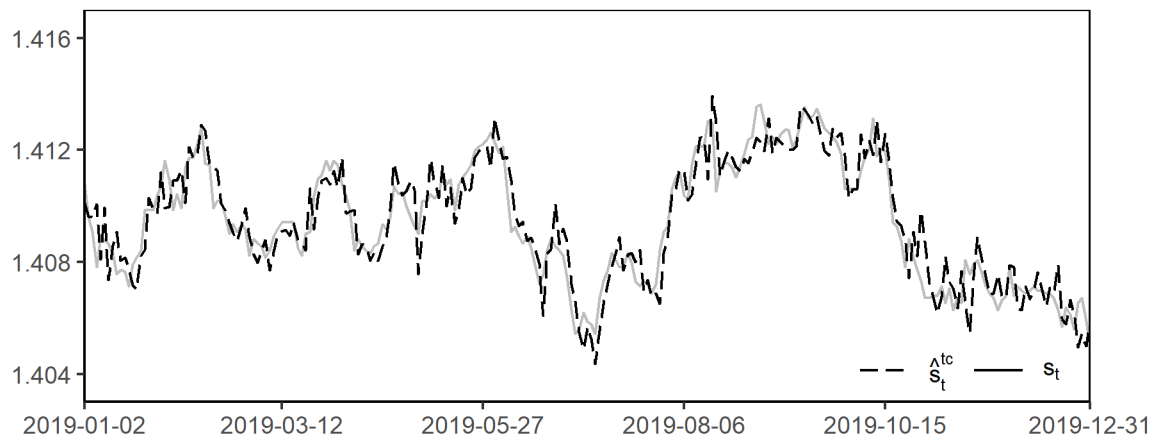
Figures 1-4 illustrate the comparison of the (logarithms of the) actual spot rate  $s_t$  and its estimates for the currency pair EUR/CZK using the forward rate with a maturity of 3 months for the period from 1 January 2019 to 31 December 2019. Figure 1 shows estimates according to the basic regression model  $\hat{s}_t$ , Figure 2 estimates according to the error correction model  $\hat{s}_t^{ec}$ , Figure 3 estimates according to the model with time-varying coefficients  $\hat{s}_t^{tc}$ , and Figure 4 estimates according to the model with time-varying risk premium  $\hat{s}_t^{rp}$ .



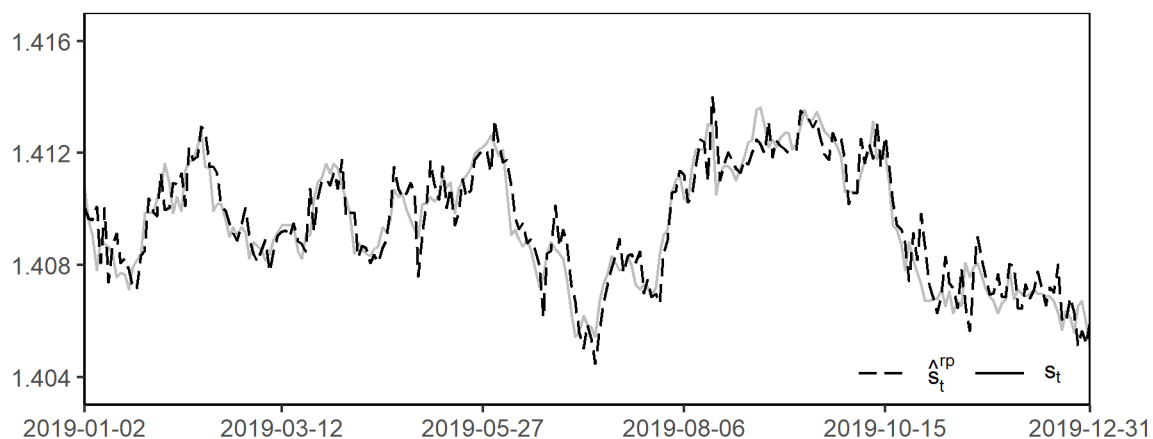
**Figure 1.** Spot rate and its estimates according to the basic regression model.



**Figure 2.** Spot rate and its estimates according to the error correction model.



**Figure 3.** Spot rate and its estimates according to the model with time-varying coefficients.



**Figure 4.** Spot rate and its estimates according to the model with time-varying risk premium.

The following descriptive statistics of the deviations of the predicted from the actual spot rate were calculated to assess the quality of the predictions: mean error (ME), mean absolute error (MAE), maximum absolute error (MAXAE), and root mean square error (RMSE). The results for both currency pairs and maturities of 3 and 6 months are shown in Table 1.

**Table 1.** Summary statistics of the predictive performance.

	ME	MAE	MAXAE	RMSE
<b>EUR/CZK, 3 months</b>				
Basic model	$8.39 \cdot 10^{-20}$	0.00783	0.06474	0.01102
Error correction model	$-1.35 \cdot 10^{-20}$	0.00097	0.01749	0.00154
Model with time-varying coefficients	$-3.26 \cdot 10^{-20}$	0.00141	0.01895	0.00216
Model with time-varying risk premium	$-3.25 \cdot 10^{-19}$	0.00140	0.01823	0.00215
<b>EUR/CZK, 6 months</b>				
Basic model	$2.06 \cdot 10^{-19}$	0.01096	0.07964	0.01542
Error correction model	$3.07 \cdot 10^{-21}$	0.00098	0.01756	0.00154
Model with time-varying coefficients	$-2.92 \cdot 10^{-20}$	0.00140	0.01790	0.00221
Model with time-varying risk premium	$-5.97 \cdot 10^{-19}$	0.00141	0.01809	0.00221
<b>USD/CZK, 3 months</b>				
Basic model	$3.48 \cdot 10^{-19}$	0.01925	0.11118	0.02478
Error correction model	$-5.50 \cdot 10^{-20}$	0.00227	0.02515	0.00315
Model with time-varying coefficients	$-1.16 \cdot 10^{-19}$	0.00318	0.03744	0.00444
Model with time-varying risk premium	$-5.10 \cdot 10^{-19}$	0.00318	0.03659	0.00442
<b>USD/CZK, 6 months</b>				
Basic model	$-2.82 \cdot 10^{-19}$	0.02647	0.13262	0.03448
Error correction model	$5.76 \cdot 10^{-21}$	0.00267	0.02513	0.00315
Model with time-varying coefficients	$-7.89 \cdot 10^{-20}$	0.00316	0.02859	0.00445
Model with time-varying risk premium	$-8.80 \cdot 10^{-19}$	0.00319	0.02846	0.00447

The table shows that the basic regression model based on the assumed equality between the forward and the future spot rate achieves the worst results. As can be seen from Figure 1, in some sub-periods the estimates are overvalued, in others the estimates are undervalued. The accuracy of the predictions of the model with time-varying coefficients and of the model with time-varying risk premium is very similar. The predictions constructed according to the error correction model are slightly more accurate. The mean error of all models does not significantly differ from zero; in the long term, the estimates are not systematically biased (however, in the case of the basic regression model, biases occur in partial periods, but on the whole these biases are compensated). In general, better

results are achieved for the currency pair EUR/CZK than for USD/CZK; the maturity period has no significant impact on the accuracy of the predictions (except for the basic regression).

#### 4. Conclusions

The paper dealt with the prediction of the future spot exchange rate on the basis of the forward rate and especially focused on the possibilities of using the Kalman filter in solving this task. Various models of the relationship between the spot and the forward rate were described and then their predictive performance was evaluated and compared using data on the rates of currency pairs EUR/CZK and USD/CZK. The basic model based on equality between the forward and the future spot rate cannot be considered appropriate according to the empirical results, the reason can be found in the possible invalidity of the theoretical assumptions of rational expectations and especially of neutral risk. This is the basis for other models that focus on describing the time-varying relationship of the rates. The model with time-varying coefficients, the model with time-varying risk premium, and the error correction model allow to use information on the deviations between the forward and the future spot rate and accordingly correct the basic estimates, enabling to achieve better predictive performance. The Kalman filter can be appropriately used to estimate the model coefficients and the risk premium.

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# Preferences in Local Taxes in Poland

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**Abstract:** The article is devoted to tax preferences applicable to local taxes in Poland. The scope of local taxes includes, in particular, property tax and vehicle tax. They result from one legal act and are paid into the municipal budget. Other taxes that flow into the same budget (but follow from other laws) are: agricultural tax and forestry tax. These taxes are undoubtedly of a local nature as they contribute to the budgets of local government units. The article focuses on the tax preferences resulting from these taxes. The main issue discussed was the issue of shaping tax rates and their reductions, introduction of exemptions from the collection of local taxes. Data for the research were obtained from reports on the execution of budgets of local government units. The research shows that real estate tax has the greatest fiscal significance and its construction has the most solutions related to tax preferences related to the tax rate and exemptions. It was subsequently pointed out that a tax on means of transport is an important tax from the point of view of tax concessions reducing the tax burden.

**Keywords:** local taxes; vehicle tax; property tax; forest tax; agricultural tax

**JEL Classification:** H2; H7; E6

## 1. Introduction

Local taxes are an important source of income for municipalities, which must pursue important public objectives at local level. Sometimes municipalities decide to introduce solutions to the construction of local taxes, which will also be aimed at achieving important economic goals. Such a solution may be various types of tax preferences, related to e.g.: reduction of the tax rate, exemption from tax of certain groups of taxpayers. Specific solutions are to exert desired changes in the local economy characterized by increased economic activity. This will translate into greater economic development of the region in the future. This article focuses on presenting the subject of local taxes in Poland and indicating the preferences we deal with in the practical implementation of tax obligations. They are different in nature as they can affect different types of taxable persons. In connection with the subject matter pursued, a hypothesis was put forward that the largest share of tax preferences to taxes collected occurs in the real estate tax, and then in the tax on means of transport, and they mainly determine the nature of the tax policy. In other taxes, i.e. tax preferences are of little importance. In order to verify the scientific hypothesis, the current literature on the subject referring to tax preferences and statistical data related to the applied tax reductions was reviewed. On this basis, the conclusions of the study were finally clarified.

## 2. The System of Local Taxes in Poland

In Poland, the system of local taxes that contribute to the budget of communes includes: (a) real estate tax, (b) tax on means of transport, (c) the agricultural tax, and (d) forestry tax.

*Real estate tax* on buildings or parts of buildings, structures or parts thereof intended for non-agricultural or forestry economic activities, or on land covered by these provisions. The basis for the property tax assessment is the usable floor area of buildings or parts thereof multiplied by the appropriate tax rate established by the municipal council. In case of structures, the tax is calculated as a product of 2% of the value of structures determined for depreciation purposes as at 1 January of the tax year or, in special cases, their market value. The amount of taxation in relation to land is the product of its area and the specific tax rate. The upper limits of the rates are set annually by the Minister of Finance, but municipalities have the possibility to reduce them. Some municipalities do not change the

statutory rates, which is undoubtedly not attractive for taxpayers because they cannot count on a tax reduction. The property tax liability in the real estate tax is imposed on natural persons, legal entities and organizational units without legal personality which are its owners, holders or managers. Real estate tax is the most efficient local tax, which is the reason why budgets receive the most money from this tax.

*Tax on means of transport*, applicable to lorries, trailers, semi-trailers, buses. The tax is paid by the owners of the means of transport. The Council of each municipality shall determine in a resolution the amount of the tax on means of transport, bearing in mind the principle that it may not exceed the limit specified in the Act. When setting the rates, the municipal council should take into account the type of measure, the cylinder capacity or engine power, the payload, the total weight and may also take into account the age or value of the means of transport.

*The agricultural tax* is paid by the owners of land belonging to the agricultural holding with a total area exceeding 1 ha. Land belonging to or owned or held by a natural or legal person is subject to agricultural tax. Land under lakes and flowing waters, constituting wastelands, entered in the property of historic monuments, occupied for economic activity other than agricultural activity, is excluded from taxation. The agricultural tax is the number of conversion hectares, which is determined on the basis of the area, types and classes of agricultural land resulting from the land register and inclusion in the tax district. The legislator established four tax districts, which include communes and towns, depending on economic, production and climatic conditions. The table contained in the Agricultural Tax Act specifies the conversion rates according to which the agricultural area expressed in hectares (physical hectares) is converted into conversion hectares. In order to calculate the tax, the relevant specific rate for 1 conversion hectare must be applied. Agricultural tax rates are annual specific rates determined by dividing 1 conversion hectare by the price of 2.5 quintals of rye calculated according to the average purchase price of rye for the first 3 quarters of the year preceding the tax year.

Conversion of agricultural tax rates, which take into account the above mentioned criteria, is presented in the table 1 below.

**Table 1.** Scale of agricultural tax.

Types of agricultural area	Arable land				Meadows and pastures				
	Tax districts	I	II	III	IV	I	II	III	IV
Class of agricultural area	Conversion factors								
I	1.95	1.80	1.65	1.45	1.75	1.60	1.45	1.35	
II	1.80	1.65	1.50	1.35	1.45	1.35	1.25	1.10	
III a	1.65	1.50	1.40	1.25					
III					1.25	1.15	1.05	0.95	
III b	1.35	1.25	1.15	1.00					
IV a	1.10	1.00	0.90	0.80					
IV					0.75	0.70	0.60	0.55	
IV b	0.80	0.75	0.65	0.60					
V	0.35	0.30	0.25	0.20	0.20	0.20	0.15	0.15	
VI	0.20	0.15	0.10	0.05	0.15	0.15	0.10	0.05	

Source: Agricultural Tax Act.

*Forestry tax* - all forests are subject to forestry tax except forests not related to forest management, occupied by recreational centers, building and recreation plots and excluded by administrative decisions from forest management for purposes other than forestry. Forests not subject to forest tax are subject to property tax. The tax obligation with respect to forestry tax is imposed on natural persons, legal persons, and organizational units without legal personality, which are the owners. Forests with stands up to 40 years old, forests included in nature reserves and national parks, protective forests and forests entered in the register of monuments are obligatorily exempt from taxation. The structure of the tax base is complex. These are the number of conversion hectares

determined on the basis of the area of the main tree species in the stand and the grading classes. The table contained in the Forest Act contains forest area conversion factors expressed in physical hectares per conversion hectare, taking into account tree species in stands and stand classification. The forest tax from 1 conversion ha for the tax year amounts to the monetary equivalent of 0.200 m<sup>3</sup> of coniferous sawmill wood, calculated according to the average sales price of wood obtained by the forest inspectorates for the first three quarters of the year preceding the tax year. The average selling price of coniferous sawn timber is determined on the basis of the announcement of the President of the Central Statistical Office, which is announced within 20 days after the end of the third quarter. For protective forests, forests belonging to nature reserves and national parks, and forests for which no forest management plan or simplified forest management plan has been drawn up, the forest tax for the fiscal year is the monetary equivalent of 0.3 q rye per 1 ha of physical forest and forest land, determined on the basis of the land register.

The taxes presented above are the main tax revenues of the municipalities' budgets. Their fiscal performance varies. The highest income usually comes from property tax, which is due to a very large tax base. The lowest tax revenue comes from the forest tax, which is due to the small number of forests. The presented taxes are subject to various tax exemptions and discounts, which will be presented in the next part of the article.

### **3. The Concept and Scope of Tax Preferences**

Tax preferences are a kind of tax advantage that is provided for in the tax laws of a country. For taxpayers, they are certain solutions that allow to reduce the tax burden or shift the tax assessment and collection to a period convenient for the taxpayer (Tegler 1998).

The notion of tax preferences refers to all legally binding elements allowing to reduce the tax burden. Such solutions do not have to be targeted at all taxpayers. They can only be used by a narrow group of taxpayers. A state with unlimited tax authority may introduce various types of tax solutions only to a specific group of entities, e. g. a company with unlimited tax authority. In order to develop a particular industry. Offering tax reductions by the state can even be treated as a kind of subsidy to the taxpayer (Tipke 1998). These tax preferences are part of the applicable tax policy. As a tool for economic impact, they refer to the impact on social and social objectives. If taxpayers use solutions to help them reduce their taxes, they can become more loyal to the state (Lamberton, De Neve, and Norton 2014).

According to the norms of the OECD organization, a tax preference is a transfer of public funds made as a result of a reduction in tax liability in relation to the adopted tax standard (OECD). The tax arrangements in place that result in a tax reduction are undoubtedly a tax preference. Among them we can observe: tax reliefs and deductions and tax exemptions. Relief and deduction allows you to reduce the tribute in a certain proportion. The tax exemption, on the other hand, refers to the exclusion of given tax sources or entities from taxation. In the Polish Act of 1997, the Tax Ordinance, which constitutes the backbone of the tax system, stipulates that: tax relief is understood as exemptions, deductions, reductions or reductions provided for in the tax law, the application of which results in a reduction of the tax base or the amount of tax with the exception of a reduction of the amount of output tax by the amount of input tax, within the meaning of the VAT regulations, and other deductions constituting an element of the tax structure (the Tax Ordinance).

The above-mentioned definitions (OECD and Tax Ordinance) correspond to each other, however, the former is much broader than the Polish statutory definition. As it was rightly noted in Report No. 7 on Tax Preferences in Poland prepared by the Ministry of Finance in Poland in 2016 that tax preferences are an alternative to direct budget transfers. The difference is, in fact, that spending money from the state budget involves two stages: receiving money and spending it - in the case of tax preferences, the revenue is immediately consumed. The Polish economic reality shows that tax preferences are most noticeable in direct taxes, e. g. income taxes. They play a lesser role in indirect taxes. Polish tax services are trying to monitor the situation with regard to tax preferences by calculating the amount of revenue foregone in the budget.

**Table 2.** Tax preferences in Poland in the years 2009-2015 – PLN.

	2009	2010	2011	2012	2013	2014	2015
<b>Value of Preferences in mln</b>	59.517	67.241	72.041	73.795	76.945	79.777	82.710
<b>Preferences % GDP</b>	4.43	4.75	4.72	4.63	4.70	4.61	4.60

Source: Report no 7 *Preferencje podatkowe w Polsce w latach 2009-2015*, Ministry of Finance 2018 r. <https://www.podatki.gov.pl/media/1221/preferencje-podatkowe-w-polsce-nr-7.pdf>

The table below shows that the value of tax preferences in Poland in the years 2009-2015 was steadily increasing. Within seven years it has increased by over 20 billion PLN. The value of the applied preferences in relation to GDP did not show a high fluctuation. In the last two years under review, it has been almost unchanged and stands at around 4.6% of GDP.

#### 4. Tax Preferences in Local Taxes

Exemptions from the real estate tax for the benefit of local taxpayers are at the forefront of the statutory regulations on local taxes:

- real estate or parts thereof occupied for the needs of local government authorities and administration,
- on condition of reciprocity - real estate owned by foreign countries or international organizations or transferred to them for perpetual usufruct, intended for the seats of diplomatic representations, consular posts and other missions enjoying privileges and immunities in accordance with international laws, agreements or customs,
- public road structures and land occupied by public roads, including road lanes,
- buildings used exclusively for public rail transport and land occupied by them,
- port infrastructure structures, infrastructure structures providing access to, and land occupied by, ports and marinas,
- land under running water and navigable canals, with the exception of lakes and land occupied by reservoirs or hydroelectric power stations,
- farm buildings or parts of farm buildings connected with forestry activities, occupied by special sections of agricultural production and agricultural holdings within the meaning of the provisions on agricultural tax, farm buildings or parts of farm buildings connected with agricultural activities,
- real estate or parts thereof occupied for the needs of statutory activity of the associations among children and youth in the field of education, upbringing, science and technology, physical culture and sport, with the exception of those used for business activity, and land permanently occupied for camps and holiday bases for children and youth,
- buildings and land entered individually in the register of monuments, provided that they are maintained and maintained in accordance with the provisions on the protection of monuments, with the exception of parts occupied for economic activities,
- buildings and land owned by registered museums,
- real estate or parts thereof exempt from real estate tax pursuant to separate acts, buildings and structures newly built or modernised, put into use, used by the group for its statutory activity, after obtaining an entry of the group in the register of groups - within 5 years from the date of obtaining an entry of the group in the register.

Other exemptions may be decided by the commune within the framework of a resolution. A very common solution applied by communes is exemption from real estate tax for entrepreneurs who conduct their business activity within special economic zones. Currently, 14 zones operate in Poland, offering various solutions. Among the exemptions from real estate tax there are also author's solutions in communes directed only and exclusively for a specific type of entrepreneurs. An example is the

commune of Radymno in the south of Poland, which offers a property tax exemption for business entities, but only after a strictly specified investment (real estate construction) has been completed in the commune. The entrepreneur must therefore submit an appropriate application in order to obtain the exemption. The length of the period during which the entrepreneur does not pay the means of transport tax is: (a) one year, if the value of the new investment is at least PLN 100,000; (b) two years, if the value of the new investment is at least PLN 300,000; (c) three years, if the value of the new investment is at least PLN 500,000 and the tax-exempt entity will conduct business activity for a period of 6 years under pain of losing the right to exemption for the entire period during which it benefited from the exemption.

In turn, the City of Wrocław and the Municipality of Wrocław provided for an exemption from property tax. The rules of the exemptions stipulate that for every created workplace connected with a new investment in Wrocław, a property tax exemption is granted for 60 m<sup>2</sup> of buildings or parts of buildings occupied for business activity. The exemption period is 12 months if up to two jobs are created. The exemption can be extended by 6 months if another job is created. Taxpayers are obliged to maintain newly created jobs in Wrocław, at least 3 years from the date of filling the first position (small and medium enterprises), and 5 years in the case of large enterprises. With regard to property tax and vehicle tax, municipalities mostly adopt specific tax rates that are lower than the upper limit set in the Act. This can also be considered as some kind of tax relief related to the reduction of tax liability.

As regards the tax on means of transport, the law regulating the tax provides for an exemption from the payment of this tax for the means of transport:

- means of transport (subject to reciprocity) owned by diplomatic representations, consular posts and other foreign missions, enjoying privileges and immunities pursuant to international laws, agreements or customs, and members of their staff, as well as other persons equal to them, if they are not Polish citizens and do not have a permanent residence in the territory of the Republic of Poland;
- means of transport constituting mobilization reserves, special vehicles and vehicles used for special purposes within the meaning of the road traffic regulations;
- historic vehicles, within the meaning of road traffic regulations.

Exemptions are also provided for in the agricultural tax for:

- the agricultural area of class V, VI and VIz and the wooded and shrubby areas established on the agricultural area, (b) farmland resulting from the use of uncultivated land - for a period of 5 years, counting from the year following the end of the use of the land;
- land occupied by water reservoirs used for supplying water to the population;
- land under flood embankments and land located in embankments;
- higher education institutions, public and non-public organizational units covered by the education system and the bodies running them, within the scope of land occupied for educational activity;
- entrepreneurs with the status of a research and development centre obtained on the basis of the principles specified in the provisions on certain forms of supporting innovative activity in relation to the objects of taxation seized for the purposes of conducted research and development works. Agricultural taxpayers are also granted investment relief, which is subject to deduction of 25% of investment expenditure from the agricultural tax due on land located in the commune in which the investment was made. Investment relief is granted in connection with expenses incurred for the construction and modernization of livestock buildings used for breeding and maintenance of farm animals and environmental protection facilities.

The latest forestry tax provides for exemptions from the payment of this tax in the following cases: woods with stands up to 40 years old; forests entered individually into the register of monuments; and organic land.

The economic literature shows that municipalities applying tax preferences make the most of tax rate reductions. The authors of the studies by Galiński, Felis, Wołowiec, Skica, Kiebała, Świaniewicz also point to the second solution in the field of tax preferences, i. e. the tax preference of the Republic of Poland (Galiński 2016; Felis 2017; Świaniewicz 2016; Wołowiec, Skica, and Kiebała 2011).

**Table 3.** The effects of reliefs and exemptions in taxes granted by the municipalities in 2016 in thousand PLN.

Specification	Tax revenue	Reduction of upper tax rates	Reliefs and exemption	Indicator in % (3+4) :2
1	2	3	4	5
<b>Agricultural tax</b>				
2016	1 513 458	138 032	1 335	9.21%
2017	1 463 712	115 467	1 340	7.98%
2018	1 460 549	110 443	1 192	7.64%
<b>Property tax</b>				
2016	20 774 468	2 095 574	711 844	13.51%
2017	13 372 486	1 811 822	598 058	18.02%
2018	13 800 359	1 962 369	611 119	18.65%
<b>Forest tax</b>				
2016	295 943	2 141	502	0.89%
2017	290 433	1 453	563	0.69%
2018	299 590	1 527	529	0.69%
<b>Vehicle tax</b>				
2016	1 055 224	763 031	3 893	72.68%
2017	752 497	587 367	6 645	78.94%
2018	785 621	701 849	2 074	89.60%

Source: Information on the execution of budgets of local government units for 2016-2018, [www.mf.gov.pl](http://www.mf.gov.pl)

The data presented in Table 3 show that the highest revenues of the commune in 2016-2018 were obtained from property tax, agricultural tax, and then from the tax on means of transport and forestry tax. The greatest tax preferences in all taxes resulted from the reduction of the upper tax rates that were provided for in the relevant legal acts. Reliefs and exemptions from these taxes played a much smaller role. In the course of the study, the value of the allowances and exemptions granted, the amount of taxes resulting from the reduction of the upper tax rates by the municipal councils were compared with the sum of tax revenues from each tax. The calculation of the indicator shows that the highest level of tax preference was given to the vehicle tax, as it ranged from 72.68% (2016) to 89.60% (2018) during the period considered.

The second place according to the calculated index was taken by the real estate tax. The preferences applied reached 13.51% (2016) of the receipts during the period considered up to 18.65% (2018). It follows from the above that municipal councils with the possibility to reduce tax rates were much more willing to do so in the area of tax on means of transport than in the area of property tax. There are known in Poland communes, which even encouraged to conduct business activity and establish a company's seat on their territory. The most frequent incentives were exemptions from the obligation to pay tax on means of transport.

The last of the analyzed tributes, i.e. agricultural and forestry taxes had the lowest tax preferences in 2016-2018. In the case of the agricultural tax, they stood at 7.64% (2018) and 9.21% (2016) of the receipts recorded. Since the beginning of 2016, the value of the applied tax preferences has been gradually decreasing. As far as forestry tax is concerned, the value of the preferences during the period considered never exceeded 1% of the income from forestry tax.

After the verification of statistical data, we can state that the municipalities applied tax policy aimed at the application of tax preferences, which was most visible in the tax on means of transport and in the tax on real estate. It had a much smaller impact on agricultural tax and forestry tax.

## 5. Conclusions

The presented topic of tax preferences in local taxes in Poland is undoubtedly important from the point of view of local economy observed in the communes. Tax solutions aimed at reducing the tax burden contribute to local economic development. The hypothesis put forward at the beginning has not been confirmed. The verification of the statistical data established that the greatest tax preferences with regard to tax revenue are in the tax on means of transport and then in the tax on real estate. It follows from the above that local authorities attach great importance to the existence of tools to reduce taxes due. Although the hypothesis was verified negatively, the established state of functioning of tax preferences in local taxes is favorable for the development of community in Poland.

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# Goals of Elites and Local Communities in the European Union Neo-endogenous Development: Differences as the Constraints on Europeanisation?

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**Abstract:** Financial support for the Local Action Groups (territorial partnerships for local development, LAGs) is an element of the European Union (EU) place-based policy, which seeks to strengthen social participation in local governance with simultaneous consideration of the goals set by the EU development strategies. However, the neo-endogenous development is mostly based on local goals and needs, which are not always fully in line with the objectives of the EU governing elites. This paper addresses the hypothesis that the difficulties in the EU objectives implementation arise, among other reasons, from the differences between the goals, priorities, needs and knowledge of both the local communities and the governing elites. Neo-endogenous development attempts to overcome this problem by supporting local activities which are in line with the objectives of the EU policy. This paper presents the considerations based on the literature review supported by the archival data from the questionnaire survey performed in three LAGs case studies, as well as the analysis of their Local Development Strategies.

**Keywords:** territorial governance; neo-endogenous development; local communities' needs; governing elite's goals; Local Action Groups; Europeanisation

**JEL Classification:** L3; O15; P2

## 1. Introduction

In recent decades, an important feature of development policies in the European Union has been the growing importance of territorial governance structures, taking into account the principles of neo-endogenous and place-based development (Ray 2006; Słupińska 2013; Boukalova et al. 2016; Furmankiewicz and Campbell 2019). It was a response to the limitations of the top-down exogenous development typical for the mid-20th century, which in many aspects was ineffective in addressing the local socio-economic problems. The territorial partnership governance concept emphasizes the role of local needs, bottom-up initiatives, social activity and wider public participation in managing local resources (Shucksmith 2000; Adamski and Górlach 2007). The EU LEADER initiative based partnerships, referred to as "Local Action Groups" (LAGs), are the main implementation tool for this type of governance in rural areas and have been widely discussed in the literature. They currently operate under the so-called Community-Led Local Development framework (Servillo and De Bruijn 2018), which emphasizes the participation of local residents in both local development strategies planning and implementation (Furmankiewicz et al. 2015; Chmieliński et al. 2018; Müller et al. 2020). This model of local resources management is implemented in all EU countries. According to Ray (2006) this approach has two primary characteristics: firstly, the valorisation and exploitation of physical and human local resources are used to maximize the benefits within the local territory; secondly, the principle and process of local participation in designing and implementing action are emphasized and the focus on local needs, capacities and perspectives of local people is highlighted. However, the EU support acts as an incentive for the local strategy makers to include the objectives of both the EU and the national rural development programmes. It is a feature peculiar to the place-

based or neo-endogenous development concepts (Böcher 2008; Furmankiewicz 2012; Bowden and Liddle 2018).

The idea of partnerships involves the shift of public policy towards the re-positioning of local authorities as facilitators, rather than suppliers in meeting the local needs (Yarwood 2002). In contrast to ideal assumptions of the Community-Led Local Development and LEADER “inclusive” territorial governance (European Commission 2006, 2014), the subject literature offers a significant amount of information about the cases of ‘governance failures’, ‘social exclusion’ or ineffective local projects (European Court of Auditors 2010). Researchers have found the community participation as quite often contested or problematic (Edwards 1998; Jones and Little 2000). LAGs are sometimes dominated by the public sector, whereas the community interest remains on the margins of power (Furmankiewicz and Macken-Walsh 2016). However, many territorial partnerships achieve significant levels of social participation and success in local development (Petrick and Gramzow 2012).

On the one hand, the frequently elite-oriented nature of LAGs’ management boards is a well-known fact (Thuesen 2010), but on the other, in both many formal documents as well as research findings the key personnel of partnerships emphasizes their attempts to activate local people in conformity with the EU programming documents. They also observe small involvement of local residents. The typical explanation of these processes is due to the role of human and physical resources at the elites’ disposal and their tendency to maintain own profitable domination (Lowndes and Sullivan 2004).

While the majority of authors focus on social capital or power relations between the stakeholders involved in LAGs, this paper attempts to discuss the role of needs and goals of both local residents and governing elites in the neo-endogenous development. It has been suggested that the achievement of specific EU objectives is often constrained by the differences between the goals of typical local residents and the aims of elites, resulting from their knowledge and/or interest. It has also been partly explained why, when even LAGs’ board members make efforts to engage local residents in the partnerships activities, all they face is social indifference and passivity.

## **2. The Role of Community Needs in Neo-endogenous Rural Development**

Cross-sectoral partnerships, e.g., LEADER type Local Action Groups, are considered to be an important tool to improve both governance and local citizens’ participation in managing local resources in rural areas of European Union. They seek to improve policy co-ordination and adaptation to local conditions, which results in better utilization and targeting of programmes, integrates the civil society concerns into strategic planning carried out through more widespread participatory democracy, stimulates corporate involvement in local projects and promotes greater satisfaction with public policies. Among several main features of the LEADER type programmes listed in the literature (territorial approach, networking and cooperation, integrated and multi-sectoral actions, innovation promotion, public-private partnership) the most distinctive one is the bottom-up approach (European Commission, 2006, 2014). Local partnerships should create community-based strategies reflecting the resources and needs of local communities on the coherent territory, however, they should also show the conformity of local goals and actions with the national rural development programme based on the EU objectives, what can be considered as a conscious stimulation of the process of “Europeanization” (promotion of the convergence in economic rules, regulation, and policies in EU countries). According to the idea of the LEADER type programmes (e.g. the Community-Led Local Development), a partnership is developed and managed by the representatives of local communities originating from the public, voluntary and private sector, which should result in better management efficiency of local resources, thus constituting an important issue for the local government (Babczuk et al. 2017).

The view about positive outcomes of the local cross-sectoral cooperation in horizontal networks derives from the influential economic models presenting the advantages (benefits) of group efforts. The important background is provided by the second-generation models of rational choice theory which, after some modifications, offer empirical support for the explanation of human behaviour in a

broad spectrum of substantive areas in sociology and political sciences (Hechter and Kanazawa 1997; Ostrom 1998). The new models emphasize rationality, both economic (goods or financial profit) and psychological (fulfilling individual needs such as satisfaction, respect of other people, etc.), as the factor implying a benefit-oriented behaviour. A rational choice is not based on logical reasoning alone. It is also influenced by an individual bias or schemas and can be modified in social interaction. The formal institutions (i.e. state administrative structures, law) and the informal ones (i.e. beliefs or local social norms) have a significant impact on the individual behaviour. Following the general opinion, people work most commonly to meet their individual needs, therefore the theories assuming the hierarchy of human needs could be used to explain the choices made.

Maslov's hierarchy of needs (Maslov 1943) represents the classical approach in behavioural sciences. It is often presented as a pyramid, with the largest and most fundamental levels of needs at the bottom (immediate physiological needs, safety, love) and the need for esteem and self-actualization at the top. This idea was criticized as ethnocentric (derived from the observation of an individualistic society), with an incorrect hierarchy, as assumed only rather than existing in reality. Kenrick et al. (2010) proposed an updated and revised hierarchy of human motives based on the theoretical and empirical developments at the interface of evolutionary biology, anthropology, and psychology. This hierarchy starts with the most important, for an individual, immediate physiological needs, through self-protection, affiliation, status/esteem, mate acquisition and retention, ending up with parenting. These needs are not met in a hierarchical order, but rather in an overlapping manner. It reflects the assumption that the early developing motives are unlikely to be totally replaced by later goals, but instead continue to be important throughout life, depending on individual differences and proximate ecological cues. The individual actions aimed at fulfilling one's own needs are influenced by knowledge and beliefs, which lead to the concept of constructivism. Constructivism is a theory of knowledge (epistemology) arguing that humans generate knowledge and meaning from an interaction between their experiences and ideas. It could also be referred to as the systems of knowledge schemas, which have a significant impact on human decisions. Following to this approach, ideas, identity and individual beliefs influence government leaders, businessmen and other local activists, playing a strong role in defining their interests (Halabi 2004).

According to Ostrom (1998) reputation, reciprocity and trust represent the core social relationships having a significant impact on the level of cooperation and finally on the common benefits. The role of trust is often analysed in terms of partnership governance, primarily in the context of government-third sector relations. Walsh (1998) emphasized that the local government in Ireland was mainly responsible for the physical development, when local partnerships were focused on socio-economic development, paying little attention to physical issues, which can lead to the conflict of interests. The negative result of incompatible stakeholders' goals was observed especially in the case of conflicts in spatial planning and investment localisation, most commonly between the local government, local communities and non-government organisations (Dubel and Królikowska 2014, Furmankiewicz et al. 2019). The public officials often advocate a narrow concept of development, focusing mainly on economic efficiency and ignoring the aspect of sustainability, participation and social needs (Dobbs and Moore 2002; Stanek 2016). In management practice, there are negative cases in which the potential of given territorial units is used very inefficiently by the local governments (Przybyła et al. 2020). These problems, to a lesser extent, also appear in the Local Action Groups. The differences of goals set by the central government and the local community constituted an important problem identified in exogenous development. In theory, bottom-up and cooperative approach used in neo-endogenous LEADER method (and Community-Led Local Development) should overcome that problem, however, power tensions described in literature also show the importance of conflicts of local stakeholder interests (Reed 1995). The authors of the paper intend to provide additional data to the debate on the role of differences in the needs and priorities of local stakeholders in the European Union development policy implementation at the local level.

### 3. Materials and Methods

The discussion covering the consistency of goals set by the European Union, LAGs' governing elites and local residents is based on archival data from the questionnaire survey carried out in the years 2006-2007, and additional data about LAGs' main targets from 2011 and 2018 (conducted in 2012 and 2019, Table 1). The compared data were collected in different projects, therefore they do not have identical methodological features (e.g. analysed categories of goals). However, they allowed pre-comparing the main development priorities of different stakeholders, which can be useful in designing more detailed future research based on the standardised methodology. Some data was used in a different research conducted by the authors (Furmankiewicz and Królikowska 2010, Furmankiewicz and Campbell 2019), however, in this study the analysis is extended by collecting current data about the studied partnerships retrieved from their development strategies and official websites.

**Table 1.** Basic information on the archival and current data used in the paper.

Data accuracy	Year of data collection	Methods used	Partly analysed in:
2006	2006-2007	- questionnaire survey addressed to local residents in three case study partnerships - questionnaire survey covering the key partnership members in three case study partnerships	Furmankiewicz and Królikowska 2010 (only in Polish)
2011	2012	- the content analysis of local development strategies of 336 LAGs	Furmankiewicz and Campbell, 2019
2018	2019	- the content analysis of local development strategies of 314 LAGs - the content analysis of national and case study partnerships documents valid for 2014-2020 UE Programming Period	Furmankiewicz and Campbell, 2019; New data

We focused on the three case study partnerships in Poland, presenting a relatively stable status in the period 2005-2019 (Table 2):

- "Leader of Strug Valley" LAG (in the paper referred to as the Strug Partnership), the case of cooperation established in mid-90s,
- "Odra River Riparian Land" LAG (formerly: Middle Odra River Partnership, in the paper – the Odra Partnership), the case of partnership initiated in the years 2000-2002 and supported by the US financial resources,
- "Pilica Valley" LAG (in the paper – the Pilica Partnership), the case of the youngest organisation established with the support of the LEADER Pilot Programme in years 2005-2006.

All three researched partnerships received funding from the Rural Development Programme in the European Union Programming Period 2007-2013 (4rd LEADER Axis) and in the Programming Period 2014-2020 (Community-Led Local Development).

We used archival data from the semi-structured in-depth interview method in all case study partnerships. In the years 2006-2007 the key representatives of local organisations in each LAG were interviewed in the study (N1=8 in Pilica Partnership; N2=15 in Strug Partnership, and N3=20 in Odra Partnership, the total of 43 interviews). The interviews consisted of open-ended and closed questions about the main targets of partnership members (so, according to them, what goals and actions should be carried out in the course of partnership work). The methodology based on interviews with the representatives of LAGs members or boards of directors is similar to the one used in the research of LAGs carried out by other authors in several case studies (Davies 2002; Nardone et al. 2010).

At the same time the authors conducted a questionnaire survey with the residents of rural areas on LAG territory. Its aim was to find out if the local needs are consistent with the goals of

partnership leaders. The question about goals and actions used the same categories as in the questionnaires addressed to the LAGs boards' members. Due to budget constraints a quota sample N=200 (96 in Odra Partnership, 53 in Strug Partnership and 51 in Pilica Partnership) was used. The survey was conducted in the randomly selected village administrative units ("sołectwo"), max. 5 respondents in a unit. The individuals were selected to represent same gender and age share in a sample as in the complete LAG rural population (according to the data from the Statistics Poland). This is not a random sample (thus, it is not a representative sample), however, it provides satisfying results in the low budget exploratory studies (Babbie 2011).

**Table 2.** Basic information about case study partnerships.

Feature	STRUG	ODRA	PILICA
Year of establishment of cross-sectoral co-operation (first agreement)	1994	2002	2006
Year of LAG registration	2006	2005	2006
Number of member municipalities	2007	4	10
	2011	4	12
	2015	4	15
Number of members	2007	30	21
	2011	36	40
	2015	46	79
Area in square km (2019)	276	1,880	2,091
Number of residents (2013)	36,028	124,957	111,791

We also used the data from LAGs strategies valid for the EU 2007-2013 Programming Period (N=336 analysed LAGs, funded by the Rural Development Programme Axis 4) and for 2004-2020 (N=314 analysed LAGs, funded either by the Rural Development Programme or by the Operational Programme "Fisheries"). The authors analysed the content of formal strategic documents ("social artefacts"). This methodology is often used in the studies on policy implementation at various administrative levels (regional, national, European) and also in social sciences (Babbie 2011; Boukalova et al. 2016; Krajewski and Solecka 2019).

#### 4. Results: Comparison of Goals

The EUROPE 2020 strategy identified five main targets to enhance growth and employment in the years 2010-2020 (European Commission 2010), which can be summarized as follows:

To increase the employment rate of the population aged 20–64 to min. 75%.

To increase investments to min. 3% of the EU GDP in the "Research and Development", mainly by improving the conditions for these investments in the private sector and develop a new indicator to track innovation.

To reduce greenhouse gas emissions by at least 20% compared to 1990 levels, to achieve min. 20% share of renewable energy in final energy consumption and min. 20% increase in energy efficiency.

To reduce the share of early school leavers to 10% and increase the share of population aged 30–34 having completed the tertiary education to at least 40%.

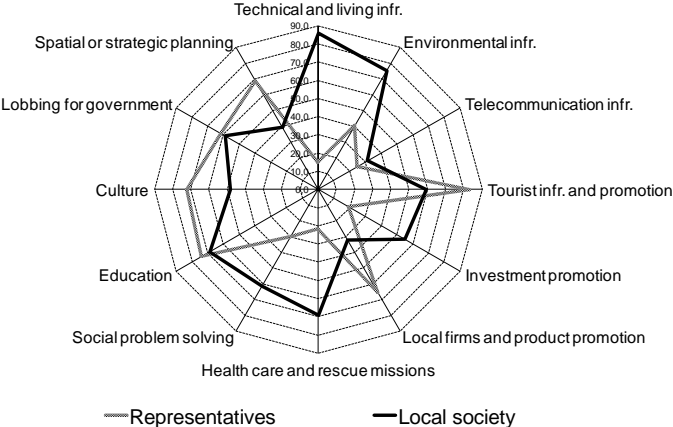
To decrease the number of Europeans living below the national poverty level by 25% and lift 20 million people out of poverty.

These goals were transferred indirectly to Polish Rural Development Programme 2014-2020 (RDP), which supports the Local Action Groups. The specific priorities to be taken into account in all national RDPs were specified in Article 5 of the EU Regulation No 1305/2013: "1. Fostering knowledge transfer and innovation in agriculture, forestry, and rural areas; 2. Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests; 3. Promoting food chain organisation,

including processing and marketing of agricultural products, animal welfare and risk management in agriculture; 4. Restoring, preserving and enhancing ecosystems related to agriculture and forestry; 5. Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors; 6. Promoting social inclusion, poverty reduction and economic development in rural areas". These priorities include the total of 18 detailed objectives. Polish RDP set out 12 of its own development "needs" (Ministry of Agriculture and Rural Development, 2019), which are to meet the total of 18 specific objectives from the Regulation 1305/2013 and 3 cross-cutting objectives (environment; mitigation and adaptation to climate change; innovations). According to the authors, Polish RDP document is highly specialized and may not be easily understood by an average resident of rural areas participating in the local strategy preparation. It may even be difficult to understand clearly what goals are to be achieved (12 national "needs", 6 EU "priorities" with 18 "specific objectives" or/and 3 "cross-cutting objectives"?). As a result, local residents could have a problem adjusting their documents to the recommendations of this overarching programme, even if they planned to do so. The main goals of the Europe 2020 strategy are much more explicit and also more specific to every reader.

Each LAG, while developing their strategies, had to show that local activities are consistent with the objectives of the overarching national support programme, which is one of the features of the neo-endogenous and place-based development (Van Depoele 2003; Böcher 2008; Furmankiewicz 2012; Bosworth et al. 2016). It should be remembered, however, that partnerships do not take over the local governments' competencies in the field of public services and the development of local infrastructure. They are rather oriented towards additional activities, incurring much lower costs, where attention is paid to the projects stimulating local communities, including local small entrepreneurs and the third sector. However, according to the procedures of the supporting programme, these small projects, meeting local needs, should take into account the paramount objectives, indirectly resulting from the EU development objectives.

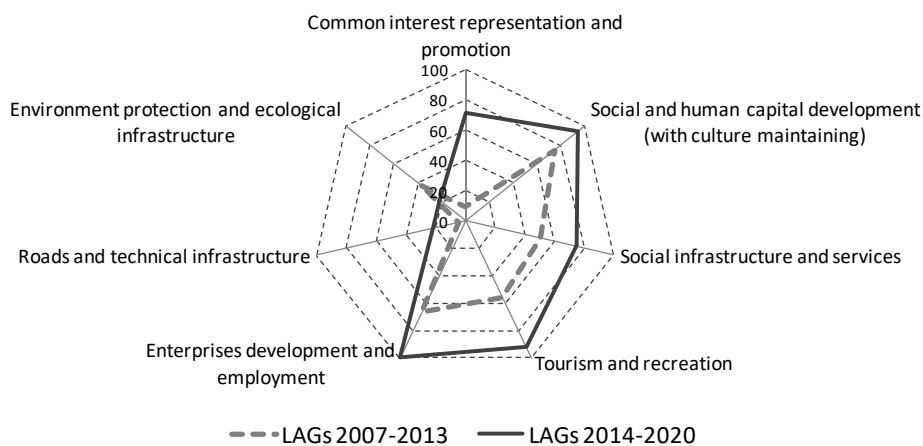
In the research conducted before the EUROPE 2010-2020 strategy period, the authors found significant differences between the main activities carried out by the institutional members of partnerships and the local residents' needs in three case study partnerships (Figure 1). For the local residents of rural areas technical and living infrastructure (roads, water and gas networks) were the most important, whereas partnerships typically do not perform this kind of tasks (however, in some partnerships municipal investments were sometimes taken into account in strategies). Similarly, the significant differences were observed in the categories of environmental infrastructure (sewerage networks, sewage treatment plants, waste management) and "health and rescue missions" (it also covers public health care) and "social problems solving".



**Figure 1.** The issues important for partnerships' institutions representatives ("Representatives") and for the local residents ("Local society") in three case studies of partnership before the Europe 2020 strategy period. The sum of the answers "very important" and "important" in the percentage of all answers (statistical mean value).

The residents focused predominantly on biophysical needs (health, technical comfort of leaving). Partnerships operated as a kind of local development agencies, mainly supporting the technical and productive needs (tourism development, local business development etc.). The governing elites in partnerships highly assessed the promotion of local products. It was an important goal for almost half of administrative units in the case study of partnerships, whereas only 9% of residents considered it important. The elites were more interested in economic development related to entrepreneurship or farming activities and the development of products and services for both local and external actors. This seems to be reasonable and in line with the EU strategy, however, it was not of a major importance for a typical local resident. On the contrary, solving social problems (such as e.g. poverty and social exclusion, very important issues in the EU) were important for the local communities and less significant for the elite managing partnerships. Perhaps they assumed that the development of entrepreneurship and employment growth would automatically contribute to the reduction of social problems (poverty, social exclusion). This may be an important reason for the failure of the partnership to improve the involvement of the local community in the work of the partnership, almost as important as the power relations resulting in the dominance of local governments. Local residents do not engage in the activities considered unimportant for the community reality. In turn, it is difficult to achieve welfare in rural areas by meeting only the typical needs connected with the living conditions or health care issues, especially that partnerships do not focus on such goals in their work.

In the opinion of individual respondents, the municipal infrastructure development, environmental issues and health care remained the priority. Sewage construction and waste management were predominantly recognized as the environmental infrastructure. It was not in compliance with the goals identified by the partnership institutional members, which mainly related to the tourism promotion and infrastructure development, cultural issues and local product promotion. Only education (especially of children) was important for both the local residents and governing elites to a similar extent.



**Figure 2.** The main goals of rural development partnerships (LAGs) in Poland in the EU Programming Period 2007-2013 (N=336) and 2014-2020 (N=314). The diagram shows the percentage of strategies referring to a given issue in the priority targets.

The analysis of the goals presented in the strategies (Figure 2) indicates that they show some specialization, comparing to the general social needs. They could be highly consistent with the EU goals in the field of entrepreneurship and social issues (education and fighting social exclusion). However, the environmental issues, including those related to renewable energy sources and reduction of greenhouse gases emissions, were not among the priorities of LAG's activities. For instance, the analysis of local strategies indicates that the local coal and wood stoves, in which residents often burn rubbish, were not perceived as a significant ecological threat. Local projects frequently focused on the preservation of cultural heritage (traditions, local products, historic

monuments) as the base for tourism development and were hardly associated with innovative investments in research and development. These elements were also noticeable in the main goals of the three partnerships analyzed (Table 3). For example, only Odra Partnership took into consideration the “Development of infrastructure and education programmers related to ecology and nature, including the Renewable Energy Sources (RES)” in detailed goals, whereas in the case of Strug and Pilica Partnership the development of local RES was not included in the strategy targets. All three partnerships focused on sustaining the local cultural and historical heritage, hence, a very “traditional” development. However, they also took into account human and social capital development problems as well as the support for local business, which seems to be in line with the EU objectives.

**Table 3.** The main goals specified in the case study of LAGs’ strategies in the 2014-2020 EU Programming Period.

LAG	Strategy period	Main goals
STRUG	2016-2022	1. Active and creative residents; 2. Support for economic development through innovative and pro-ecological activities; 3. Strengthening the attractiveness of the region by using cultural, tourist, historical resources and promoting local products.
ODRA	2015-2023	1. Preservation of the natural and cultural heritage of the area based on the entrepreneurship of residents and the development of tourism in the region; 2. Building an integrated, educated and active civil society and increasing the residents’ sense of identity with the LAG region.
PILICA	2014-2020	1. Developing tourist, recreational and cultural infrastructure; 2. Supporting historical and cultural heritage and artistic creativity; 3. Promotion of the area, including local products and services.

## 5. Discussion: Local Partnerships – the Tool of the EU Policy and/or the Instrument for Meeting Social Needs?

The literature indicates that top-down programmes may be inefficient in solving social problems such as unemployment or low social activity (Willis 2005; Chruscinski et al. 2019; Hełdak et al. 2018). Neo-endogenous initiatives are meant to be a remedy for this problem by defining the needs and priorities of actions at grassroots, but partially steered by external, national or the EU goals (Ray 2006). In turn, however, bottom-up initiatives may hamper the implementation of supra-local goals, when the local community is not interested in achieving the abstract external targets, like biodiversity conservation, Natura 2000 sites or integrated water management (Dubel et al. 2013; Dubel and Królikowska, 2014). Similarly, such goals as mitigating climate change and development of renewable energy sources were not important for the analysed LAGs.

The European and even local governing elites involved in territorial partnerships can have a different hierarchy of development priorities than the “average” citizen. This may result from the usually higher level of education or the social status achieved by the governing elites, compared to the probably lower average education, status and income of the typical rural areas residents, which was visible in Poland (Furmankiewicz et al. 2016; Czapiewski and Janc 2019). Similarly, Thuessen et al. (2010) observed, based on the survey covering the Local Action Groups in Denmark, that the majority of board members were extremely well-educated older men holding other significant positions in society. Even when there exists evidence suggesting a widespread involvement, partnership structures often established relations with only a limited number of individuals or the community interest groups organized by active, affluent, often well-educated local citizens representing specific community interests rather than the community as a whole (Jones 2002). Ostrom and Ostrom (1977, p. 34) state that “when professional personnel presume to know what is good for people rather than providing people with the opportunity to express their own preferences, we should not be surprised to find that increasing professionalization of public services is



accompanied by a serious erosion in the quality of those services". Public managers often represent the dominant group in partnership boards, thus excluding the general public from formal partnership boards, however, they have high qualifications for management and administrative work (Munro et al. 2008; Furmankiewicz and Macken-Walsh 2016). In theory partnership arrangements can work to "join up" the dispersed service providers along with harnessing the distinct contributions that different agencies can make to meet the diverse and complex local needs, including social exclusion (Lowndes and Sullivan 2004). The clash of interests is smaller at the local level, however, it does exist, making the wide implementation of the "external" EU goals more difficult.

Dobbs and Moore (2002) emphasize that even if policy makers and practitioners attempted to adopt a more bottom-up, community centred approach in local planning and regeneration, frequently the requirements of local authorities and other partners to involve local communities provided neither the time nor the resources to support this involvement. Overall, a general failure to get the public involved in the development policy was often observed. Local authorities and government clerks, representing the significant part of local elites, are in the possession of the main financial resources, remain the dominant player, with other partners often playing just minor roles. Community actors are also generally less powerful, having smaller resources at their disposal in terms of finance, time, tools and experience to empower themselves and compete at the same level, often dependent on local authorities' support, which was also visible in Poland (Furmankiewicz 2013; Furmankiewicz and Macken Walsh 2016).

The infrastructure modernisation, most frequently listed by the local residents as an important issue, often does not generate any development incentives and changes in individual enterprises, as observed by Gorzelak in the case of the Local Initiative Programme implemented in mid-90s in several municipalities in Poland (Gorzelak 2000). However, the evolution of partnerships shows that the social issues and local small business needs are becoming an increasingly important topic of territorial cooperation in Poland, especially in cross-sectoral partnerships (Furmankiewicz and Campbell 2019).

Currently the neo-endogenous model of local community development is not limited to rural areas alone. Since 2015 Urban Local Action Groups have also been established in Poland, although their focus is primarily on social issues. However, they could support solving social problems like social exclusion resulting from, e.g., poverty or disability (Świąder et al. 2016) and the development of various types of strategic and planning documents related to land management issues, investment location or urban sprawl (Zajda et al. 2017).

## **Conclusions**

The presented paper addresses the differences between the goals included in the EU programming documents, LAGs' strategies, the goals of local elites and LAGs' residents. The local residents, typically featuring lower education and income level than the elites, paid more attention to the immediate physiological needs and self-protection (thus, perceived technical living infrastructure and public services as the most important) as well as sustaining local heritage. The active elites, typically with higher education, status and probably income, based their goals on the rational conviction that stimulating economic activity of local residents, innovations and diversification of local economy are more important for the local development. These differences are in line with the new models of the hierarchy of needs (Kenrick et al. 2010) and could have some impact on social passivity and social engagement in partnerships work. If the EU goals are to be effectively implemented, it is important to bring the social goals and targets set by the educated elites closer together. It is the objective of neo-endogenous development concept (Ray 2006; Böcher 2008). LAGs' strategy can be considered a compromise between the interests of the strongest local stakeholders and top-down national or European policies (Bosworth et al. 2016). The promotion of the new co-management methods could also help in determining the local development goals and actions (Pappalardo et al. 2018). However, the innovative development based on local needs and goals can also be limited by the local norms and habits (Halabi 2004). It can remain a significant constraint in

implementing the European strategies and policies. An extensive promotion of the importance of the EU development goals as well as the educational activities raising the residents' awareness of how the local activities are linked to the development processes at both national and global level, are indispensable to overcome these problems.

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# Spatial Effects of Productive Service Industry Agglomeration on China's Provincial Economic Growth

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**Abstract:** This paper uses Chinese provincial panel data from 2003-2013 to measure the degree of agglomeration of the productive service industries in China as a whole and the provinces using the spatial Gini coefficient. Next, on the basis of confirming the spatial correlation of inter-provincial economic growth in China, we use a spatial econometric analysis method to examine the spatial effect of productive service industry agglomeration within and between provinces on China's economic growth. This spatial effect is further decomposed into direct and indirect effects. The results of the study found that: (1) China's inter-provincial economic growth spatial correlation test confirmed that there was a significant spatial correlation in China's inter-provincial economic growth; (2) The agglomeration of productive services played a role in China's inter-provincial economic growth through spatial agglomeration significant impacts; (3) The inspection and decomposition of spatial effects show that the direct and indirect effects of productive service industry agglomeration on China's inter-provincial economic growth are significant, and the indirect effect is greater than the direct effect. There is a spatial spillover effect of economic growth, and the benefits of this agglomeration of productive service industries also spillover into neighboring regions with economic interaction.

**Keywords:** productive service industry agglomeration; spatial correlation; direct effect; indirect effect; spillover effect

**JEL Classification:** O14; O18; R12

## 1. Introduction

As the world economic structure shifts from an "industrial economy" to a "service economy," the role of services, especially the productive service industry, in economic growth has become more important. The agglomeration and growth level of the service industry has become an important indicator to measure the comprehensive competitiveness of the regional economy. The contribution rate of tertiary industry to GDP in China has gradually increased from about 28.49% in 1995 to 46.72% in 2013; the contribution of the growth of the productive service industry to GDP has increased from 18% in 1995 to 22% in 2013. However, compared with the world level, the degree of agglomeration and development scale of China's productive service industry is still low, and there are huge differences between provinces, which have different effects on provincial economic growth. In the world, the output value of the productive service industry generally exceeds 50% of the total output value of the service industry, while in China it is less than 30%.

The agglomeration of economy is the key to promote economic growth. The agglomeration of productive service industry can promote regional economic growth through specialized division of labor, reducing intermediate service costs and transaction costs, exerting spatial externalities, generating competition effects and learning effect, technology spillover effects, and improving labor productivity.

A large number of studies at home and abroad have shown that the productive service industry has an industrial agglomeration effect, and has a significant driving effect on manufacturing production efficiency and economic growth (Jiang Jing et al. 2007; Zhan Haoyong 2013; Hanssens et al. 2013); it is

helps to generate high-tech industries and achieve sustainable economic growth (Aslesen and Isaksen 2007). However, some studies suggest that the agglomeration of productive service industry has not significantly promoted economic development, some other studies suggest that the impact of productive service industry agglomeration on economic growth is inverted U-shaped, with the marginal contribution increasing first and then decreasing (Han Feng et al. 2014). Hanssens et al. (2013) also demonstrated that there is a spatial and functional connection between producers and consumers in the productive service industry. Ying (2003) analyzed the spatial lag model of provincial data in China and found that there is a spatial correlation between the GDP growth of each province.

Regional spatial differences are an important factor in the study of regional economic growth, but the potential interactions between regions are often ignored. Some of the existing researches ignored the spatial correlation of the interpreted variables, that is, the level of regional economic growth. Some literatures using spatial economic models ignore the spatial interactions of agglomeration of productive services as explanatory variables. In view of this, based on previous research, this paper will try to test the impact of productive service industry agglomeration on China's inter-provincial economic growth from the spatial dimension, and further consider the productive service industry agglomeration into the analysis framework of regional economic growth. By constructing a spatial panel measurement model, we use the panel data of 31 provinces and municipalities in China to test and decompose the spatial effects of factors such as the agglomeration of productive service industries that have a spatial impact on inter-provincial economic growth in China. This paper will mainly explore the following questions: (1) Is there exist a spillover in the productive service industry agglomeration area? (2) Are there exist spatial correlation in economic growth between neighboring provinces? (3) Is the spatial interaction of economic growth between provinces caused by the spillover of productive service industry agglomeration area to adjacent areas?

## 2. Methodology, Model Settings and Data Description

According to the employment statistics of China's sub-sectors, among the 14 service industries in the statistical yearbook of China, we divide them into three categories: producer service industry, consumer service industry and public service industry. Among them, producer services mainly refer to those service industries that provide service activities to other productive sectors that can be used in the production process of their products, and are characterized by high concentration, high knowledge and high economic radiation. Productive services include: transportation, warehousing and postal services; information transmission, computer services and software; finance; real estate; leasing and business services; scientific research, technical services and geological surveys. Consumer services include: wholesale and retail; accommodation and catering. Public services include: water conservancy; environment and public facilities management; health, social security and social welfare; culture, sports and entertainment; public management and social organization.

### 2.1. Measurement of productive service industries in China

There are different methods for the measurement of industries agglomeration based on varies angles. The measurement indicators mainly include the spatial Gini coefficient, Herfindahl index, E-G index, and location entropy. Due to the limitation of data availability, this paper uses Krugman (1991) and others to measure the degree of industrial agglomeration of manufacturing industry in the United States to measure the degree of industrial spatial distribution uniformity, and only selects the spatial Gini coefficient to measure the degree of producer service industry agglomeration in all provinces of China. Assuming that an economy (country or region) can be divided into  $n$  regions, the formula for calculating the spatial Gini coefficient of the economy is:

$$GiNi = \sum_i^n (s_i - x_i)^2 = \sum_i^n \left( \frac{s_{ij}}{\sum_i s_{ij}} - \frac{x_i}{\sum_i x_i} \right)^2 \quad (1)$$

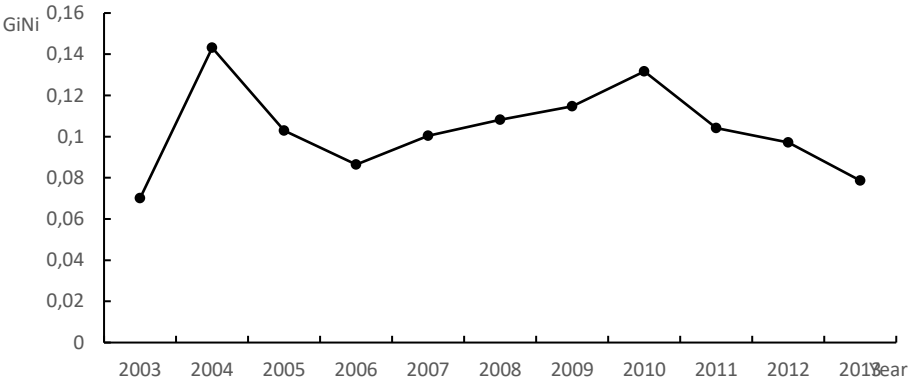
Where,  $GiNi$  represents the spatial Gini coefficient,  $s_i$  represents the proportion of employment in an industry in the region  $i$  to the total employment in the economy, and  $x_i$  represents the proportion of employment in the region  $i$  to the total employment in the economy.  $s_{ij}$  is the number of employees

in the industry of  $j$  in city  $i$  of a province,  $\sum_i S_{ij}$  is the number of employees in the industry of  $j$  in all cities of the province,  $X_i$  is the number of employees in the city of  $I$  in a province, and  $\sum_i X_i$  is the number of employees in all cities of the province.

The value range of spatial Gini coefficient is  $[0, 1]$ . The larger the coefficient is, the higher the degree of agglomeration is, and the smaller the coefficient is, the lower the degree of agglomeration is. A value of 0 indicates that the distribution of the industry in the economy is completely evenly distributed, and a value of 1 indicates that all production activities in the industry are concentrated in the same area.

1. China’s overall productive services’ spatial Gini coefficient

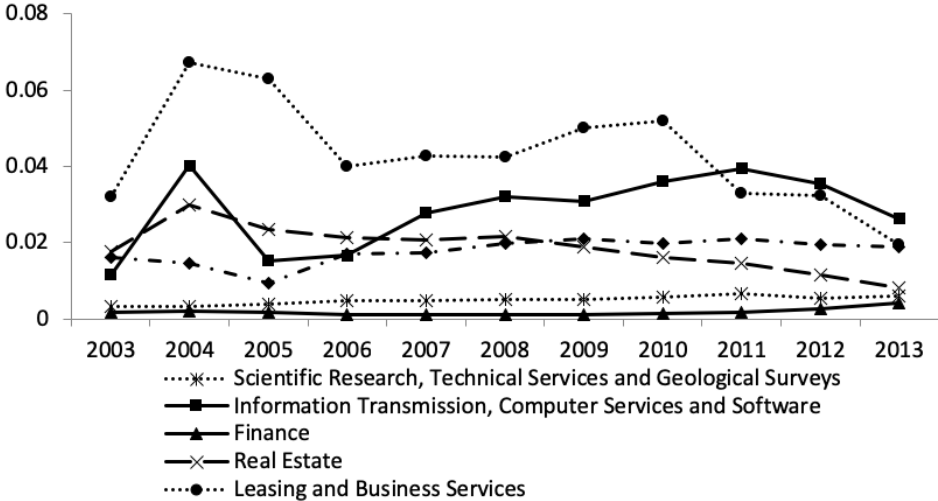
By calculating the spatial Gini coefficient of China's overall productive service industry from 2003 to 2013 as the Figure 1. It can be found that the overall agglomeration degree of China's productive service industry shows an upward trend of volatility.



**Figure 1.** Spatial Gini coefficient of producer services in China, 2003-2013. Based on the relevant data of 286 cities at prefecture level and above in 2004-2014 *China Statistical Yearbook*, *China Urban Statistical Yearbook* and *China regional economic statistical yearbook*.

2. Spatial Gini coefficient of China's productive services by sub-industry

By calculating the spatial Gini coefficient of China's producer services from 2003 to 2013 as the Figure 2. It can be found that the agglomeration degree of different industries in China's producer services is not only different in the changing trend, but also in the absolute value. In these six industries, the spatial Gini coefficient of leasing and business service industry is the highest and fluctuates greatly, while the spatial Gini coefficient of financial industry is the lowest and changes slowly. In this paper, the calculation results of the spatial Gini coefficients of the six sub industries over the years are consistent with the analysis results of Chen Jianjun et al. (2009).



**Figure 2.** Spatial Gini coefficient of China's productive services by sub-sectors in 2003-2013.

### 3. Drawing maps

Draw a quarter map of the spatial distribution of China's inter provincial producer services agglomeration in 2003, 2008 and 2013 as the Figure 3, Figure 4 and Figure 5. The darker the color, the higher the degree of the representative productive service industry agglomeration. It can be found that productive service cluster as a whole presents a ladder like spatial agglomeration structure from east to west and from south to north. The regions with high degree of agglomeration are mainly located in the Yangtze River Delta city group, Pearl River Delta Megalopolitan, Beijing-Tianjin-Hebei Megalopolitan, Shandong peninsula Megalopolitan and Chengdu-Chongqing Megalopolitan.

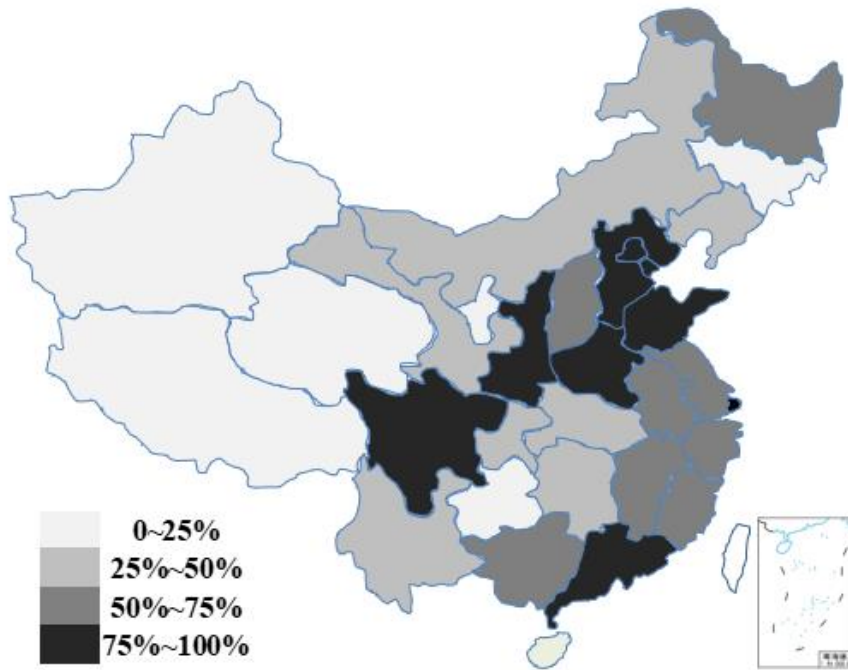


Figure 3. Spatial distribution of producer services in China in 2003.

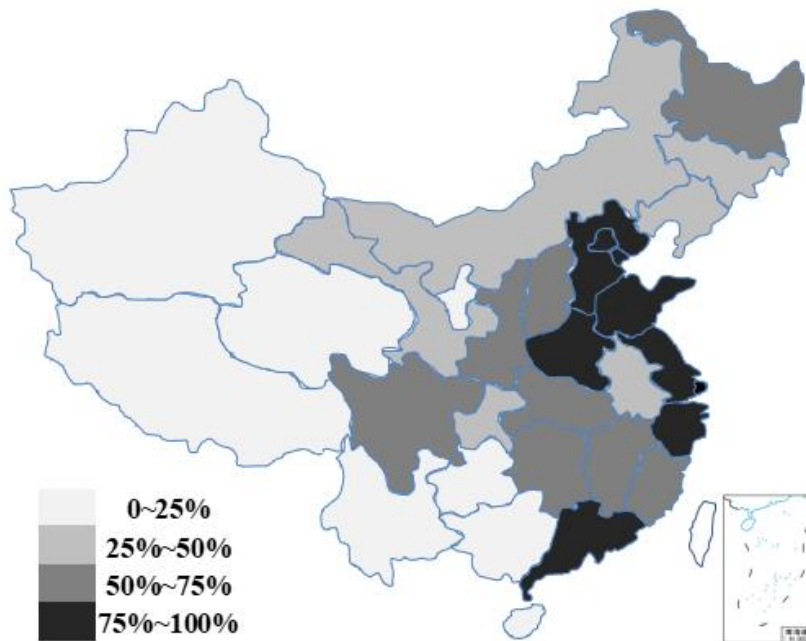
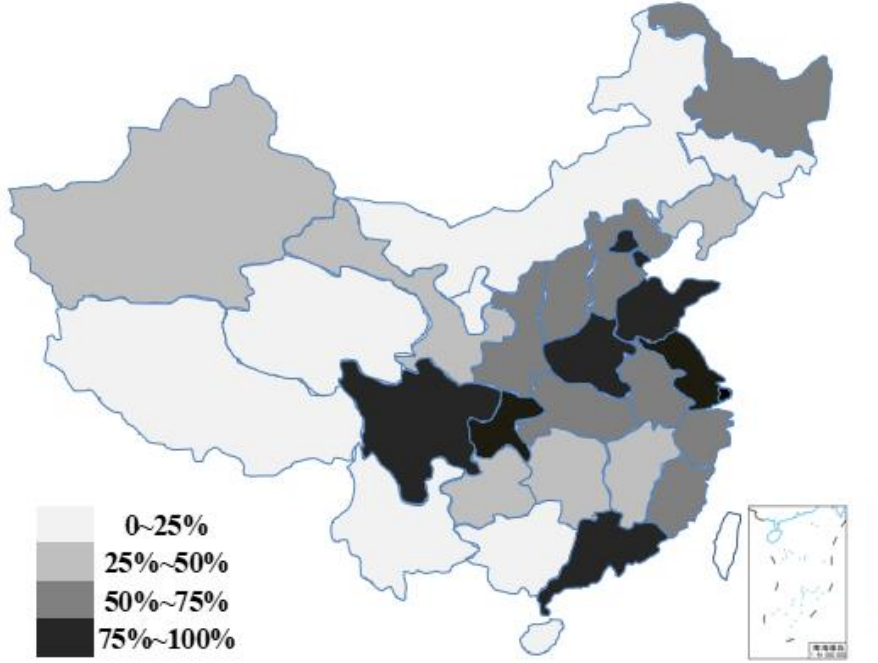


Figure 4. Spatial distribution of producer services in China in 2008.





**Figure 5.** Spatial distribution of producer services in China in 2015.

From the above description, it can be found that productive service industry in China has the characteristics of spatial agglomeration, and the regions with high degree of agglomeration show a state of continuous agglomeration, while the economic development level and population agglomeration degree of these regions are high. It can be inferred that the development of China's inter-provincial productive service industry has obvious spatial correlation, and the spatial correlation is more significant in the regions with higher economic development level. Therefore, this paper will focus on the spatial effect of productive service industry agglomeration on China's inter-provincial economic growth.

## 2.2. Basic model

Establishing production function is the most commonly used method to estimate regional agglomeration effects. Based on the general research framework of measuring the relationship between industrial agglomeration and economic growth summarized by Rosenthal and strange (2004), this paper introduces the factors of industrial agglomeration and expresses the economic growth function as follows:

$$Y_i = f(x_i)g(G_i) \quad (2)$$

For simplicity, suppose that (2) is in the form of Cobb-Douglas production function, that is,  $f(x_i) = A_i K_i^\alpha L_i^\beta$ , and the function  $g(G_i)$  also enters the production function in the form of product, and causes the change of the production function. Where,  $Y_i$  represents the economic output of region  $i$ ;  $x_i$  represents the input variable, mainly including capital input factor  $K_i$  and labor input factor  $L_i$ ;  $G_i$  represents the industrial agglomeration degree of region  $i$ , in this paper, it represents the agglomeration degree of productive service industry.

The expression (2) is expressed as per capita form and natural logarithm is taken, and the following basic function forms are obtained by further rewriting:

$$\ln\left(\frac{Y_i}{L_i}\right) = \ln A_i + \alpha \ln\left(\frac{K_i}{L_i}\right) + (\alpha + \beta - 1)\ln L_i + \gamma \ln G_i \quad (3)$$

In addition to the above main factors, other factors input is also significantly related to regional economic growth. This paper refers to the research on regional economic growth by Brühlhart and Sbergami (2009), and selects factors such as education, R & D investment, government expenditure,

infrastructure construction and the degree of opening-up as control variables in combination with the provincial characteristics of China. The basic form of panel data measurement model in this paper can be expressed as follows:

$$\ln y_{it} = a_0 + a_1 \ln k_{it} + a_2 \ln L_{it} + a_3 \ln G_{it} + a_4 Z_{it} + \xi_{it} \quad (4)$$

Where,  $y_{it}$  is the per capita real GDP of region  $i$  at period  $t$ ,  $k_{it}$  is the per capita capital input of region  $i$  at period  $t$ ,  $G_{it}$  is the agglomeration degree of productive service industry in region  $i$  at period  $t$ , and  $Z_{it}$  is the set of control variables,  $a_i$  is the parameter with estimation,  $\xi_{it} = u_i + v_t + \varepsilon_{it}$ . Among them,  $u_i$  is the individual effect,  $v_t$  is the time effect, and  $\varepsilon_{it}$  is the random error term.

The formula (4) shows that the real GDP per capita in region  $i$  is mainly affected by the degree of industrial agglomeration, capital input per capita, labor input and other input factors. In the above basic model, this paper focuses on the spatial impact of producer services agglomeration variable  $G$  on provincial economic growth variables.

### 2.3. Data description and variable description

The research scope of this paper is 31 provinces, municipalities and autonomous regions in China. Hong Kong, Macao and Taiwan are excluded due to the availability of data and relatively poor economic connections with other provinces. In addition, since China adjusted the industry classification in 2003 and adjusted the service industry from the original 11 industries to the current 14 industries, in order to unify the statistical caliber and compare the sample data, the collection of data in various industries of the productive service industry started from 2003. Therefore, the provincial panel data from 2003 to 2013 and the panel data of 286 cities and above in China are finally used in this paper. All the data in this paper are mainly from *China Statistical Yearbook* and *China City Statistical Yearbook* over the years, and some of the data in some years and city characteristics are from *China Education Funds Statistical Yearbook* and *China Regional Economic Statistical Yearbook*. In order to increase the comparability and eliminate the influence of price factors, this paper uses the corresponding deflator to deflate the main research data.

In order to eliminate the heteroscedasticity in the estimation of production function, all variables are treated logarithmically in this paper. The construction and measurement of the main variables are described below. The statistical description of the main variables is shown in Table 1.

**Table 1.** Statistical description of variables.

Variables' Name	Variables	Unit	Mean	Standard Deviation	Minimum	Maximum
Per capita Real GDP	rpGDP	yuan/person	13248.86	7416.226	3685.633	38523.73
Per capita Total Investment in Fixed Assets of the whole society	k	yuan/person	12709.51	8344.245	1896.857	48089.59
Proportion of Employees in the Total Population at the end of the year	L	%	10.15091	6.947295	2.868217	57.09038
Spatial Gini coefficient of Productive Services	G	—	0.0037	0.0153626	5.00e-06	0.1307652
Per capita Traffic Density	trans	km/10,000	346589.4	336657.1	38171.64	2279275
Per capita Total Business Volume of Post and Telecommunications	mail	yuan/person	1183.215	813.1196	258.4496	5571.48
Per capita R&D Expenditure	rd	yuan/person	389.025	646.0676	11.40506	4429.262
Per capita Public Financial Expenditure	gov	yuan/person	4499.101	3514.964	741.2825	23984.19

Per capita Total Import and Export of Goods	open	yuan/person	11854.47	21764.32	210.5245	105085.4
Per capita Education Expenditure	edu	yuan/person	1042.434	625.1801	246.5161	3737.015

Thus, the form of the common panel measurement model in this paper is set as follows:

$$\ln rpgdp_{it} = \beta_0 + \beta_1 \ln k_{it} + \beta_2 \ln L_{it} + \beta_3 \ln G_{it} + \beta_4 \ln trans_{it} + \beta_5 \ln mail_{it} + \beta_6 \ln rd_{it} + \beta_7 \ln gov_{it} + \beta_8 \ln open_{it} + \beta_9 \ln edu_{it} + u_i + v_t + \varepsilon_{it} \quad (5)$$

### 3. Measurement Results and Analysis

According to the first law of geography, there is a connection between anything and other things around it. Due to the existence of spatial heterogeneity and spatial correlation, time series regression method or common panel data analysis is no longer suitable to explain the complex relationship between productive service industry agglomeration and economic growth and the real economic connotation behind the variables. Therefore, this paper introduces spatial correlation analysis and uses spatial panel data model to study the spatial effect and heterogeneity of productive service industry agglomeration on inter-provincial economic growth in China.

#### 3.1. Spatial correlation analysis

First of all, we will test whether the explained variables, that is, the real GDP per capita in China's provinces, have spatial autocorrelation from two aspects of global spatial autocorrelation and local spatial autocorrelation.

##### 1. Global spatial autocorrelation test

The global spatial autocorrelation test can be performed by measuring the *Moran's I* index. The calculation formula is as follows:

$$Moran's I = \frac{\sum_{i=1}^n \sum_{j=1}^n W_{ij} (Y_i - \bar{Y})(Y_j - \bar{Y})}{S^2 \sum_{i=1}^n \sum_{j=1}^n W_{ij}} \quad (6)$$

The range of the *Moran's I* index is  $-1 \leq I \leq 1$ . When the value of *I* is greater than 0 and close to 1, it means that there is a positive spatial correlation between regions. When the value of *I* is less than 0 and close to -1, it means that there is a negative spatial correlation between regions. When the value of *I* is close to 0, it means that there is no spatial correlation between regions. Where,  $S^2 = \frac{1}{n} \sum_{i=1}^n (Y_i - \bar{Y})^2$ ,  $\bar{Y} = \frac{1}{n} \sum_{i=1}^n Y_i$ , and  $Y_i$  means the per capita GDP of region *i*, *n* is the total number of regions, and  $W_{ij}$  is the element in the spatial weight matrix *W*, which can reflect the degree of interaction between adjacent or similar regions.

$$w_{ij} = \begin{cases} 1, & d_{ij} < d_{min} \\ 0, & d_{ij} \geq d_{min} \end{cases} \quad (7)$$

Where,  $d_{min}$  is the threshold distance given in advance;  $w_{ij}$  is the matrix element of row *i* and column *j*, the elements on the diagonal are zero, and the elements in the matrix are used to reflect the spatial correlation between the two regions. In particular,  $d_{ij}$  is the inter-provincial distance between region *i* and region *j*. Considering that the majority of productive services activities are concentrated in the capital cities or municipalities directly under the central government of China, we build a spatial distance weight matrix based on the distance between the two regional capital cities (or municipalities directly under the central government) calculated from the longitude and latitude data of the two regions, which can more reflect the socio-economic characteristics of China's provinces. All spatial weighting matrices are row standardized.

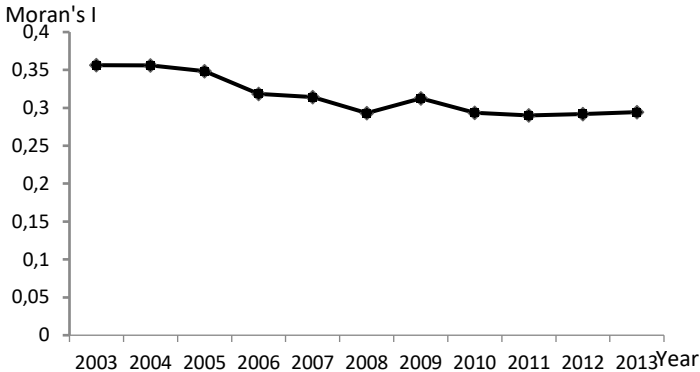
We use Geoda1.10 software to analyze the *Moran's I* statistical value and Monte Carlo test as Table 2 for three equidistant years (2003, 2008 and 2013). At the same time, according to the spatial

correlation *Moran's I* index of China's per capita real GDP from 2003 to 2013, the *Moran's I* change trend chart of China's inter-provincial economic growth from 2003 to 2013 is drawn as Figure 6.

**Table 2.** Moran's I statistical value of real GDP per capita and its statistical test.

Year	<i>Moran's I</i> value	E (I)	Mean	Standard Deviation	P value
2003	0.3563	-0.0333	-0.0322	0.1359	0.0060
2008	0.2932	-0.0333	-0.0270	0.1327	0.0120
2013	0.2946	-0.0333	-0.0302	0.1353	0.0090

<sup>1</sup> Monte Carlo tests all use a significance level of 0.001

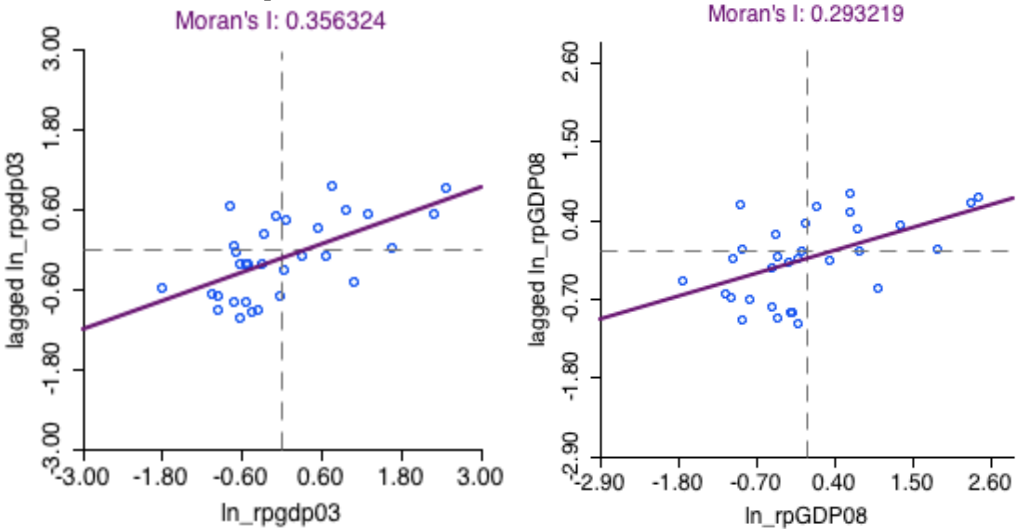


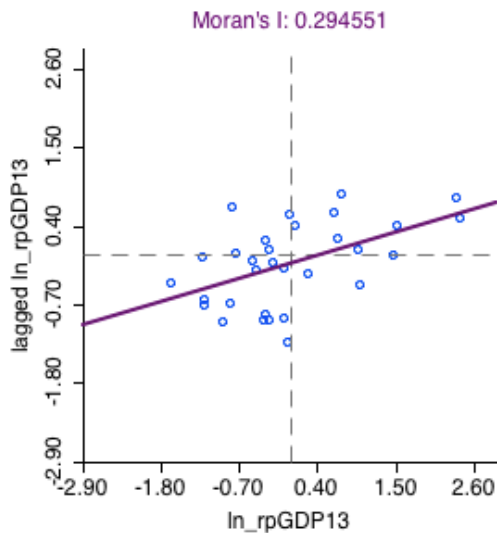
**Figure 6.** Moran's I change in real GDP per capita from 2003 to 2013.

The results in Table 2 and Figure 6 show that *Moran's I* statistics from 2003 to 2013 are both greater than 0 and less than 1 at a significant level of 1%, indicating that China's real GDP per capita does have a spatial correlation and is a significant positive global autocorrelation. It shows that there is a spatial correlation between the real GDP per capita of 31 provinces and municipalities in China, which is suitable for spatial econometric analysis.

2. Local spatial autocorrelation test

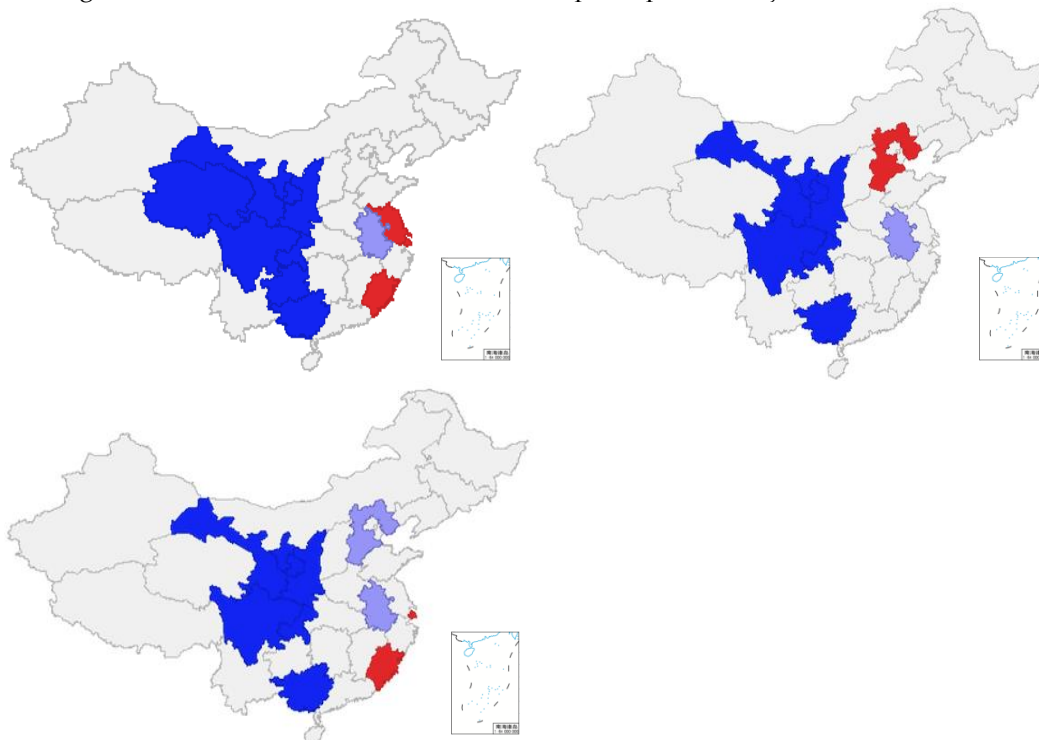
In order to more clearly observe the spatial distribution and specific agglomeration characteristics of real GDP per capita, we use geoda1.10 software to draw *Moran's I* scatter diagram as Figure 7 and Lisa agglomeration diagram as Figure 6 of real GDP per capita in 2003, 2008 and 2013, respectively, to further test their local spatial correlation characteristics.





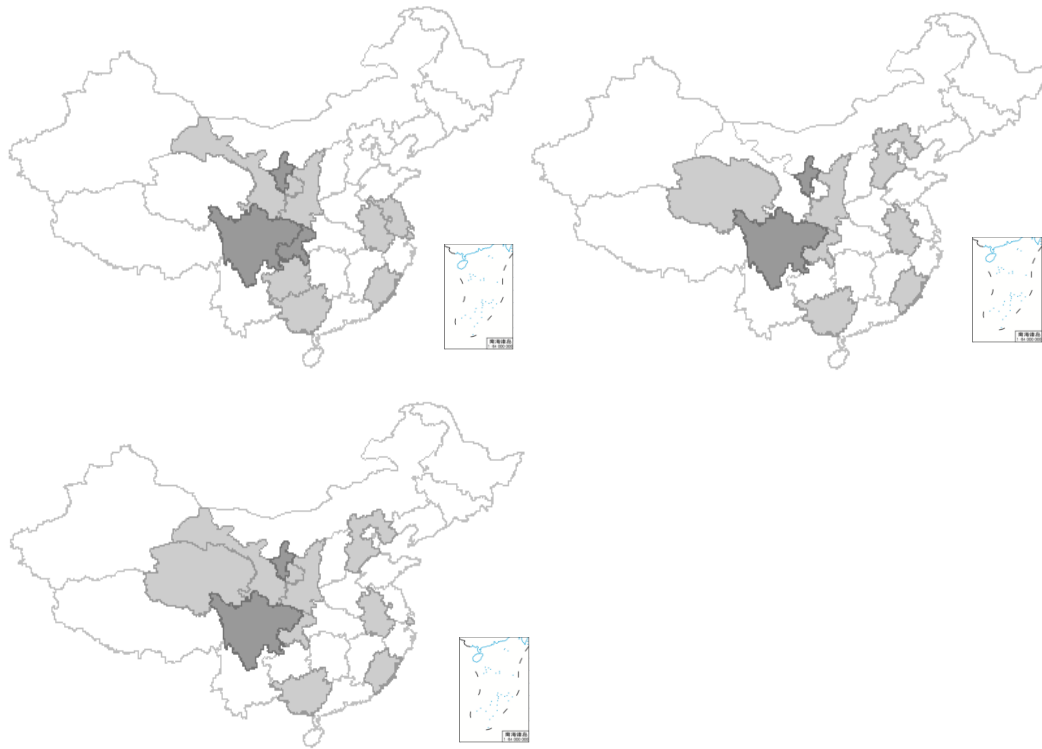
**Figure 7.** Comparison of scatter plots of Moran's I in 2003, 2008 and 2013.

Each small circle in *Moran's I* scatter diagram represents a province (municipality or autonomous region), which can directly depict the heterogeneity of research objects in different regions. Among them, the first and the third quadrants indicate that there is a positive spatial correlation between the agglomeration areas, and the second and the fourth quadrants indicate that there is a negative spatial correlation between the agglomeration areas. It can be seen from Figure 7 that the observed values of real GDP per capita in three years are mostly distributed in the first and third quadrants, showing the phenomenon that regions with high concentration of real GDP per capita are adjacent to each other, and regions with low concentration of real GDP per capita are adjacent.



**Figure 8.** Comparison of local LISA in 2003, 2008 and 2013.

In the local Lisa cluster diagram as Figure 8, the red part is the high-high area, the blue part is the low-low area, indicating that there is a positive local space autocorrelation cluster center; the light purple part is the low high area, indicating that there is a negative local space autocorrelation cluster center; the gray part is the radiation area around the spatial cluster center.



**Figure 9.** Significant comparison of local LISA in 2003, 2008 and 2013.

The significance map of local Lisa as Figure 9 can show the significance degree of the corresponding regional agglomeration. The dark gray area represents the agglomeration at the significance level of 0.01, and the light gray area represents the agglomeration at the significance level of 0.05.

It can be seen that the agglomeration centers of China's inter-provincial per capita GDP in the representative years are significant and have little change. The agglomeration centers of high per capita real GDP and their adjacent provinces and cities are basically concentrated in the eastern region, while the agglomeration centers of low per capita real GDP and their adjacent provinces and cities are generally concentrated in the western region. The regions with high concentration of producer services in China are basically consistent with the regions with positive spatial correlation of real GDP per capita, while the regions with low concentration of producer services are roughly coincident with the regions with negative spatial correlation of real GDP per capita. Therefore, the following issues are discussed in this paper: (1) is there spatial spillover in producer services agglomeration area? (2) Is the inter provincial economic growth affected by the spatial spillover of producer services agglomeration in neighboring provinces?

### 3.2. Spatial econometric model

Compared with the classical linear econometric model, which assumes that the samples are independent of each other, the spatial econometric model considers the spatial dependence among regions when processing the spatial data related to geographical location (Anselin 1988). This spatial dependence is also reflected in the lag term of the interpreted variable and the lag term of the error term, reflecting that the interpreted variable in this region is not only affected by the local explanatory variable, but also may be affected by the adjacent interpreted variable and its error impact. Therefore, when analyzing the spatial impact of productive service industry agglomeration on China's inter provincial economic growth, we need to consider the spatial distribution characteristics of producer services agglomeration, as well as the spatial spillover effect of productive service industry agglomeration on the economic growth of the surrounding areas.

After Cliff and Ord (1973) proposed a spatial measurement model for cross-section data, Anselin (1988), Elhorst (2003), Lesage and Pace (2009) etc. extended its improvement to panel data spatial

measurement model, mainly including spatial lag model (SLM), spatial error model (SEM) and spatial Doberman model (SDM). SDM is a general form of SLM and SEM. It can be verified whether SDM can be simplified to SLM or SEM by Wald test or LR test (Burrige 1981). If the form of measurement model is SLM or SDM, the spatial effect of independent variables on dependent variables can be divided into direct effect and indirect effect (Lesage and Pace 2009). The direct effect measures the spatial effect of the change of explanatory variables on the interpreted variables, including the feedback effect of the local spatial effect on the interpreted variables when it is transferred to the adjacent areas and then returned to the local area; the indirect effect measures the spatial effect of the change of the local explanatory variables on the interpreted variables in all other areas; the sum of the direct effect and the indirect effect is called the total effect. In this paper, the total effect of producer services agglomeration on China's inter-provincial economic growth is divided into direct effect and indirect effect, in order to investigate and compare the degree and direction of different types of spatial effects.

### 3.3. Selection, estimation and result analysis of spatial econometric model

#### 1. The choice of econometric model of space panel

Before choosing the econometric model of spatial panel, we need to test the spatial correlation. In the above, we have determined the spatial correlation of China's inter provincial economic growth through Moran 's I index test. Next, this paper will use the maximum likelihood LM-error test, LM-lag test, robust LM-error test and robust LM-lag test to judge the specific form of the spatial econometric model. The test results are shown in Table 3.

**Table 3.** Spatial correlation test results.

Test	Statistics	p-value
LM (lag)	2.3335	0.127
Robust LM (lag)	0.6351	0.425
LM (error)	16.9216	0.000
Robust LM (error)	15.2232	0.000

The test results in Table 3 show that LM (lag) and LM (error) statistics and p-values show that there is a spatial effect, and the spatial lag effect and spatial error effect are significant, the former is significant at the level of 10% and the latter is significant at the level of 1%; and robust form of robot LM (error) passed the 1% significance level test, while the result of robot LM (lag) failed to pass the 10% significance level test, that is, the original hypothesis that there is no spatial lag effect cannot be rejected. The comparison shows that for this paper, SEM is better than SLM.

Hausman test is applied to panel data to determine whether fixed effect model estimation or random effect model estimation should be used. The results of Hausman test show that the test statistic is 84.94, prob > chi<sup>2</sup> = 0.0000, indicating that the original hypothesis of random effect is rejected at 1% significance level, that is, panel data has fixed effect.

In conclusion, the SEM model of fixed effect panel is set as follows:

$$\ln rpGDP = \beta_0 + \beta_1 \ln k_{it} + \beta_2 \ln L_{it} + \beta_3 \ln G_{it} + \beta_4 trans_{it} + \beta_5 mail_{it} + \beta_6 rd_{it} + \beta_7 gov_{it} + \beta_8 open_{it} + \beta_9 edu_{it} + u_i + v_t + e_{it}, e_{it} = \lambda W \varepsilon_{it} + \varepsilon_{it} \quad (8)$$

Where  $u_i$  is the individual effect,  $v_t$  is the time effect,  $W$  is the spatial distance weight matrix,  $\varepsilon_{it}$  is the random error term,  $\varepsilon_{it} \sim N(0, \sigma^2 I_n)$ .

#### 2. Analysis of the estimation results of the econometric model of space panel

We use Matlab R2014b and its spatial measurement software package to estimate and test the spatial panel model. When the samples are randomly taken from the population, it is more appropriate to choose the random effect model, while when the samples are composed of some specific individuals or the samples are the population, it is more appropriate to choose the fixed effect model (Baltagi 2009). The research sample of this paper consists of 31 provincial administrative regions in China. Obviously,

the fixed effect model is a better choice. In addition, according to the different control of fixed effect model to two kinds of non-observation effects, it can be divided into four types: non fixed effect, space fixed time non fixed effect, time fixed space non fixed effect and space and time double fixed effect.

Next, we need to establish panel SDM model and SEM model for comparison, through Wald test and LR test to determine which is more suitable for this study.

The specific form of SDM is as follows:

$$\begin{aligned} \ln rpGDP = & \beta_0 + \rho W \times \ln rpGDP + \beta_1 \ln k_{it} + \beta_2 \ln L_{it} + \beta_3 \ln G_{it} + \beta_4 \text{trans}_{it} + \beta_5 \text{mail}_{it} + \\ & \beta_6 \text{rd}_{it} + \beta_7 \ln gov_{it} + \beta_8 \text{open}_{it} + \beta_9 \text{edu}_{it} + \theta_1 W \times \ln k_{it} + \theta_2 W \times \ln L_{it} + \theta_3 W \times \ln G_{it} + \\ & \theta_4 W \times \text{trans}_{it} + \theta_5 W \times \text{mail}_{it} + \theta_6 W \times \text{rd}_{it} + \theta_7 W \times \text{gov}_{it} + \theta_8 W \times \text{open}_{it} + \theta_9 W \times \text{edu}_{it} + \\ & u_i + v_t + \varepsilon_{it} \end{aligned} \quad (9)$$

**Table 4.** Wald test and LR test of SDM.

	Spatial fixed effect	Time fixed effect	Spatial and time fixed effects
Wald test spatial lag	23.3798 (p=0.0054)	78.7544 (p=0.0000)	83.1454 (p=0.0000)
LR test spatial lag	21.9496 (p=0.0090)	74.2613 (p=0.0000)	65.9617 (p=0.0000)
Wald test spatial error	12.8980 (p=0.1673)	78.8267 (p=0.0000)	82.2740 (p=0.0000)
LR test spatial error	15.5565 (p=0.0767)	73.8517 (p=0.0000)	68.4319 (p=0.0000)

<sup>2</sup> Figures in parentheses are p-values.

Table 4 reports SDM of the Wald test and LR test results. For the hypothesis test with the null hypothesis of " $H_0: \theta = 0$ ", the Wald test and LR test in three forms of spatial fixed effect, time fixed effect and spatial and time fixed effects passed the 1% significance test, rejected the null hypothesis that SDM can be simplified as SLM. For the hypothesis test with the null hypothesis of " $H_0: \theta + \rho\beta = 0$ ", the Wald test and LR test under the fixed time and double fixed effects both passed the 1% significance test. The hypothesis that SDM can be simplified as SEM was rejected, while Wald test under the spatial fixed effect failed to pass the 10% significance test, and LR test passed the 10% significance test.

According to the above analysis, SDM is the optimal model for this study, so we will focus on the estimation and in-depth discussion of SDM. In order to facilitate comparison, the estimation results of the SEM model under the fixed spatial effect are also given. In addition, the model (3) is estimated by the standard panel data measurement model, and four estimation results of the non-spatial panel data model are given comparing as Table 5.

**Table 5.** Estimation and test of non-spatial panel model.

	Non-spatial effect	Spatial fixed effect	Time fixed effect	Spatial and time fixed effect
C	5.971373***			
ln_k	0.438441***	0.162983***	0.607182***	0.114994***
ln_L	0.120006***	0.037453**	0.105221***	0.043424**
ln_G	0.084165***	-0.017051**	0.060455***	-0.016874***
trans	-0.000001***	0.000001***	-0.000001***	0.000001***
mail	-0.000033	-0.000035***	0.000001	-0.000022
rd	-0.000038	-0.000210***	-0.000070	-0.000152***
gov	-0.000128***	-0.000028*	0.000024	-0.000038**



	Non-spatial effect	Spatial fixed effect	Time fixed effect	Spatial and time fixed effect
open	0.000019***	0.000001	0.000014***	-0.000004**
edu	0.000069	0.000149***	-0.000165*	0.000185***
R <sup>2</sup>	0.8487	0.8153	0.8872	0.5336
LogL	96.7280	527.8393	154.5769	564.0712
σ <sup>2</sup>	0.0342	0.0027	0.0243	0.0022
DW	2.1016	1.4820	2.3712	1.7483

<sup>3</sup> \*, \*\*, \*\*\* respectively represent that the estimated results of the coefficient are significant at the level of 10%, 5% and 1%.

In order to avoid the influence of endogenous variables on the estimation results, the above spatial measurement models are estimated by the maximum likelihood estimation method (ML), and the estimation results of all spatial panel measurement models are shown in Table 6. In this paper, the standard panel data econometric model passed Stata 12.1, and all spatial panel data econometric models passed the estimation and test of Matlab R2014b.

**Table 6.** Summary of estimation results of SEM and SDM.

Model	SEM		SDM		
Variables	Spatial fixed effect	Non-fixed effect	Spatial fixed effect	Time fixed effect	Spatial and time fixed effect
C		2.296074***			
ln_k	0.149898***	0.533663***	0.121388***	0.536862***	0.122836***
ln_L	0.044807***	0.205989***	0.020331	0.207045***	0.026599
ln_G	-0.019815***	0.039308***	-0.015482**	0.036967***	-0.010102*
trans	0.000001***	-0.000001***	0.000001***	-0.000001***	0.000001***
mail	-0.000022*	0.000035	-0.000017	0.000033	-0.000019
rd	-0.000137***	-0.000092	-0.000150***	-0.000059	-0.000063
gov	-0.000020	0.000014	-0.000017	0.000003	-0.000038***
open	-0.000003	0.000013***	-0.000004**	0.000014***	-0.000006***
edu	0.000099*	-0.000078	0.000105*	-0.000083	0.000131**
W*ln_k		-0.176753**	-0.106792***	0.020189	-0.006737
W*ln_L		-0.017597	-0.055715	0.048547	0.164495*
W*ln_G		-0.079926**	0.037512	-0.083789*	0.049586*
W*trans		-0.000001	-0.000000	0.000000	0.000005***
W*mail		-0.000097*	0.000017	-0.000265*	-0.000078
W*rd		0.000212	-0.000245	0.000259	0.001154***
W*gov		-0.000114	-0.000021	-0.000241	-0.000515***
W*open		0.000035***	0.000005	0.000052***	-0.000039***
W*edu		-0.000271	0.000320**	0.000015	0.001527***
ρ		0.364977***	0.567975***	0.155966	0.336981**
λ	0.634977***				
R <sup>2</sup>	0.9873	0.9115	0.9903	0.9140	0.9921
LogL	551.75752	186.56824	559.68267	192.64554	598.44283
σ <sup>2</sup>	0.0024	0.0194	0.0023	0.0195	0.0017

This paper focuses on the relationship between the agglomeration of producer services and economic growth. From the coefficient value (0.049586) and its significance (significantly positive at the level of 10%) of the spatial lag term W\*ln G of producer services reported in the last column of table 6, it can be seen that there is a significant interaction effect between the agglomeration of producer services in neighboring areas and the agglomeration of producer services in this area. This kind of spatial interaction between regions will promote the economic growth of the region.

Productive service industry agglomeration has passed the significance level test of at least 10% in both the general panel data model as Table 5 and the spatial panel data model as Table 6, which confirms that producer services agglomeration in China has played a significant role in the provincial economic growth through the spatial agglomeration effect.

The above empirical test results also show that there are significant spatial spillovers and spatial interactive growth in producer services agglomeration. From the last column of table 6, the spatial lag coefficient (i.e.  $\rho$ ) of per capita real GDP is 0.336981, which is significantly positive at the level of 5%, indicating that there is a significant interaction effect between the economic growth of this region and that of adjacent regions, and the economic growth of adjacent regions does have an interaction effect, and the improvement of the economic level of adjacent regions will promote the economic growth level of this region Improvement.

In the estimation results of SDM, the parameter estimation of explanatory variable cannot represent the marginal effect of the influence on the explanatory variable, and the analysis of its coefficient is meaningless. Table 7 shows the direct effect, indirect effect and total effect decomposition results of the explanatory variables under the double fixed effects of space and time on the provincial economic growth.

**Table 7.** Decomposition of spatial and time fixed effects (SDM).

Variables	Direct effect	Indirect effect	Total effect
ln_k	0.123246***	-0.038698	0.084548
ln_L	0.024722	0.115665	0.140387*
ln_G	-0.011145*	0.042285*	0.031140*
trans	0.000001***	0.000003***	0.000004***
mail	-0.000018	-0.000052	-0.000070
rd	-0.000081*	0.000911***	0.000829***
gov	-0.000030*	-0.000390***	-0.000420***
open	-0.000005***	-0.000029***	-0.000034***
edu	0.000109**	0.001148***	0.001257***

From the direct effect part of the spatial effect decomposition results in Table 7, the direct effect coefficient of the agglomeration of productive services on the region's economic growth is -0.011145, and it is significantly negative at a significance level of 10%. It is important to point out that the direct effect of the agglomeration of productive service industries is different from its coefficient estimation because this direct effect includes not only the effect of the agglomeration of productive service industries on the region's economic growth, but also the feedback effect. The feedback effect is due to the spatial effect of the clustering of productive service industries in the region, which is transmitted to neighboring regions and then returns to the region to affect the region's economic growth. The degree of feedback effect is determined by two parts, one part is attributed to the coefficient of the explanatory variable  $W*ln\_rpGDP$  ( $\rho$ ), and the other part is attributed to the coefficient of the productive service industry agglomeration spatial lag term  $W*ln\_G$ .

From the indirect effect part of the spatial effect decomposition results in Table 7, the spillover effect coefficient of the agglomeration of productive services to the region's economic growth is 0.042285, and it is significantly positive at a significance level of 10%. The indirect effect of the agglomeration of production and service industries is also called the spillover effect, which measures the degree of impact of changes in the production service industry agglomeration on the economic growth of all other regions. The increase of 1% will indirectly promote the economic growth of neighboring areas by 0.04% through spatial interaction. The indirect effect of producer services agglomeration is greater than the direct effect as a whole, which is determined by the nature of producer services itself. For example, financial industry and real estate industry have higher requirements for the level of human capital and the timely updating of knowledge and technology information. The spillover effect of producer services in the economically developed areas plays a leading role in the development of related industries in the surrounding areas. The intra-industry and

inter-industry spillover effects can strengthen the connection between production and consumption, and better serve as an effective connection and coordination between different regions and sectors.

In addition, the estimation results of the spatiotemporal double fixed-effect SDM model show that there are also significant spatial interactions in explanatory variables such as labor input  $L$  and traffic density  $trans$ . This shows that there are many uncertain spatial impact factors in our actual economic development, and these factors also have a certain impact on the spatial effect of the production service industry agglomeration. The indirect effect coefficients of infrastructure, R&D investment and education investment are all significantly positive and much larger than the direct effects, indicating that the spillover effects of infrastructure, R&D investment and education investment in this region have significantly improved the economic growth of surrounding areas. The indirect effect coefficients of government expenditure and opening to the outside world are both significantly negative and much larger than the direct effects, indicating that government expenditure and spillover effects of opening up in the region have a restraining effect on the economic growth of the surrounding areas.

The above empirical results show that there is indeed a space spillover phenomenon of economic growth in the cluster of productive service industries, and the benefits of this cluster of productive service industries also spill over into neighboring regions with economic interaction.

#### 4. Conclusions

Based on the panel data of 31 provinces (cities, autonomous regions) in China from 2003 to 2013, this paper analyzes the spatial impact of producer services agglomeration on inter provincial economic growth, as well as the direct and spillover effects of producer services agglomeration on regional economic growth. The results show that: first, the impact of spatial correlation cannot be ignored, and the level of inter provincial economic growth in China has significant spatial correlation. Secondly, the spatial spillover phenomenon of economic growth does exist in producer services agglomeration, and the interaction phenomenon of economic growth exists between neighboring provinces. Thirdly, the agglomeration of productive service industries has a significant difference in the direct spatial effect and spatial spillover effect of regional economic growth, and the direct effect is significantly negative, indicating that the agglomeration of productive service industries has a direct inhibitory effect on the region's economic growth through multiple channels. The indirect effect is significantly positive and much larger than the direct effect, which indicates that the agglomeration of productive service industries has a significant driving effect on the economic growth of neighboring areas.

At the present stage of China's economic development, the spatial agglomeration of productive service industries cannot be ignored, and regions should develop corresponding productive service industries based on their comparative advantages. The key to using producer services to drive economic growth lies in the rational adjustment and development of the spatial agglomeration structure of producer services. By controlling the agglomeration factors of producer services with significant spatial impact, regional resources can be integrated to the greatest extent to promote the upgrading of industrial structure and provincial economic growth, so as to achieve high-quality economic development.

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# Perception of Gender Issues at Work

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**Abstract:** In this article we deal with the analysis of the situation of equal opportunities in the field of gender issues in practice. The aim of the article is to describe the importance of creating a corporate culture that promotes equality and diversity in the workplace, as well as to describe the specific situation of gender inequality in the labor market and to testify to people affected by gender issues in practice. In this work, we investigate statistically significant differences in the perception of gender issues in practice between managers and executives, as well as between the working areas of education and transport. The questionnaires were used to verify the hypotheses and respondents' opinion on the issue, which also implies an analysis of partial objectives. The aim of the research is to analyze gender differences in the labor market and describe the perception of the issue of the position of men and women in the work process and to compare their equal chances. The work is concluded with proposals and recommendations to support equalization of inequalities in the labor market.

**Keywords:** gender; discrimination; equal opportunities; gender issues

**JEL Classification:** J7; J70; J71

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## 1. Introduction

In the knowledge of the hierarchy of society and the subsequent division of labor, the most important step is the knowledge of biologically given differences and the socio-cultural gender, the so-called female and male roles are claimed by the authors (Borchorst and Siim 2008).

Thus, undoubtedly, the basic definitions include gender and gender. (Groucutt et al. 2018) briefly describe that sex is exclusively about the biological differences between men and women, on the basis of which we can categorize human beings as men and women. Gender is already related to the social meanings given in relation to the gender. Gender points out the differences between men and women and is concerned with building gender identities.

In relation to gender differences, we should also define the concept of discrimination, which (Kliestikova et al. 2018) cite as a disproportionate difference in treatment of individuals or groups of individuals. Discriminatory treatment fails to respect the established equal rights for all groups and individuals, and this demonstrates resistance to diversity.

(Luminița 2018) claims that gender differences point to forms of discrimination, namely direct and indirect. Direct discrimination means an act or omission in which a person is treated less favorably than that treated, or could be treated in the comparable situation, with another person. Indirect discrimination is defined as a situation where an outwardly neutral regulation, decision, instruction or practice disadvantages a person in comparison with another person.

(Neary et al. 2018) also mention another type of discrimination, namely multiple discrimination. It defines it as a number of concurrent factors such as gender and age, or health and age, which intensify disadvantage. They refer to other forms of discrimination according to the applicable anti-discrimination law and are: Harassment, Sexual Harassment, Unauthorized Sanction, Instruction to Discrimination and Encouraging Discrimination.

(Ranki et al. 2018) already define a specific form of gender discrimination, and that is gender role, which is based on the anticipated behavior of men and women based on the images of understanding of "masculinity" and "femininity". Gender roles are a learned gender socialization that begins shortly after birth and transmits socio-cultural beliefs and values that are transmitted to the child.

(Tesch-Romer et al. 2008) point to discrimination against women in hidden forms of the labor market, as confirmed by a published analysis by the European Commission based on the following factors of a survey of horizontal segregation in the labor market, indicating high employment rates of women with low pay. It was also a sectoral segregation where women's attention was more concentrated in the public sector, while men mostly in the private sector. In vertical segregation, it is a glass ceiling, limiting women's opportunities and opportunities. Remuneration structures focus on personal remuneration in which women are found to be disadvantaged (e.g. paying overtime which not every woman can perform in addition to family responsibilities).

In practice, there is a system of collective bargaining characterized by an androgenic approach. Furthermore, inequalities in household and family responsibilities and multiple discrimination of inequalities in education based on prejudice and gender stereotypes manifested in the choice of fields of study as well as the "male model" of the labor market and its remuneration system - points to efforts to integrate into the work environment and this often forces women to adapt to a typical male model. (Van den Brink et al. 2010) argue that due to gender stereotypes, society is devaluing and subordinating women's work. The authors take the view that the structure and organization of society is based on gender stereotypes and that unequal power relations between men and women exist and persist.

## 2. Methodology

We carry out the research using a questionnaire, which is necessary for obtaining information on the research objectives. The questionnaire consists of two parts. The first part is devoted to surveying demographic data about respondents. In these informative questions we find out gender, age, region, marital status, number of children, educational attainment, work area and position in organizations. The respondents come mainly from three main work areas, namely transport, education and health. When it comes to organizational issues, we differentiate between a manager in a particular organization or an executive. The second part of the questionnaire is composed of questions concerning the gender issue in practice.

The questionnaire contains 9 questions, to which we obtained answers in a scale consisting of 5 variants of answers in the following wording with numerical expression: 1 - Definitely yes, 2 - Rather yes, 3 - Don't know, 4 - Rather not, 5 - Definitely not. Respondents should mark only one answer that is closest to their opinion. 162 respondents participate in the research. Respondents are randomly addressed through an online version of the questionnaire. We approached schools, transport and health organizations from all over Slovakia. We assume that there are statistically significant differences in the perception of gender issues in practice between executives and managers and we assume that there are statistically significant differences in the perception of gender issues in practice among respondents working in the field of education and transport.

We used arithmetic mean and standard deviation in descriptive statistics. The arithmetic mean is the most commonly used positioning characteristic and is calculated from all quantitative values. Defines the sum of all character values divided by their number - the range of the file.

The standard deviation  $\sigma$  is the square root of the variance. The variability of a feature is usually characterized by a guide deviation, because the standard deviation has the same dimension as observed sign.

To evaluate the hypotheses, we used a paired t-test, which is used to compare the mean values of two populations. We compare two samples, where in samples from one observation can be paired with samples from another observation.

## 3. Results

In the first hypothesis we analyzed statistically significant differences in the perception of gender issues in practice between managers and executives. We addressed 24 managers, representing 15% of the respondents and 88 executives, representing 54% of the respondents. The test results are shown in Table 1.

**Table 1.** Statistically significant differences in the perception of gender issues in practice between managers and workers.

Questionnaire items	Organization classification	Average	Standard deviation	Standard deviation	Significance
Q 1	Managers	3,21	1,449	2,065	,024
	Workers	2,47	1,375		
Q 2	Managers	3,92	1,176	2,813	,003
	Workers	3,01	1,450		
Q 3	Managers	4,54	,884	2,626	,001
	Workers	3,75	1,400		
Q 4	Managers	4,50	,885	2,550	,002
	Workers	3,76	1,339		
Q 5	Managers	3,38	1,345	2,200	,018
	Workers	2,58	1,624		
Q 6	Managers	3,13	1,541	2,657	,007
	Workers	2,19	1,453		

The full questionnaire items were as follows:

Q1: Have you ever encountered any form of discrimination in employment?

Q2: Do you think there is an unjustified penalty in your workplace?

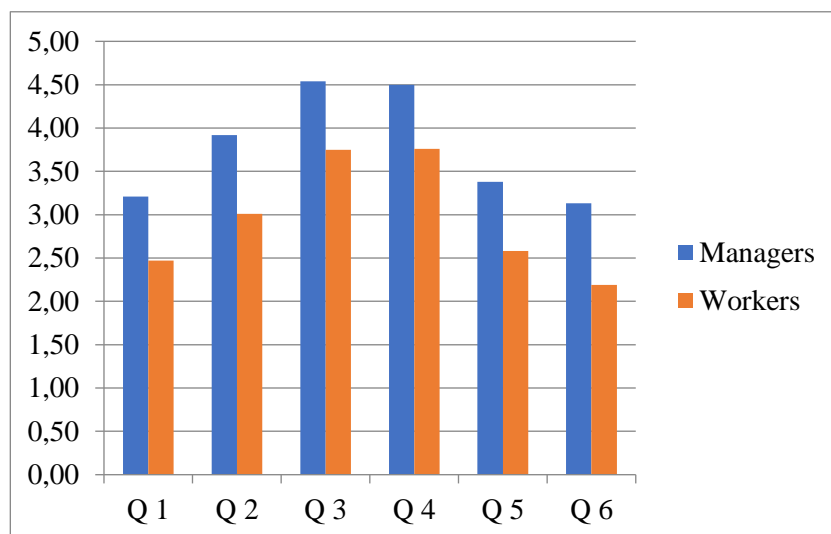
Q3: Do you think there is a discrimination instruction in your workplace?

Q4: Do you think there is incitement to discriminate in your workplace?

Q5: Do you have personal experience in different pay for work of the same value?

Q6: Do you know someone who has had a problem with pay discrimination?

In figure 1 we can see differences in the perception of gender issues in practice in terms of inclusion in organizations, namely in managerial and executive positions.



**Figure 1.** Average response values in terms of inclusion in organizations.

Neither managers nor executives responded to the question of whether they encountered any form of discrimination but executives were closer to a positive answer than managers. On the question

of unjustified sanction at the workplace, the managers replied that they had not previously encountered unjustified sanction while executives took a neutral stance. Neither managers nor executives have encountered this form of instruction and incitement to discriminate, but managers tend not to answer, while executives tend not to answer. On the question of personal experience in remuneration for work of the same value, more managers were more neutral than executives. Regarding the question of knowing someone who had a problem with pay discrimination, executives answered positively.

We state that hypothesis 1: We assume that there are statistically significant differences in the perception of gender issues in practice between executives and managers have been confirmed.

In the second hypothesis we analyzed statistically significant differences in the perception of gender issues in practice among respondents working in the field of education and transport. We addressed 53 respondents from education, which represents 33% of respondents and 59 respondents working in transport, which represents 36% of respondents.

**Table 2.** Statistically significant differences in gender perception in practice in education and transport.

Questionnaire items	Organization classification	Average	Standard deviation	Standard deviation	Significance
Q 7	Education	,51	,973	2,630	,010
	Transportation	1,08	1,330		
Q 8	Education	1,58	,865	-3,632	,000
	Transportation	2,34	1,308		
Q 9	Education	1,53	,823	-2,830	,006
	Transportation	2,08	1,236		

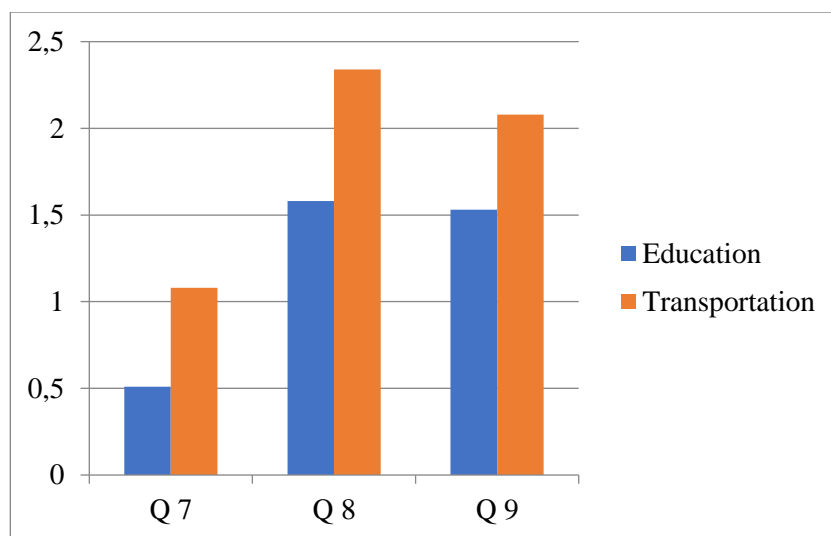
Full questionnaire items:

Q7: How did the employer react to defending your rights?

Q8: Are you aware of the opportunities for the employer to promote equal conditions through retraining?

Q9: Are you aware of the opportunities for employer to promote equal opportunities through training?

In figure 2 we can see differences in the perception of gender issues in practice in terms of work, education and transport in particular.



**Figure 2.** Mean response values in terms of work area.



Question no. 7 is not compiled by scale as other questions. It consists of specific model responses of the employer when the employee defended his rights in remuneration. Education respondents were more inclined to reply that the employer pointed out differences in the quality or quantity of work done. Transport respondents were inclined to reply that their employer criticized their work and pointed out their shortcomings. The respondents answered the question whether respondents are aware of the promotion of equal opportunities by the employer in the form of retraining and provision of vocational training.

We state that hypothesis 2: We assume that there are statistically significant differences in the perception of gender issues in practice among respondents working in the field of education and transport have not been confirmed.

#### 4. Discussion

Research activities on gender issues, multiple causes analysis and knowledge of the link between obstacles to gender equality in employment were also addressed by the authors (Belén et al. 2018) as part of the Sectoral Operational Program Human Resources. In this research, the authors dealt with the characteristics of the labor market both in Slovakia and in Europe and its gender imbalance in terms of the proportion of employment of men and women in individual labor sectors, which they believe is one of the most important cause of gender inequality.

(Diehl 2009) see the main differences in the degree of participation between men and women, opportunities and rights. The authors build on the empirical findings that follow from the research of OECD member states.

(Durana et al. 2019) analyzed differences in wage valuation between men and women in her analyzes, and found differences in wage valuation between men and women. She found that wage differences are greater where women work in their sector than when they work in the male sector. It is based on gender segregation of the sector, with the term 'female' sector attributed by the author to the service sector and 'male' to craftsmen, manufacturing workers and skilled workers in the use of machines, apparatus and equipment. The findings are based on the gender segregation index for occupational groups and on sectoral segregation and average wages in 2001.

(Jenson 2009) further elaborates on the findings of the analyzes, while pointing to discrimination against women in the following areas, women have experienced higher long-term unemployment and higher concentration in lower-paid jobs. In addition, we have seen a low representation in management positions and differences in pay in the same or related job positions.

The authors (Allison and Risman 2013) were also interested in the evaluation of factors taking into account regional disparities and territorial specificities of labor markets. On the one hand, they examined the various causes in relation to the analysis of demographic data and the concentration of employment and vacancies, and on the other hand the findings of the social construction of labor policy, the reconciliation of work and family, motivation, but also the barriers associated with it.

The aim of the article was to point out the perception of gender issues in the labor market. Gender issues in practice are still a persistent form of discrimination. Gender discrimination seems to be most apparent in the field of work. The employment rate of women is still significantly lower than that of men. There are many unjustifiable differences in paying wages for work of equal value between men and women. Lower wages or under-representation of women in managerial positions are still problematic areas of gender inequality in the labor market.

It is the development of terms related to gender issues and specific general gender differences given by genetic equipment and gender differences in the workplace in the theoretical part. We discussed the concept of opportunities and the importance of creating a corporate culture with an appeal to the principles of equality. The research carried out confirmed the persisting differences in the perception of gender issues between managers and executives. Even the Anti-Discrimination Act is not sufficient to ensure that differences in perception of inequality are not demonstrable. It is increasingly appealing for the implementation of the internal directives of enterprises that are focused on equal opportunities.

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# Fuzzy Sets as an Initial Analysis for the Prediction of the Bankruptcy Situation

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**Abstract:** The financial analyses of a company are substantially complicated. Especially when it comes to the situations where there are high levels of uncertainty. In this paper, we address the issues regarding the prediction of a bankruptcy situation with the help of fuzzy sets and compare the results of different analytical methods and approaches. A significant part of fuzzy sets theory is related to optimization of the decision making and it is clearly it's best used in the situations where the use of prediction methods that rely on the past data is not possible due to the significance of error caused by the level of uncertainty. The construction of predictions through linear models is not yet offered in the literature. The main reason is the inconsistency of the methodology, which could find application in practice. Work on the use of fuzzy sets in financial analysis is part of a larger project to design a bankruptcy model or methodology that must be able to take into account possible errors (or its dispersion).

**Keywords:** fuzzy sets; bankruptcy; financial analysis

**JEL Classification:** C1; G0

## 1. Introduction

The word “fuzzy” means wispy, unclear, misty, vague, and uncertain (Zadeh 1965). It is possible to understand the fuzzy set as the complete universe, where only some elements are not definitely in it, and the membership degree to the fuzzy set is specified by mathematical functions (Kainz 2010).

The field of impact of the fuzzy sets in mathematic modeling of vagueness cannot be separated from the terms used in verbal description. The terms used in financial analysis do not and cannot have exact borders. It is possible to mention such terms as rapid onset of a bankruptcy situation, prospective development of financial management, reasonable debt level, a financially sound company etc. These terms are not clearly and exactly delimited and it is not adequate to use the probability either. However the related insecurity is not of stochastic, arbitrary type (Mareš 2002).

Mathematic operations used for the description of fuzziness are naturally different from operations with random events and variables. That is why the fuzzy sets theory has been created. A significant part of this theory is related to optimization of the decision making and evaluation of the fuzzy data files. In case of classical deterministic sets it is possible to clearly determine if each object belongs to a specific set or not (industrial company, debt sources, long-term property). Fuzzy sets can be used with objects (see above), whose membership cannot be definitively determined.

To get a clear description of a fuzzy sub-set “A”, it is possible to generalize the characteristic-membership function  $\mu_A$  in such a way, that for each element  $x$  applies:

$$\mu_A(x) = 1 \text{ if } x \text{ certainly belongs to } A, \quad \mu_A(x) = 0 \text{ if } x \text{ certainly does not belong to } A, \\ 0 < \mu_A(x) < 1 \quad \text{If certain, that } x \text{ belongs to } A.$$

In the last case the value of  $\mu_A(x)$  will be the closer to 1, the more likely  $x$  can be considered an element of a fuzzy set  $A$  (Navara and Olšák 2002). From this point of view an expert opinion is a source of fuzziness of quantitative data; reasonable profit rate, relatively high correlation, an appropriate structure of capital resources, frequent decline in the economic sector etc. And thus if financial analysis

uses verbal description of the economic reality, it is necessary to know, how to clearly distinguish the relative significance of descriptive characteristics. If fuzzy sets are used, the vagueness of the results increases enormously, however this theory enables to work efficiently with the fuzzy quantitative and qualitative data. In this expression a fuzzy set is an ordered pair  $\tilde{A} = (U, \mu_{\tilde{A}})$ , where  $U$  is the basic set and  $\mu_{\tilde{A}}$  is the membership function defined as  $U \rightarrow \mu_{\tilde{A}}: U \rightarrow [0, 1]$  (Zadeh 1965).

The value  $\mu_{\tilde{A}}(x)$  then expresses the grade of membership of  $x$  to the fuzzy set  $\tilde{A}$ . It is possible to simplify the expression of a fuzzy set  $\tilde{A}$  using grades of membership in the discrete case of universe (i.e. the basic set)  $U$ , so that the given elements are omitted and the fuzzy set  $\tilde{A}$  is written as a row vector where the vector components are equal to grades of membership of individual elements. If a fuzzy set is expressed in this way, it is possible to work with it same as with a usual vector, the only difference being use of special operations (e.g. to set if the selected asset of the entity was acquired recently or not, a so called "new property". The vagueness of the description of the economic reality consists in the attribute "new". The value  $\mu_{\tilde{A}}(x)$  sets a date in the calendar. If  $x$  (meaning new property) is acquired on January 1st, then  $\mu_{\tilde{A}}(x) = 1$ , 31st of December  $\mu_{\tilde{A}}(x) = 0$ , other values (dates) are within the interval  $0 < \mu_{\tilde{A}}(x) < 1$ . This division is based on the idea of a calendar year with 365 days. A more appropriate approach for calculations would be based on the length of different vectors, where e.g. the length of the value 1st of January is 1, 3 of 3rd February is 34 etc. From the point of view of vector operations, it is already evident, that the longer the vector is the older is the asset).

## 2. Results and Discussion

Within financial analysis such a way of expression of descriptive relations can be considered sufficient, even though for a user of outputs and conclusions, such an intermediate result of the analysis may be rather confusing. Moreover, such an entry is often not even considered a clear result of monitoring of two variables. In case of bankruptcy it is important to know what debt ratio; eventually the amount of debt finance is acceptable with the monitored entity. It is possible to use the recommended values, however even their boundaries are too wide.

In case of debt financing it is thus possible, that one processor of the financial analysis considers the amount of loan capital at the level  $CK_1$  adequate, another processor does not. In a similar way, at the level  $CK_2 > CK_1$  the data can be seen in a different way. In this case we often consider the verbal descriptions and financial analysis conclusions as inaccurate. (They are findings and expressions of acceptable amount of debt finance with different analysts and of different analyzed companies). Graphic expression of the above mentioned problem can certainly be as follows in figure 1:

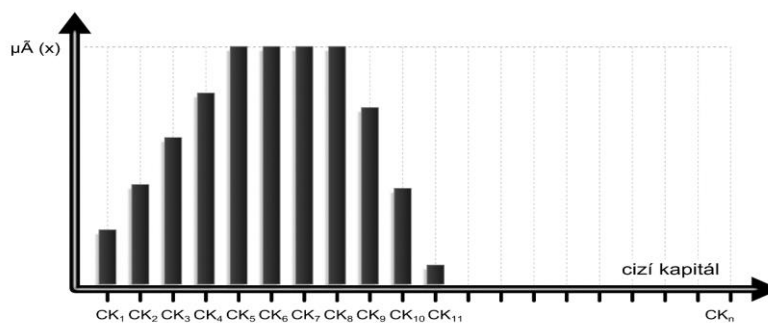


Figure 1: Foreign capital.

In case it is necessary to define a set of all levels of loan capital, that can be marked as acceptable, then the limit values of a selected company would be:  $CK_1$  e.g.: 1 million Czech crowns) < acceptable <  $CK_2$  (e.g. 10 million Czech crowns). The value of  $CK_3$  (e.g.: 500 000 Czech crowns) would not belong to the mentioned set (value log. 0), while the value  $CK_2$  (10 million Czech crowns) would (log. 1). How could the analyst classify the value  $CK_4$  (e.g. 999 000 Czech crowns)? In practice such level would probably be acceptable. If such level could be acceptable, how should we classify the level of 998,000 CZK and 997,000 CZK?

However, e.g. Boolean logic that is often used in standard bankruptcy models, does not know the above mentioned details. The mentioned problem is solved by the grade of membership. In case of debt resources it is the value of probability, that the given element (999,000 CZK of debts resources) belongs to the given set "acceptable". It can be written as follows:  $\mu_{\tilde{A}} = 0.9$  (999),  $\mu_{\tilde{A}} = 1$  (10),  $\mu_{\tilde{A}} = 0$  (2).

Within the CCB model, universe is estimated according to the economy area, in which the company operates. In that case the debt sources are:  $U = [0, 20]$  million Czech crowns. For all companies in general probably:  $U = [-20, 100]$  million Czech crowns. [Here the CCB model emphasizes the accounting aspect, where it is possible to recognize negative values of debt sources (claims) and their maximum level is determined by the biggest company (from the point of view of balance sheet total) in the area].

A value from the interval  $[0, 1]$  that expresses the grade of membership to the given set "acceptable" is assigned to each level of debt sources. This assignment can be done with help of calculation types, charts (fields) or with definition of the membership function, the membership function of the set "acceptable". This membership is possible with use of calculation types, charts (fields) or with definition of the membership function. The membership function to a set could be of the following form:

$$A \text{ acceptable} \begin{cases} 0, \text{if } CK < 0.9 \text{mil. CZK} \\ \frac{CK-0.9}{1-0.9}, \text{if } 0.9 < CK < 1 \text{mil. CZK} \\ 1, \text{if } 1 < CK < 10 \text{mil. CZK} \\ \frac{10-t}{20-10}, \text{if } 10 < CK < 20 \text{mil. CZK} \\ 0, \text{if } CK > 20 \text{mil. CZK} \end{cases}$$

The fuzzy set is created by elements  $x$  selected from the set  $U$ ,  $x \in U$ , where to each element is assigned a number  $a \in [0, 1]$ , i.e. the grade of membership of the element into the fuzzy set  $A$ . It is a set of ordered pairs – its grade of membership. It is possible to explicitly write the fuzzy set as:

$$A = \{a_1 / x_1, \dots, a_n / x_n\}, \quad (1)$$

where  $x_1, \dots, x_n \in U$  are elements with associated grades of membership  $a_1, \dots, a_n \in (0, 1]$ , i.e. elements with grades of membership 0 are not included. If universe is not the final set and it is not possible to be written down as a list of elements, it is possible to write it down as follows:

$$A = \{a_i / x_i \mid i \in I\}, \quad (2)$$

where  $I$  is an index set or it is possible to specify the characteristics of  $x_i$  and  $a_i$  in a more detailed way. If for example the elements  $x$  are real numbers and the grades of membership are defined by a function, the fuzzy set may be written down as follows:

$$A = \{f(x) / x \mid x \in R\}, \quad (3)$$

where  $R$  is a set of real numbers. Other specific sets (carrier,  $a$ -cut and core) are further used only in theoretical way to write down the analyses results, however the CCB uses this knowledge (recording the value of a selected ratio in the form of singleton.) The carrier of the fuzzy set  $A$  is a set of all elements of the universe, whose grade of membership into  $A$  is not zero.

This set is very important as it contains all elements that are interesting for those who elaborate the financial analysis. The elements whose grade of membership is zero are not interesting as they can be absolutely arbitrary.

$$\text{Supp}(A) = \{x \mid A(x) > 0\}, \quad (4)$$

$A$ -cut is a set of elements whose grade of membership is at least (i.e. bigger or equal) the given grade  $a$ . This set can be obtained from the fuzzy set cutting all elements whose grade of membership is less than  $a$ .

$$A_a = \{x \mid A(x) \geq a\}, \quad (5)$$

For  $\alpha$ -cuts of fuzzy sets the following applies: if  $\alpha \leq \beta$ , then  $A_\alpha \supseteq A_\beta$

Equality the so-called clause about representation of a fuzzy set means, that the grade of membership of the element  $x$  into the fuzzy set  $A$  equals the supreme of all indexes and cuts according to the image:

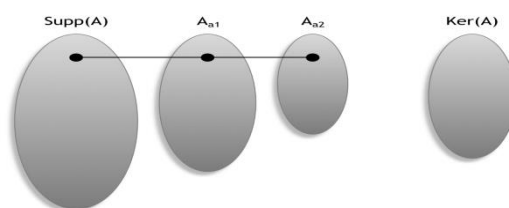


Figure 2: The supreme of all indexes. (Source: Author)

The core is a set of those elements that for sure belong in the fuzzy set  $A$ . They represent typical elements for the given fuzzy set. It will be linguistically typically “acceptable” from 1 million Czech crowns to 10 million Czech crowns.

$$\text{Ker}(A) = \{x \mid A(x)=1\}, \quad (6)$$

A fuzzy one-element set (singleton) or a fuzzy unit  $\{a/x\}$  plays an important role too. The term of a fuzzy unit is very important especially in fuzzy regulation, because it is the way how to understand the result of a specific result, for example the ratio – the debt ratio (CK/VK) of 0,400 will be in the form  $\{1/0.400\}$  (Klepárník 2003).

According to Klepárník (2003) aspects of fuzzy approach to modeling can be:

- Modeling of vagueness and non-stochastic uncertainty of values and intensity of relations,
- Expert evaluation with use of grades of membership and linguistic terms (variables),
- Transformation of fuzzy models into classical models that can be solved with use of existing methods, eventually creating of new special methods.

Within financial analysis fuzzy sets, thus enable to solve the character of some “attributes” that are often vital for partial characteristics of the bankruptcy state. However, methodology of fuzzy sets (including work with their elements) does not allow determining concretely what sets are going to be analyzed.

This again confirms the presumption, that cooperation of two analysts is ideal for financial analysis elaboration. If all the analytical activity and prediction is done only e.g. with use of calculation software, that is able to connect both procedures, then it can be thought that it is much more important to select the data and its attributes (see “acceptable”) than to do the mathematical work with the data.

The same point of view can be used even in case of fractional geometry that, as it is often stated, does not methodologically serve to predict (bankruptcy, financial health), but knowledge resulting from fractals must be seen as a new way of data elaboration. The selection of analyzed data and information depends again on the decision of the analyst or the person who presents the financial analysis. In relation with the hypothesis of the effective market it is good to remind here that for a long time it was generally assumed, that prices of securities reflect more or less arbitrary events in the world of business and that their fluctuation is arbitrary.

However, if that was so, the bankruptcy prediction, eventually reasoning based on time change of the security of the analyzed entity, would be absolutely useless. The first described point of view was introduced by Louis Bachelier, who worked on modeling price fluctuation. Later on it became apparent, that his pattern was very approximate and that it significantly underestimates the probability of a relatively big price fluctuation. Benoit Mandelbrot later proposes to express price fluctuation with use of the so called Lévy distribution. It is characterized especially by the fact that for big fluctuations it gets closer to power distribution in the form:

$$P(\Delta x) \approx (\Delta x)^{-1-\alpha}, \quad (7)$$

The power distribution is almost always a manifestation of the mentioned fractional geometry. And a power price distribution indicates the fractional characteristics of price fluctuation. A more subtle manifestation of fractionality in economics is the so called scaling, that observes change of price with a simultaneous change of time. The characteristics scaling means: the probable distribution will not change if the prices scale does not change either. And thus the price distribution does not depend on two variables, time interval  $\Delta t$  and price change  $\Delta x$ , but on one variable only, and that is the selected combination (e.g. rise and decline of prices of different commodities develop in the same way in time - they decline in the time of crisis and rise in the time of recovery, however it does not matter if recession period is one day in a month, one month in a year or one year in a century. It can be expressed as follows:

$$P\Delta t(\Delta x) = (\Delta t)^{-H} f((\Delta t)^{-H} \Delta x), \quad (8)$$

where  $f$  is a function that decreases as power  $f(y) \approx y^{-1-\alpha}$ , and  $H$  constant is the Hurst exponent. Bachelier's idea of price fluctuation as a random walk meets exactly the characteristics of scaling with the value  $H = 1/2$ . The problem is, that real data indicate a significantly higher value around  $H = 2/3$ . Apart from the power form of the scaling function  $f$  the higher value of the Hurst exponent is one of the reasons why a usual random walk is absolutely inappropriate as a model of stock exchange fluctuations and it is necessary to search for something substantially better (Slanina 2006).

Any fractal object can be generally defined with use of two basic characteristics: (1) repeated similarity of the basic form that appears in one object in different sizes, (2) all near points are strongly correlated (for example during crisis the number of entities active in business decreases no matter if it is a global crisis, national crisis, crisis in the specific industry, regional crisis or a crisis between suppliers). These characteristics create appropriate conditions for prediction of time series that are important for financial analysis. Fractal geometry states, that even in an absolute chaos it is possible to find situations that repeat and describes more complex structures that use more simple structures that are their part (Sojka and Mendelík 2001). In an apparent chaos fractals represent the repeating elements (Moravec 2006). The market development has a number of chaos creating factors. R. N. Elliot was regularly observing hourly data on a New York stock exchange between 1935 and 1947. Thanks to the accumulated data he was able to describe market behavior. The so-called Elliot wave was then named after him.

### *2.1. The issue of data analysis with use of expert systems and neural networks*

Data analysis tools are also often integrated into database and information systems. They are tools for the use of data warehouses and part of analytical elaboration (i.e. data mining issue). Further development in this area will probably mean combination of individual technologies in order to get optimal approaches for different types of data files. It can be, for example, a combination of genetic and neuron algorithms with decision trees. Nowadays, the term hybrid system in term of a combination of various algorithms can already be found in literature. Armingier et al. (1997) use problems with repayment to show the combination of the logistic discrimination analysis, classification tree and neuron network. As far as the program equipment is concerned, statistic program systems are the base. Apart from that, specialized products focused on decision trees or neuron networks are also offered. Among other types of software equipment with integrated data mining technology are relational database systems, systems supporting decision making. These procedures can be also used in the analysis of economic trends in the analyzed entity. There are different types of tasks (see Table 1) to be solved same as different procedures that can be used.

**Table 1.** Classification of data analysis.

Task	Method
Classification	Discriminant analysis, Logistic regression, Classification (decision) trees, Neuron networks
Predictions of values of the explained variable	Linear regression analysis, Non-Linear regression analysis, Neuron networks
Segmentation (clustering)	Cluster analysis, Genetic algorithms Neuron clustering (Kohonen maps)
Relation analysis	Association algorithm for derivation of rules like If X, then Y

When classifying and estimating values with some entities, it is possible to use values of explanatory variables as well as values of the explained variable. The aim is to analyze the influence of explanatory variables on the explained variable, so that it was possible to estimate the value of an entity with unknown value of the explained variable. In the terminology of neuron networks it is supervised learning. The same principle is also used with prediction of time series (Řezanková 2001). (The use of neuron networks is justified in case when either during a problem solution it is not possible to mathematically describe all relationships and contexts, that influence the observed process or in cases when it is possible to create the exact mathematical model, but it is so complicated, that it is almost impossible to algorithmize the task. They are especially complex and non-linear systems. Among the biggest advantages of artificial neuron networks is the ability to learn. It means to acquire knowledge by learning with use of a set of presented formula without necessity of knowing the algorithm of solution. Neuron networks may be used in financial analysis for prediction of time series and eventual consecutive decision making.

In segmentation (clustering) the data file is divided into groups and thus clusters of objects are created. The appropriate number of groups is usually identified in the course of the data analysis. Association algorithm is used in the relationship analysis to acquire rules, i.e. implications of IF (logical combination fact) THEN fact, where fact is an elemental logical statement. It is found out, what percentage of a specific logical combination of facts (antecedent) implies a fact on the right side of the rule and what percentage of records can be found in this association. Detection of deviations can be made with use of a graph with original (identified) values (a correlation graph XY) or statistical characteristics of the file. The basis for the data analysis is creation of a model that represents the data set. There are several modeling techniques, within which there are a lot of different approaches. The aim of modeling in case of classification decision trees is creation of a tree structure. There is a number of different algorithms for categorical data. These algorithms can be combined.

In this way it is possible to identify high-risk entities from a selected sector of economy (i.e. to select possible entities endangered by financial distress) on the basis of:

- Their property / capital structure,
- Size of the unit,
- Market orientation of the company,
- Active years in business.

The algorithm CART is in this case based on the fact, that from each node that is not final (the last) lead two branches (other methods admit more branches, and the maximum number of branches depends on the number of categories of the variable, that serves as a predictor).

The procedure of creating the model can be divided into 3 steps:

1. Selection of variables from the data file. The user chooses the variable whose values are to estimate (financial distress, financial structure of the company). Then he/she chooses the explanatory variables used to carry out the estimation.



2. Creation of the groups of values. On the basis of statistical tests (chi square, see further) two groups of values are created for each explanatory variable. The principle of the test is to find out what are the two groups with the biggest variability between the groups and the smallest variability inside the groups. It is an iterative process.
3. Creation of a tree structure. A variable that contributes to the greatest extent to estimation of the explained variable is identified. On its basis the tree structure is created (Řezanková 2001).

Among the disciplines that are a basis for data mining are especially intuitive learning, machine learning and statistics. They are also basis for the models used in data mining. There are 7 types of models (table 2) used for solution of standard problems:

**Table 2.** Data mining models.

<b>Model</b>	<b>Description of behavior</b>	<b>Prediction</b>
Classification		×
Regression		×
Time series		×
Neuron networks		×
Clustering	×	
Exploratory analysis	×	
Association analysis	×	

It is obvious that, when using the techniques of data mining, it is necessary to use the appropriate software. Expert writings remind (Klímek 2005), that success of data mining depends not only on a good choice of the model and statistical method, but especially on a good formulation of the problem and use of correct data. That again confirms the assumption of the CCB model about the necessity of precise selection of data to be analyzed and then the use of methods for the data elaboration.

Recommendation about the form of the analytical tool for data mining is based on the following characteristics:

- Analytical abilities. The tools for data mining contain currently most used methods for data mining: decision trees, clustering and modeling with use of neuron networks and a number of other algorithms. There is different scope and possibilities of parameterization for different products, the products also support creating of proper models.
- Ease of use and analytical work. Creation of a specific model in the frame of data mining is often an iterative and complicated process. In clustering analysis it is usual to try an optimal method (e.g. K-means, Kohonen network, probability model) and testing of the optimal number of clusters. If a multi-layer neuron networks are used, the behavior can be radically changed due to the change of number of neurons, way of normalization of the input data etc. These and other reasons lead to a requirement of intuitive environment for creation, administration, connection and continuous evaluation of models and source and modified sets.
- Connectivity for input data, operability of work with data sets. All mentioned tools enable to flexibly import the input data with use of different sampling methods, to create their subsets and manipulate with them flexibly. Different kinds of functions for input data transformation are supported as well, e.g. filtering, normalization, compensation of values, change of distribution characteristics etc.
- Visualization and statistical evaluation of data and results of the models. Profiling, visualization and statistical elaboration of the input data and analyses results is always a part of the project of data mining (Klímek 2005).

### 3. Materials and Methods

Point estimates, as first of the group of statistical methods of financial analysis of a company, are used for a rough  $\bar{x}$  estimate of a normal or comparative value of a specific indicator for a group of companies. The value of the point estimate quantitatively represents the whole file (arithmetic mean standard deviation  $\sigma$ ). In case that certain statistical assumption do not apply (which is very typical in the  $\bar{x}$  economic reality), the use of point estimates is not appropriate due to their sensitivity to remote data, that is usually present in financial data. In order to remedy robustness (sensitivity to remote data) point estimates of another class, the so-called ordinal statistics [median] are used, (Průcha 2005). In scientific literature it was already proven, that relative measures (ratio of two selected items) do not give the real image of the financial situation of the company, if they are compared with average values of the indicators of the so called corresponding undertakings. Mr. And Mrs. Kovanic state, that the assumption, that both numerator and denominator of a ratio indicator are directly proportional to the size of the company, is complied with only exceptionally. (Kovanicová and Kovanic 1996). If the text of this publication is primarily based on elemental statistic methods, we assume, that for the estimation of the financial situation of a company focus should be put especially on point and interval forecast, that however from the statistical point of view are based on absolutely different characteristics than the mentioned point estimates.

Forecast construction based on models with variable regimes that serve for forecast is generally characterized in the following A general non-linear model of the order one in the form:

$$X_t = G(X_{t-1}, \delta) + a_t, \quad (9)$$

where  $G$  is a non-linear function and  $\delta$  is a vector of parameters. An optimal point forecast is the conditional median value. An optimal forecast with the horizon  $h$  made in time  $T$  can in general be expressed as:

$$X_{T+h} = E(X_{T+h} | \Omega_T), \quad (10)$$

where  $\Omega_T$  expresses history of the time series until time  $T$  included, i.e. a line of values  $X_T, X_{T-1}, X_{T-2}, \dots$ . The optimal forecast with horizon one is in the form of:

$$X_{T+1} = E(X_{T+1} | \Omega_T) = G(X_T, \delta), \quad (11)$$

It is a forecast that is constructed in a similar way as in case of linear models. The situation becomes more complicated though, if the forecast horizon increases. The optimal forecast with horizon two is in the form:

$$X_{T+2} = E(X_{T+2} | \Omega_T) = E[G(X_{T+1}, \delta) | \Omega_T], \quad (12)$$

The basic problem is, that in contrast with linear models, inequality applies  $E[G(X_{T+1}, \delta) | \Omega_T] \neq E[G(X_{T+1} | \Omega_T), \delta]$  which means, that the linear operator of the conditional median value  $E$  cannot be exchanged with non-linear operator  $G$ . It is possible to conclude, that in case of non-linear models there is no simple relationship between forecasts with different horizons, same as in case of linear models. In this context several possibilities of construction of point forecasts appeared. They may be based on the relationship  $X_{T+2} = E(X_{T+2} | \Omega_T) = E[G(X_{T+1}, \delta) | \Omega_T] = E[G(G(X_T, \delta) + a_{T+1}, \delta) | \Omega_T] = E[G(X_{T+1} + a_{T+1}, \delta) | \Omega_T]$

Supposing, that  $a_{T+1} = 0$ , it is possible to remove the conditional median value from the relationship and then the forecast can be written down as:

$$X_{T+2}(n) = G(X_{T+1}, \delta), \quad (13)$$

In literature this type of forecast is denominated as naive (Kohout 2005). From this denomination it is evident, that it is possible to construct more appropriate forms of point forecasts. One of them is the closed form of forecast that can be expressed as follows:

$$X_{T+2}(n) = \int_{-\infty}^{\infty} G(X_{T+1}, \delta) f(X_{T+1} | \Omega_T) dX_{T+1}, \quad (14)$$

where  $f(X_{T+1} | \Omega_T)$  is conditional density of probability  $X_{T+1}$  on condition  $\Omega_T$ . It is direct expression of point forecast  $J$  in form of calculation. One of the problems of this point forecast is, that the integral is not generally available in analytical form and it is necessary to approximate it numerically, this activity can be, especially in case of a forecast with high horizon, relatively time demanding. Another problem is lack of knowledge about distribution of the variable at. In order to achieve a complex analysis of forecasts of time series it is efficient to use interval forecasts (constructed on the basis of linear models) whose typical characteristics is symmetry around point forecasts.

This fact is based on the assumption of normality of conditional distribution of the variable  $X_{T+h}$  with median value  $X_T(h)$  that is the basis for these models. In case of non-linear models the conditional distribution can be asymmetric and multimodal. And thus it is a question, if the symmetric forecast interval is a good choice. In literature (Hyndman 1995) there already have been three proposals of the way of construction of forecast intervals for non-linear models. Symmetric model around median value:

$$S\alpha = (X_T(h) - \Delta, X_T(h) + \Delta), \quad (15)$$

where  $\Delta$  shall be such, that  $P(X_{T+h} \in S\alpha | \Omega_T) = 1 - \alpha$ . The interval between  $100(\alpha/2)\%$  and  $100(1 - \alpha/2)\%$  of the quantile of the forecast distribution  $Q\alpha = (q_{\alpha/2}, q_{1-\alpha/2})$  (2.23)

Area with highest density:

$$HDR\alpha = \{X_{T+h} | [f(X_{T+h} | \Omega_T) \geq f\alpha]\}, \quad (16)$$

Where  $f\alpha$  is such, that  $P(X_{T+h} \in HDR\alpha | \Omega_T) = 1 - \alpha$ . In case of symmetric division with one mode the above mentioned forecast intervals are identical, in case of asymmetric distribution or distribution with more modes, the forecasts are not identical. The most natural is the third forecast interval, as it is the smallest of all possible intervals

$100(1 - \alpha) \%$  of forecast intervals and each point within this interval has conditional density of  $f(X_{T+h} | \Omega_T)$  at least the same as every point outside of the interval. It is interesting to compare the quality of forecasts constructed on the basis of linear and non-linear models.

However, the proposed bankruptcy model must be able to count with an eventual mistake (eventually its variance). Therefore, it is obvious, that despite the validity of conclusions of point and interval forecasts, the model must admit an error in case the horizon  $h$  increases.

We believe that the mere statement about the relationship of the accuracy of the forecast and horizon, that indicates its indirect dependence, is already sufficient here. We assume, that in case of any quantitative estimates of time series, that are a result of extension of development from the past till the present, the known assumptions are too unreal (e.g. Selection of the model, permanence of the model parameters). In this estimation the analyst examining the data is able to exhibit an error that is within the CCB model constructed at the level:

$$\hat{a}_{T+h} = y_{T+h} - \hat{y}_T(h), \quad (17)$$

The error supposed by the model is further divided in two parts  $\hat{a}_{T+h} = \hat{c}S1 + \hat{c}S2$  where each of the parts  $\hat{c}S$  is explained by the CCB model in a different way  $\hat{c}S1$  refers to the model selection and  $\hat{c}S2$  is allocated to the estimates of parameters by the proposed model.

The relationship can thus be noted as  $\hat{a}_{T+h} = (y_{T+h} - Y_{T+h}) + (Y_{T+h} - \hat{y}_T(h))$ , where  $y_{T+h} - Y_{T+h}$  is dedicated to the error made by the model selection (in case an appropriate model is selected  $y_{T+h} - Y_{T+h} = 0$ ) and  $Y_{T+h} - \hat{y}_T(h)$  explains the error made by the estimate of the model parameters. For exact extrapolation the CCB model further requires, that the forecast was an undistorted and a solid estimate  $E\{(\hat{a}_{T+h})\} = E\{(y_{T+h} - \hat{y}_T(h))\} = 0$  (2.27)  $E\{(\hat{a}_{T+h})^2\} = E\{(y_{T+h} - \hat{y}_T(h))^2\} = \sigma_p^2 \Rightarrow \min$ .

#### 4. Conclusions

In our opinion, the financial analysis of a company would be considerably complicated, if the analyst did not know not only the purpose of its processing, but especially the object of its activity of the analyzed company. The object of the activity of the analyzed company will without doubt be

influenced by the extent of extensive indicators. The extent of extensive indicators (tax liabilities, receivables from clients, basic capital, etc.) is certainly varied, depending on the object of the activity. In case of industrial companies this extent will be much bigger than for example in financial companies. E.g. expected return on debt from a group of textile manufacturing companies (and furthermore its development) should then reflect the situation in textile industry as a whole. Due to the uncertainty of point estimates, interval forecasts with a concrete horizon were used. This forecast precisely reflects the character of debt yields (and furthermore its development) of the present and past development, however the use of the same method for prediction is not possible anymore, as increase in error rate burdens the total result. Therefore, in this case it is not possible to use the past data to describe future development of the debt yield in textile industry as a whole.

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# The Comparison of Business Regulations in Czech and Malaysian Economies in 2020

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**Abstract:** The paper compares the present business circumstances that the International Bank for Reconstruction and Development evaluates for the last 17 years annually. The data acquired from this data set are further analyzed in order to obtain insight into similarities and differences of the business regulation in selected economies with dissimilar political, cultural, historical and territorial background, completely different sizes and populations. Czech and Malay economies are assessed on the basis to 10 criteria selected from a very wide range of areas that clearly contribute to the quality of the business environment. The data were collected for the period between May 2018 and May 2019. The analysis shows that the Czech Republic and Malaysia have not similar business regulation, completely different position in the ranking of surveyed countries. This contribution uses data from the October report called *Doing Business 2020*. A more detailed assessment of individual subsections shows a significant difference in protecting minority investors, dealing with construction permits for business purposes, in trading across borders and differences in legal enforcement of valid contracts.

**Keywords:** Doing Business 2020; entrepreneurship; business environment; business regulation

**JEL Classification:** L25; L26; O10

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## 1. Introduction

Business environment and the comparison of business conditions is an important parameter of macroeconomic stability and an important determinant of economic growth (Commander and Svejnar 2011), (Korner et al. 2002) and (Odehnal and Michalek 2011). The impact of the macroeconomic business environment on the development of corporate social responsibility has been examined by (Hategan et al. 2018), (Krajnakova 2018). These authors have found out that the business environment can affect corporate social responsibility in a variety of ways, and even in unfavourable macroeconomic conditions, companies continue to participate in socially responsible activities due to the fact that they bring them long-term benefits. In order to verify this statement, a quantitative assessment of the quality of institutions is needed. The importance of business environment has been evaluated in other articles by other authors, for example (Carmeli 2001), (Slavik and Jurikova 2002), (Petrik 2001), (Klapper and Parker 2011), (Chavis et al. 2011) and (Young 2001).

This paper explores the International Bank for Reconstruction and Development studies, especially the last one from 2019, which focuses on defining individual aspects of the quality of the business environment worldwide. In particular, we will focus on assessing the conditions for doing business in Malaysia and the Czech Republic.

Business conditions in various countries have been assessed for the last 17 years by World Bank Group and International Bank for Reconstruction. Then, the results are made public in final reports named "Doing Business" (DB 2019). The study affords quantitative indicators containing 12 sections of the business environment in 190 economies. The goal of the periodical studies is to afford objective data for practice by governments in proposing to publish business regulatory policies and to advance study on the important topics of the regulatory surroundings for companies. The yearbook *Doing Business*

2020 is the 17th in sequences of summary exploring the rules that magnify enterprise activity and those that confine it.

## **2. Methodology and Procedure for Assessing the Quality of Business Environment**

The current report compares business regulations and rules in 190 countries around the world practicing 12 main indices. The overall indicator ranks each compared country in the global ranking like the result of the average value of only 10 indicators. The total overview completes further 7 territorial groups (32 OECD high income countries, 25 from East Asia & Pacific, 25 from Europe & Central Asia, 8 from South Asia, 32 from Latin America & Caribbean, 19 from Middle East & North Africa, 49 from Sub-Saharan Africa).

Doing Business presented progress in the last few years to all its index groups. In the 2015 yearbook, the existing measures of Protecting Minority Investors and Getting Credit were broadened, while Resolving Insolvency introduced new measures of quality. In the yearbook Doing Business 2016, a new case scenario was introduced by Trading across Borders with the intention to raise the relevance of economy and index groups of Enforcing Contracts, Getting Electricity, Registering Property and Dealing with Construction Permits presented new quality measures as well. Doing Business 2017 yearbook contains the addition of gender components by Enforcing Contracts, Registering Property and Starting a Business and new measures of post filing processes introduced by Paying Taxes.

Calculation of scorings is only available for the Doing Business 2020 annual report. The comparability of the prior years is influenced by year-to-year changing numbers of economies, indicators and methodology. The recalculation of each methodology extension for one year took place in order to give corresponding index values and ranking for the previous year. The data which were obtained from Doing Business 2020 study cover two following areas:

- AREA I. Indicators characterizing the complexity and cost of regulatory processes in the monitored country in the form of an assessment:
  - Starting a Business,
  - Dealing with Construction Permits,
  - Getting Electricity,
  - Registering Property,
  - Paying Taxes and
  - Trading Across Borders.
  
- AREA II. Indicators characterizing the strength of legal institutions in the monitored country, namely:
  - Getting Credit,
  - Protecting Minority Investors,
  - Enforcing Contracts and
  - Resolving Insolvency.

Within the monitored areas, the indicators are evaluated according to 3-6 additional sub-criteria, which ensures the objectivity of the evaluation and, in particular, the expertise because all individual assessments are done by competent auditing and legal offices in each country. Each of the 10 indicators has the same weight in the overall rating, but it does not mean that the country ranked first in the overall rankings ranks first in sub-ratings. What is important is the average placement of the country according to all individual sub-areas.

## **3. Ease of Doing Business Ranking and Ease of Doing Business Score Results**

The comparison of countries shown in the ease of doing business (EODB) ranking is done with regard to regulatory best practice; countries are benchmarked to each other in the ease of doing

business score, indicating the entire range to the top regulatory performance on each Doing Business index. In this range, the topmost record is the example of the best regulatory achievement on the indicator among all the countries since 2005 or the third year when data for the index were processed.

When the analysis over years is carried out, the ease of doing business ranking shows, how much a country's administrative climate for local entrepreneurs has changed over time in absolute values, while in the ease of doing business ranking only the amount of administrative climate transformation in relation to other countries can be presented. The very top countries in the ease of doing business list (see Tab. 1) are those with permanently well-created business climate or those having favourable administrative surroundings due to extensive enhancement throughout the years. The five highest ranking economies of this year - New Zealand, Singapore, Hong Kong, Denmark and Korea Republic – represent a business-friendly climate and they have been leading the ranking since 2010.

### 3.1. Ease of doing business ranking overview

**Table 1.** Ease of doing business ranking – TOP 12 (DB, 2019).

Rank	Economy	Region	EODB score (2020)	EODB score change (2020/2019)
1	New Zealand	OECD high income	86.8	-0.02
2	Singapore	East Asia & Pacific	86.2	+0.4
3	Denmark	OECD high income	85.3	+0.1
4	Hong Kong SAR China	East Asia & Pacific	85.3	+0.2
5	Korea Rep.	OECD high income	84.0	0.0
6	United States	OECD high income	84.0	+0.4
7	Georgia	Europe & Central Asia	83.7	+0.2
8	United Kingdom	OECD high income	83.5	-0.1
9	Norway	OECD high income	82.6	-0.3
10	Sweden	OECD high income	82.0	0.0
11	Lithuania	Europe & Central Asia	81.6	+0.6
12	Malaysia	East Asia & Pacific	81.5	+0.2
:	:			
40	Poland	OECD high income	76.4	-0.5
41	Czech Republic	OECD high income	76.3	0.0
45	Slovak Republic	OECD high income	75.6	+0.2
52	Hungary	OECD high income	73.4	+0.2

<sup>1</sup> Notes: The range from 1 to 190 is captured by the ease of doing business ranking. The ease of doing business score shows the gap in each economy from the highest regulatory performance monitored on each of the indicators across all economies in the Doing Business sample since 2005. The position on the scale from 0 to 100 reflects an economy's ease of doing business, where 0 means the lowest and 100 the highest performance.

### 3.2. Malaysia and the Czech Republic – details of Doing Business conditions

The evaluation of the situation in the countries under review is shown in Table 2. In terms of complexity and cost of regulatory processes, three out of six indicators in Malaysia are clearly better evaluated than in the Czech Republic, while the remaining three are better in the latter. Malaysia is much better rated in dealing with building permits. Malaysia scores higher than the OECD average or the East Asia Pacific region in this assessment, mainly due to the very low number of days and procedures to build a warehouse. Procedure is any interaction between the managers or employees of

a company and external parties. There are only insignificant differences in other sub-indicators. The costs are a percentage of the value of the warehouse and the quality assurance index based on six other indices - quality assurance after construction, quality assurance during construction, quality assurance before construction, quality of building regulations, liability and insurance regimes and indices of professional certification.

On the contrary, the Czech Republic is significantly better than Malaysia in Trading across borders. The Czech Republic receives a better score than the OECD average, East Asia & Pacific area as well. It is the recording of time and costs associated with the logistics process for exporting and importing goods, time and cost measurement associated with the following procedures - national transport, border compliance, and document compliance - as part of the overall process of shipment, import and export of goods. Although the database contains and reports data on time and cost of local transport, it is not used to calculate the index of cross-border trading or assess its ease. The main point is that local transport time and costs are affected by many external factors. Among them, the topography, geography, and general infrastructure of the transit area, the location of warehouses where goods are kept, road capacity and proximity to the nearest port or border. Therefore, they are not directly influenced by trade policies and economic improvements of the country in question.

**Table 2.** Complexity and cost of regulatory processes (DB 2019).

Topic and indicator	Malaysia	Czech Republic	East Asia & Pacific/OECD high income countries	EODB score Malaysia	EODB score Czech Republic
<b>Starting a business</b>			<b>83.9/91.3</b>	<b>83.3</b>	<b>82.1</b>
				<b>(126)</b>	<b>(134)</b>
Procedures (number)	8(9)	9	6.5(6)/4.9		
Time (days)	17(18)	24.5	25.6(7)/9.2		
Cost (% of income per capita)	17.4	1.1	3.0		
Minimum capital (% of income per capita)	0.0	0.0	3.5/7.6		
<b>Dealing with construction permits</b>			<b>70.0/75.6</b>	<b>89.9</b>	<b>56.20</b>
				<b>(2)</b>	<b>(157)</b>
Procedures (number)	9	21	14.8/12.7		
Time (days)	41	246	132.3/152.3		
Cost (% of warehouse value)	1.3	0.2	3.2/1.5		
Building quality control index (0–15)	13	8.0	9.4/11.6		
<b>Getting electricity</b>			<b>75.1/85.9</b>	<b>99.3</b>	<b>95.6</b>
				<b>(4)</b>	<b>(11)</b>
Procedures (number)	3	3	4.2/4.4		
Time (days)	24	58	63.2/74.8		
Cost (% of income p.c.)	25.6	23.1	594.6/61.0		
Reliability of supply and transparency of tariffs index (0–8)	8	8	4.0/7.4		



**Table 2.** Complexity and cost of regulatory processes (continued)

Topic and indicator	Malaysia	Czech Republic	East Asia & Pacific/OECD high income countries	EODB score Malaysia	EODB score Czech Republic
<b>Registering property</b>				<b>57.5/77.0</b>	<b>79.5</b>
				<b>(33)</b>	<b>(32)</b>
Procedures (number)	6	4	5.5/4.7		
Time (days)	11.5	27.5	71.9/23.6		
Cost (% of property value)	3.5	4.0	4.5/4.2		
Quality of land administration index (0–30)	26.5	25.0	16.2/23.2		
<b>Paying taxes</b>				<b>73.6/84.3</b>	<b>76.0</b>
				<b>(80)</b>	<b>(53)</b>
Payments (number per year)	9	8	20.6/10.3		
Time (hours per year)	174	230	173/158.8		
Total tax and contribution rate (% of profit)	38.7	46.1	33.6/39.9		
Postfiling index (0-100)	51.0	90.5	56.4/86.7		
<b>Trading across borders</b>				<b>71.6/94.3</b>	<b>88.50</b>
				<b>(49)</b>	<b>(1)</b>
Time to export import: Border compliance (hours)	28 36	0 0	57.5 68.4/ 12.7 8.5		
Cost to export import: Border compliance (USD)	213 213	0 0	281.1 422.8/ 136.8 98.1		
Time to export import: Documentary compliance (hours)	10 7	1 1	55.6 53.7/ 2.3 3.4		

The assessment of the situation of the monitored countries shows the following results (see Table 3). Concerning the strength of legal institutions, three of the four indicators are clearly in favor of Malaysia, whereas the remaining one is better in case of the Czech Republic. Malaysia is doing significantly better in Protecting Minority Investors, Enforcing Contracts and Getting Credit. The fourth sub-indicator – Resolving Insolvency – is favorable for the Czech Republic. The data is derived from a questionnaire collected by company and securities lawyers and is based on company law, civil code of law, court rules of evidence and the disposition of securities. Protection of minority investors helps prevent conflicts of interest by means of a set of indices. These scores are the sum of the extent of conflict of interest regulation index and the extent of shareholder governance indicator. The indicator called Enforcement Contract measures the cost and time of needed to solve commercial disputes by local courts of first instance and the index of quality of litigation. It also assesses whether or not the country in question has adopted best practices supporting the quality and efficiency of the justice system.

**Table 3.** Strength of legal institutions (DB 2019).

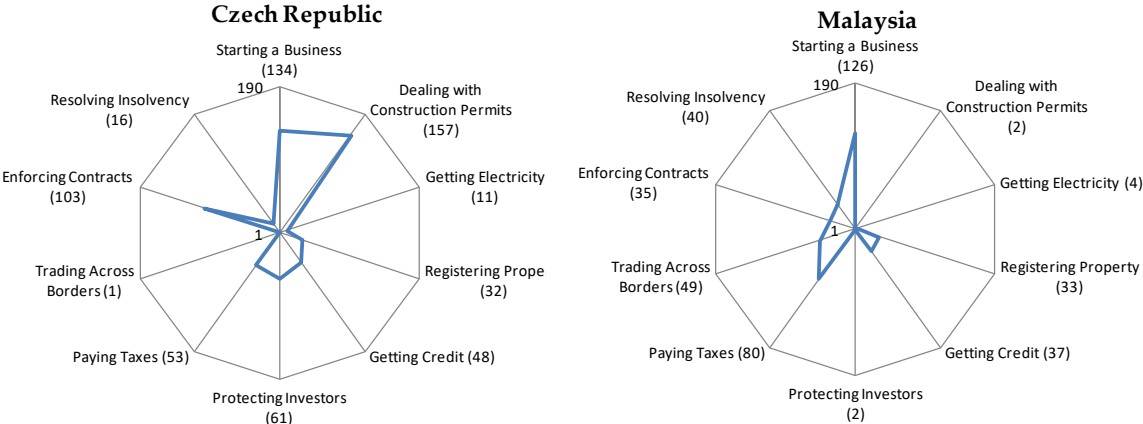
Topic and indicator	Malaysia	Czech Republic	East Asia & Pacific/OECD high income countries	EODB score Malaysia	EODB score Czech Republic
<b>Getting credit</b>				<b>58.0/64.3</b>	<b>75.00 (37)</b>
Strength of legal rights index (0–12)	7	7	7.1/6.1		
Depth of credit information index (0–8)	8	7	4.5/6.8		
Credit registry coverage (% of adults)	64.9	7.3	16.6/24.4		
Credit bureau coverage (% of adults)	89.1	81.1	23.8/66.7		
Strength of legal rights index (0–12)	7	7	7.1/6.1		
Depth of credit information index (0–8)	8	7	4.5/6.8		
Credit registry coverage (% of adults)	64.9	7.3	16.6/24.4		
Credit bureau coverage (% of adults)	89.1	81.1	23.8/66.7		
<b>Protecting minority investors</b>				<b>49.7/68.2</b>	<b>88.0 (2)</b>
Extent of disclosure index (0-10)	10	2	5.9/6.5		
Extent of director liability index (0–10)	9	6	5.2/5.3		
Ease of shareholder suits index (0–10)	8	9	6.7/7.3		
Extent of shareholder rights index (0–10)	5	5	2.0/4.7		
Extent of ownership and control index (0–10)	6	5	2.4/4.5		
Extent of corporate transparency index (0–10)	6	4	2.6/5.7		
<b>Enforcing contracts</b>				<b>53.0/67.8</b>	<b>68.2 (35)</b>
Time (days)	425	678	581.1/589.6		
Cost (% of claim)	37.9	33.8	47.2/21.5		
Quality of judicial processes index (0–18)	13.0	9.5	8.1/11.7		
<b>Resolving insolvency</b>				<b>40.9/74.9</b>	<b>67.0 (40)</b>
Recovery rate (cents on the dollar)	81.0	67.5	35.5/70.2		
Time (years)	1	2.1	2.6/1.7		
Cost (% of estate)	10	17	20.6/9.3		
Outcome (0 as piecemeal sale and 1 as going concern)	1	1	:		
Strength of insolvency framework index (0–16)	7.5	14	7.0/11.9		

The Resolving insolvency category is a weak point in evaluating business conditions in Malaysia. It is measured the time, cost and outcome of insolvency proceedings involving domestic entities as well as the strength of the legal framework applicable to judicial liquidation and reorganization proceedings. Data for solving insolvency indicators are derived from the replies to questionnaire created by local insolvency trustees and verified by studying laws and regulations as well as

public information on insolvency systems. The ranking of countries according to the ease of solving insolvency is determined by classifying their score for solving insolvency. The indicator is counted simply as an average of the score of Recovery Rate and Strength of Insolvency Framework Score.

**4. Discussion**

This paper focuses on the assessment of business conditions published by the International Bank for Reconstruction and Development this year. This institution has been evaluating the conditions for doing business in 10 different areas according to a very sophisticated methodology for 17 years. The authors' interest was to compare the conditions for doing business in Malaysia and the Czech Republic. These countries have a very different history, politics and culture. Nonetheless, the basic dissimilarity are their respective areas and populations. Malaysia is four times larger and has nearly 3 times more inhabitants. Malaysia ranked 12th and Czech Republic 41st among 190 countries.



**Figure 1.** Similarities and differences of the business regulation between the Czech Republic and Malaysia.

It is clear that the conditions for doing business in both countries are different, but there are some similarities and in some areas Malaysia has its weaknesses. In the overall evaluation, criteria relating to the complexity and cost of regulatory processes are analyzed first, followed by criteria relating to the strength of legal institutions. The complexity and cost of regulatory processes are defined by 6 indicators. There is the only indicator of business conditions that both these countries have identical, that is Registering Property.

Differences are evident in the indicators Dealing with Construction Permits, Starting a Business and Getting Electricity. Establishing your own company in the conditions of the Malaysian economy is easier than in the Czech economy, but due to a large number of procedures, days and, ultimately, costs, the establishment of a company in both countries is very difficult. The fundamental difference between the two economies can be seen in the indicator Dealing with Construction Permits. This indicator clearly shows the very low number of procedures required to obtain a building permit, thus reducing the time required for it. The differences between the two economies are so significant that Malaysia is in this respect gaining a significant advantage over the Czech Republic in the overall ranking. Malaysia is better ranking in the area of Getting Electricity. On the other hand, the Czech Republic boasts of better conditions for doing business in the areas of Paying Taxes or Trading Across Borders. Still, even these advantages cannot move the Czech economy among the top 40 economies. In the second important area of evaluation - Strength of Legal Institutions - almost all criteria are evaluated in favor of Malaysia. Enforcing Contracts, Getting Credit and especially Protecting Minority Investors are areas where Malaysia is gaining a significant advantage over the Czech

Republic thanks to the strength of its legal institutions. Only one area out of four resulted in favor of the Czech Republic, namely Resolving Insolvency.

Malaysia has been continuously improving its Doing Business rankings over the past three years through its reforms. It was during these years that it carried out nine major reforms. For instance, in 2019 Malaysia streamlined the process of Dealing with Construction Permits by eliminating the road and drainage inspection performed by Kuala Lumpur City Hall. In 2018, Malaysia made starting a business easier by introducing an online registration system for goods and service tax. Unfortunately, the position of the Czech Republic has been declining over the past three years. The position of the Czech Republic in the Doing Business 2020 study is worst in seven years. The last reform that could have had a positive effect, took place in 2017 - the Czech Republic made starting a business less expensive by introducing lower fees for simple limited liability companies. Unfortunately, the positive effect was ruined by the measure whereby the Czech Republic made paying taxes more complicated by introducing new requirements for filing VAT control statements. Reforms that would simplify doing business and make it more efficient are not detected in the Czech economy. This is a major problem and this situation has clearly manifested itself in the current ranking of the Czech economy among all the evaluated economies of the world.

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# Prevalence of Alzheimer's Disease in Retirement Homes and Homes with a Special Regime in the Czech Republic

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**Abstract:** Alzheimer's disease (AD) and its growing prevalence is an important issue both today and in the future. An important aspect concerning the management of the disease is having a sufficient capacity of accommodation facilities and professional inpatient care. The aim of this work is to determine the prevalence of patients with Alzheimer's disease in Retirement Homes (RH) and in Homes with a Special Regime (HSR) in the Czech Republic. For this purpose, a questionnaire survey was conducted for RH and HSR directors. The prevalence rate of the disease was found to be different for each type of home. The prevalence of AD in retirement homes was found to be 16%, while the prevalence in homes with special regime is 78%. This difference reflects the main purpose of the facilities, but at the same time points to insufficient capacities in both type of homes. Based on our calculations, we estimate that in Czech Republic, in 2020 there are about 21,000 people with Alzheimer's disease in both types of homes. Some 162,000 people with dementia/AD stay at home, putting a lot of pressure on families who have an AD relative in their midst and take care of them at home.

**Keywords:** Alzheimer's disease; prevalence; capacities; inpatient social services; Czech Republic

**JEL Classification:** I10; I11; I13

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## 1. Introduction

Alzheimer's disease is an incurable neuro-degenerative brain disease in which irreversible cell destruction and damage occurs. Alzheimer's disease is also the most common cause of dementia. A patient suffering from Alzheimer's disease gradually loses cognitive functions such as memory, speech, clear thinking and problem-solving abilities. These patients lose the ability to perform daily activities such as cooking, getting dressed, washing and have to rely on the help from others. Patients at this stage may be aggressive or confused and require care and supervision. As the disease progresses, the disease also attacks other parts of the brain and inability to perform basic body functions such as walking or swallowing. At this stage, the patient is bedridden and requires continuous care. (Alzheimer's Association Report 2019).

Alzheimer's disease lasts an average of 7–10 years from the first symptoms of the disease to the patient's death. However, the course of the disease varies by the individual. Some patients can live with the disease for up to 15 years, others only 3 years (Jiráček 2008).

The issues surrounding Alzheimer's disease are becoming increasingly important, as the prevalence of this incurable disease continues to increase. The number of people with dementia/Alzheimer's disease in the Czech Republic is now estimated to be between 143,000 (Alzheimer Europe 2013) and 153,000 (Mátl et al. 2016). These estimates are based on epidemiological studies. In 2019, the Ministry of Health (2019) published data from the UZIS database in which 102,000 people with dementia and 62,000 people with Alzheimer's disease were diagnosed in the Czech Republic. Furthermore, the report of the Ministry of Health of the Czech Republic adds that up to 75% of patients may be under-diagnosed.

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According to estimates, the number of patients with dementia could increase to 383 thousand by 2050 (Mátl et al. 2016). Válková et al. (2010) take a more positive attitude, which reports the prognosis for 2050 as having 227,000 affected dementia patients. The Ministry of Health (2019) states that by 2030 there can be up to 90,000 people with Alzheimer's disease.

A very important aspect to consider is where these people are and what care they receive. Therefore, the main aim of the article is to look at the prevalence of patients with Alzheimer's disease in retirement homes and in homes with special regime. This is important mainly because of the unsustainability of home care, which in most cases cannot be permanent and needs to be replaced with professional care over time (homes with special regime etc.), which may not be available due to the increasing prevalence of patients (Mátl et al. 2016).

This high prevalence of AD worldwide has already had a high economic impact, but it will have an even greater impact in the future. Every year, the number of cases of Alzheimer's disease is increasing by 7.7 million worldwide each year, and not only Czech society should prepare for this and adapt capacities in retirement homes and homes with special regimes (WHO 2012).

In-patient social services and direct care are now the most expensive part of the direct cost of overall care for Alzheimer's patients, and thus the prevalence of clients with this disease in homes with special regimes and retirement homes is a good indicator and predictor of economic aspects of the disease (Tomášková 2019).

This work contributes to mapping the prevalence of patients with Alzheimer's disease across individual regions of the Czech Republic. The research question is: What is the prevalence rate of AD in RH and HSR by region and overall in the Czech Republic?

## 2. Methodology

Quantitative research covers retirement homes (RH) and homes with a special regime (HSR). These services have a different purpose and target group and are defined in the Social Services Act (2206).

According to this Act, in a retirement home (§49), *"residential services are provided to persons who have reduced self-sufficiency mainly because of their age, whose situation requires regular assistance from another natural person."* In a home with a special regime (§50) *"residential services shall be provided to persons who have reduced self-sufficiency due to chronic mental illness or substance abuse and to persons with age, Alzheimer's dementia and other types of dementia who have reduced self-sufficiency due to those illnesses whose situation requires regular assistance from another natural person. The regime in these facilities for the provision of social services is adapted to the specific needs of these persons."*

According to our findings, based on data from individual regions (from their regional networks) in the Czech Republic, there are 417 RH and 310 HSR with a total capacity of 32,121 beds in RH and 20,351 beds in HSR. Information on the number of homes and their capacities/beds is available on the websites of regions and individual homes. Data verifying the capacity of the facilities and researching the prevalence of Alzheimer's patients were collected through phone calls, email interviews and face-to-face interviews. The data were collected through a questionnaire survey. The questionnaire consisted of five questions and took about 5 minutes. The data was collected from August 2019 to January 2020.

For a representative result, it was necessary to reach at least 5 RH and 5 HSR questionnaires from each region and cover at least 10% of homes. These results were achieved, and the research is applicable to the whole of the Czech Republic. The research includes 81 RH (99 addressed) out of 417 total (Table 1) and 83 HSR (94 addressed) out of 310 (Table 2). This means, that 19% of the retirement homes and 27% of homes with special regime were involved in the research.

**Table 1.** Coverage of research in Retirement Homes (RH) by region.

Region	Total homes by region	Homes addressed	Homes involved in the research	Research coverage
South Bohemia	27	7	6	22%
South Moravia	40	5	5	13%
Karlovy Vary	12	7	6	50%
Hradec Králové	34	8	6	18%
Liberec	13	7	5	38%
Moravian-Silesian	37	6	5	14%
Olomouc	25	7	5	20%
Pardubice	19	6	5	26%
Plzeň	23	5	5	22%
Prague	34	13	8	24%
Central Bohemian	61	5	5	8%
Ústí nad Labem	32	5	5	16%
Vysočina	30	12	10	33%
Zlín	30	6	5	17%
TOTAL	417	99	81	19%

**Table 2.** Coverage of research in Homes with a Special Regime (HSR) by region.

Region	Total homes by region	Homes addressed	Homes involved in the research	Research coverage
South Bohemia	21	6	5	24%
South Moravia	42	5	5	12%
Karlovy Vary	11	5	5	45%
Hradec Králové	12	9	7	58%
Liberec	13	7	6	46%
Moravian-Silesian	39	5	5	13%
Olomouc	13	8	6	46%
Pardubice	12	5	5	42%
Plzeň	15	5	5	33%
Prague	19	8	5	26%
Central Bohemian	42	5	5	12%
Ústí nad Labem	33	6	6	18%
Vysočina	18	14	13	72%
Zlín	20	6	5	25%
TOTAL	310	94	83	27%

Tables 3 and 4 show the total capacities for each type of facility and region, compared to the capacities from which the data are obtained. In terms of capacities, 19% of all RH and 24% of HSR are covered throughout the country.

**Table 3.** Beds in Retirement Homes (RH) and research coverage by region.

Region	Total capacity by region	Capacities of homes involved in research	Research coverage
South Bohemia	2,281	472	21%
South Moravia	2,202	236	11%
Karlovy Vary	696	370	53%
Hradec Králové	2,386	358	15%
Liberec	1,170	397	34%
Moravian-Silesian	3,318	326	10%
Olomouc	2,403	505	21%
Pardubice	1,679	484	29%
Plzeň	1,660	315	19%
Prague	3,074	633	21%
Central Bohemian	4,610	368	8%
Ústí nad Labem	2,730	346	13%
Vysočina	1,951	829	42%
Zlín	1,961	401	20%
TOTAL	32,121	6,040	19%

**Table 4.** Coverage of research in Homes with a Special Regime (HSR) by region.

	Total capacity by region	Capacities of homes involved in research	Research coverage
South Bohemian	1,349	191	14%
South Moravian	3,098	413	13%
Karlovy Vary	716	280	39%
Hradec Králové	574	367	64%
Liberec	911	341	37%
Moravian-Silesian	2,734	297	11%
Olomouc	725	220	30%
Pardubice	794	622	78%
Plzeň	1,020	258	25%
Prague	1,289	398	31%
Central Bohemian	2,705	307	11%
Ústí nad Labem	1,907	537	28%
Vysočina	847	530	63%
Zlín	1,682	167	10%
TOTAL	20,351	4928	24%



### 3. Results

The research focuses on prevalence of Alzheimer's Disease in Retirement Homes (RH) and Homes with a Special Regime (HSR) and it covers all regions of the Czech Republic. The research suggests that prevalence rates differ significantly in RH and HSR. It is on average 78% in HSR and 16% in RH (Table 5). The variability of the results of individual regions is relatively high. The lowest proportion of Alzheimer's Disease in RH is in the Moravian-Silesian Region (4%) and the highest in the Central Bohemian Region (30%). The lowest proportion of AD in HSR is found in the Pardubice Region (58%) and the highest in Prague (97%).

**Table 5.** Average estimate of the prevalence of Alzheimer's disease.

Region	Capacities of homes involved in research		Prevalence of Alzheimer's disease in %	
	Retirement Homes	Homes with a Special Regime	Retirement Homes	Homes with a Special Regime
South Bohemia	472	191	23%	88%
South Moravian	236	413	6%	73%
Karlovy Vary	370	280	15%	77%
Hradec Králové	358	367	17%	90%
Liberec	397	341	17%	63%
Moravian-Silesian	326	297	4%	60%
Olomouc	505	220	9%	89%
Pardubice	484	622	8%	58%
Plzeň	315	258	10%	82%
Prague	633	398	19%	97%
Central Bohemian	368	307	30%	85%
Ústí nad Labem	346	537	28%	62%
Vysočina	829	530	20%	80%
Zlín	401	167	9%	77%
Total sum	6,040	4,928	16%	78%

#### 3.1. Limitations

A factor that may misrepresent the data obtained could be the unwillingness to communicate the real disease rate data at Retirement Homes, where patients with Alzheimer's disease should not be placed at all by law. However, after face-to-face interviews with home managers, we believe that this factor will have little effect on the end results.

Another limitation of our methodology is the fact that the words "dementia" and "Alzheimer's disease" are often considered synonymous, and therefore it is difficult to strictly separate Alzheimer's disease from dementia. It is therefore possible that even when we specifically asked about the occurrence of Alzheimer's disease, the interviewee did not necessarily know exactly how many people in their facility had dementia and how many had Alzheimer's disease.

### 4. Discussion

The observed prevalence rate of AD by our methodology is lower than expected in both RH and HSR. Compared to the study by Hana Vaňková (2013), which declares about 70% prevalence rate in Retirement Homes and 90% prevalence rate in Homes with a Special Regime, our results surprisingly point to 16% prevalence rate in RH and 78% in HSR. Compared to the mentioned study, the sample used here is more than ten times larger. The study by Hana Vaňková includes 626 persons from HSR

and 351 from RH, whereas this study included a sample of 6,040 beds from RH and 4,928 beds from HSR.

**Table 6.** Comparing the prevalence of Alzheimer's disease in DS and DZR, according to Vaňková's 2014 study and the results of our study.

	Retirement homes	Nursing homes
Vaňková (2013)	70%	90%
Research according to our study	16%	78%

## 5. Conclusions

Research on the prevalence of AD showed a 78% prevalence rate in Homes with a Special Regime and a 16% prevalence in Retirement homes. For the Czech Republic, this may represent 5,139 clients in RH and 15,784 in HSR (Table 7), which in total makes up 20,921 people with Alzheimer's who are staying in social homes.

**Table 7.** Estimated number of clients with AD at social homes in the Czech Republic.

	Retirement Homes	Homes with a Special Regime
Total capacities in the Czech Republic	32,121	20,351
Prevalence of Alzheimer's disease	16%	78%
Estimated number of clients with AD	5,139	15,874

According to studies presented by the Czech Alzheimer Society (Mátl et al. 2016), an estimated 183,000 people will suffer from dementia/Alzheimer's disease in 2020. According to the results of our study, approximately 21,000 patients are in Retirement homes and Homes with a Special Regime. When these two figures are subtracted, we get 162,000 patients in the Czech Republic who are suffering from dementia/Alzheimer's today, but who are not placed in any type of Social home.

Where are the remaining 162,000 patients suffering from dementia/Alzheimer's disease? These people are still at home, which puts a lot of pressure on families who have an AD relative in their circle and take care of them at home. Furthermore, where will be these patients placed when their condition inevitably worsens?

RH and HSR capacities are almost 100% filled and waiting lists are long. 61,000 applicants are waiting for placement in Retirement homes and 22,000 are waiting for placement in Homes with a Special Regime (Novák 2018). These figures indicate an insufficient bed capacity of these Social homes. Despite the possibility of duplicate records, when one person is simultaneously on the waiting list for multiple social homes, these numbers are alarming.

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# Analysis of the Health Spending and GDP in the Visegrad Group and in Germany

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**Abstract:** The aim of this article is to analyze health care expenditures in Czech Republic and in states of Visegrad Group and Germany as a comparison. Correlation analysis with significance testing and time series prognosis will be used. Data for analysis were obtained from Eurostat and OECD. Correlation coefficients for health care expenditures and GDP per capita were calculated for individual states of the Visegrad Group and for comparison of Germany. Most correlated are these variables in Poland, where computed value is 0.9905, which is very closed to one. It means, that trend of health care expenditures and GDP per capita is almost the same. Subsequently, prognosis of health care expenditures was carried out in the Czech Republic, which showed a further increase in health care expenditures by 2028, which corresponds to the demographic and economic trend. There is a similar trend in other analysis countries.

**Keywords:** health care expenditures; costs; correlation analysis; GDP; prognosis

**JEL Classification:** I15, H51, E60, C35

## 1. Introduction

Health care expenditure is a widely discussed issue in most countries in the European Union. Health protection is one of the most important topics of social policy of each EU countries (Giammanco and Gitto 2019). In recent years there has been a steady increase in healthcare expenditure. There is also an increase in life expectancy, which has a significant impact on health spending (Krabbe-Alkemade et al. 2020; Frączkiewicz-Wronka et al. 2019). The health harm from pollution (air, water, etc.) leads to increased healthcare expenditures (Apergis et al. 2020; Giannakis et al. 2019; Cincinelli and Martellini 2017; Szemik et al. 2019). Polluted air is the cause of health and economic losses (Dzikuć et al. 2019; Piwowar and Dzikuć 2020).

Health systems are organized and funded in different ways in EU Member States. Finding the best universal access to quality health care at an affordable price, both for individuals and for society in general (Azzopardi-Muscat 2015; Kosycarz et al. 2019; Rechel 2019). It is generally regarded as a basic need; moreover, this is one of the common values and principles of EU health systems (Eurostat 2019).

Healthcare expenditure relative to GDP was 9.9% in the European Union in 2016. France and Germany had the highest healthcare expenditure relative to GDP in 2016. Romania and Luxembourg had the lowest healthcare expenditure relative to GDP in 2016 (Eurostat 2019).

In the reference scenario, global health spending was projected to increase from US\$10 trillion (95% uncertainty interval 10 trillion to 10 trillion) in 2015 to \$20 trillion (18 trillion to 22 trillion) in 2040. Per capita health spending was projected to increase fastest in upper-middle-income countries, at 42% (34–51) per year, followed by lower-middle-income countries (40%, 36–45) and low-income countries (22%, 17–28). Despite global growth, per capita health spending was projected to range from only \$40 (24–65) to \$413 (263–668) in 2040 in low-income countries, and from \$140 (90–200) to \$1699 (711–3423) in lower-middle-income countries. (Global Burden of Disease Health Financing Collaborator Network 2018).

Neofytidou and Fountas (2020) find that total life expectancy, male life expectancy, and female life expectancy have all a positive and statistically significant short-run and the long-run effect on both total and per capita income. As a consequence, they conclude that health should be considered an important ingredient of the economic performance of an economy.

Results of Hitiris and Posnett (1992) confirm the importance of GDP as a determinant of health spending, with an estimated income elasticity at or around unity, but also suggest that OECD countries should not be regarded as a single, homogeneous group. Hartwig (2008) tests yield robust evidence in favor of Baumol's theory that health care expenditure is driven by wage increases in excess of productivity growth. Causality between healthcare expenditure and GDP is mostly bilateral (Amiria and Venteloub 2012). Devlin and Hansen (2010) tested that for some of the 20 OECD countries tested it appears that health care expenditure Granger causes GDP, and vice versa for others. Utilizing Granger Causality within the framework of a panel cointegration model, Mehrara and Musai (2011) findings suggest that there is strong causality running from GDP and oil revenues to health expenditure with no feedback effects from health to GDP for oil exporting countries. Hedvičáková and Pozdílková (2019) shown dependence of health expenditure of households on their income. Hedvičáková and Pozdílková (2018) verified by correlation analysis the dependency health expenditure of individual households and GDP in Czech Republic between 2010 and 2017.

## 2. Methodology

Health spending measures (according to OECD 2020a) the final consumption of health care goods and services (i.e. current health expenditure) including personal health care (curative care, rehabilitative care, long-term care, ancillary services and medical goods) and collective services (prevention and public health services as well as health administration), but excluding spending on investments. Health care is financed through a mix of financing arrangements including government spending and compulsory health insurance ("Government/compulsory") as well as voluntary health insurance and private funds such as households' out-of-pocket payments, NGOs and private corporations ("Voluntary"). This indicator is presented as a total and by type of financing ("Government/compulsory", "Voluntary", "Out-of-pocket") and is measured as a share of GDP, as a share of total health spending and in USD per capita (using economy-wide PPPs).

Gross domestic product (GDP) is the standard measure of the value added created through the production of goods and services in a country during a certain period. Real gross domestic product (GDP) is GDP given in constant prices and refers to the volume level of GDP (OECDb).

The aim of correlation analysis is to determine the strength of linear dependence between quantities. Then a zero correlation coefficient means that the quantities are independent. If the assumption of two-dimensional normality is not satisfied, the zero value of the correlation coefficient cannot be inferred more than that the quantities are uncorrelated. The closer the relationship between the two variables, the closer the absolute value of the correlation coefficient is to one. Negative correlation coefficients express indirect correlation (with increasing values of one variable the values of the other variable decrease).

Significance of correlation coefficient can be verified using significance test of the correlation coefficient. The test statistic is  $T = r \sqrt{\frac{n-2}{1-r^2}}$ , if  $|T| \geq t_{n-2,0.975}$ , time series are similar in character over a given time period.

Data for statistical analysis were from OECD. Used algorithms were implemented in software MATLAB, version R2013b.

## 3. Results

### 3.1. Correlation analysis

In this article correlation coefficients will be calculated, and their significance will be verified using significance test of the correlation coefficient, where the test statistic  $T = r \sqrt{\frac{n-2}{1-r^2}}$ .

If  $|T| \geq t_{13-2,0.975} = t_{11,0.975} = 2.20$ , series have a similar trend.

From the given relation we calculate correlation coefficient  $r$ :  $2.20 \leq r \sqrt{\frac{13-2}{1-r^2}}$

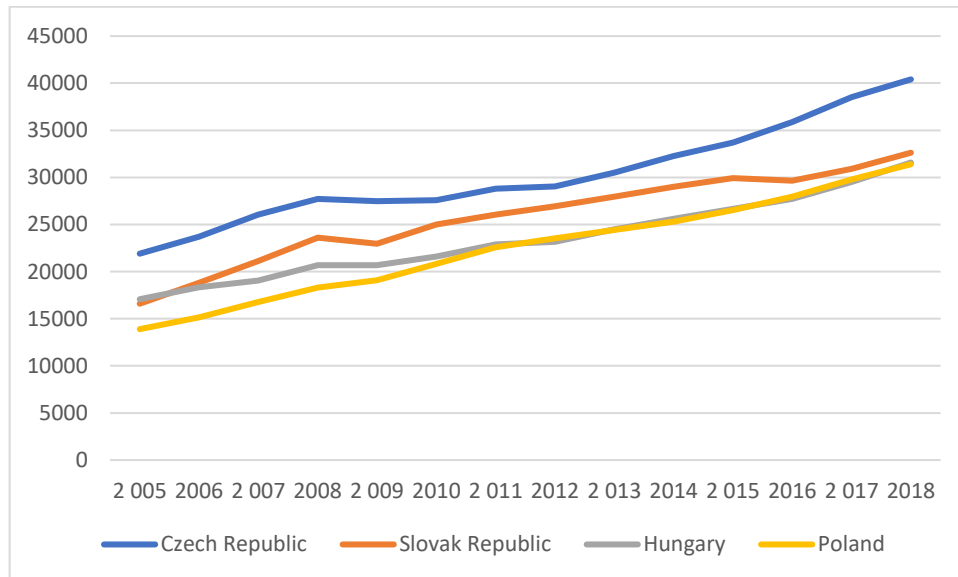
$$(2.2)^2 \leq \frac{r^2}{\sqrt{1-r^2}} \sqrt{11} \Rightarrow \frac{r^2}{\sqrt{1-r^2}} \geq \frac{(2.2)^2}{\sqrt{11}} = 1.4593 \Rightarrow |r| \geq 0.8612$$

We will compute correlation coefficients for health care expenditures and GDP per capita in years 2005–2018 in countries of Visegrad Group. Correlation coefficients for these countries are following:

- Czech Republic 0.9646;
- Slovak Republic 0.9390;
- Hungary 0.9252;
- Poland 0.9905.

All these values are greater than calculated  $r$ , so all countries of Visegrad Group have the same trend of growth of health care expenditures and GDP. Most correlated are these variables in Poland, where computed value is 0.9905, which is very closed to one.

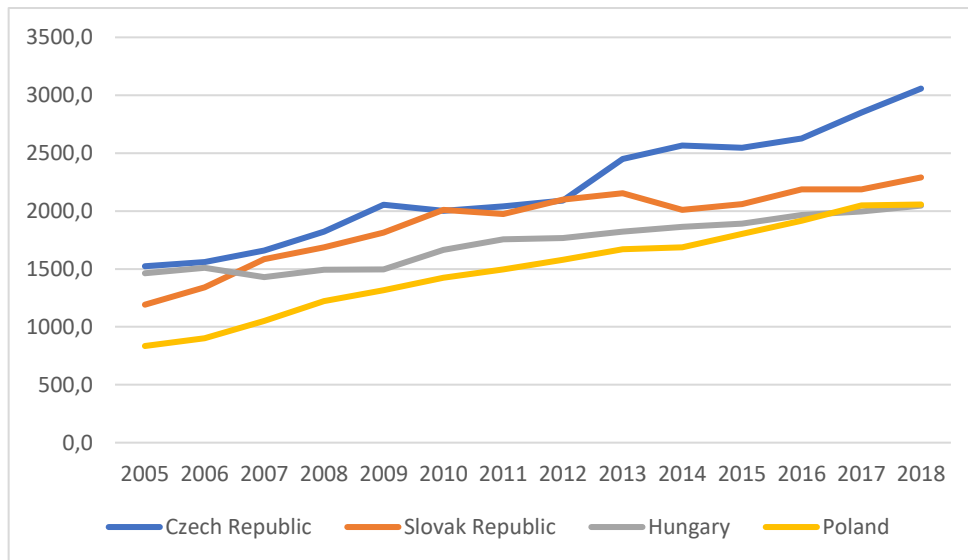
Following Figure 1 and 2 show similar trends of health care expenditures and GDP per capita in V4 countries.



**Figure 1.** GDP in US dollars/capita for Visegrad group in 2005–2018.

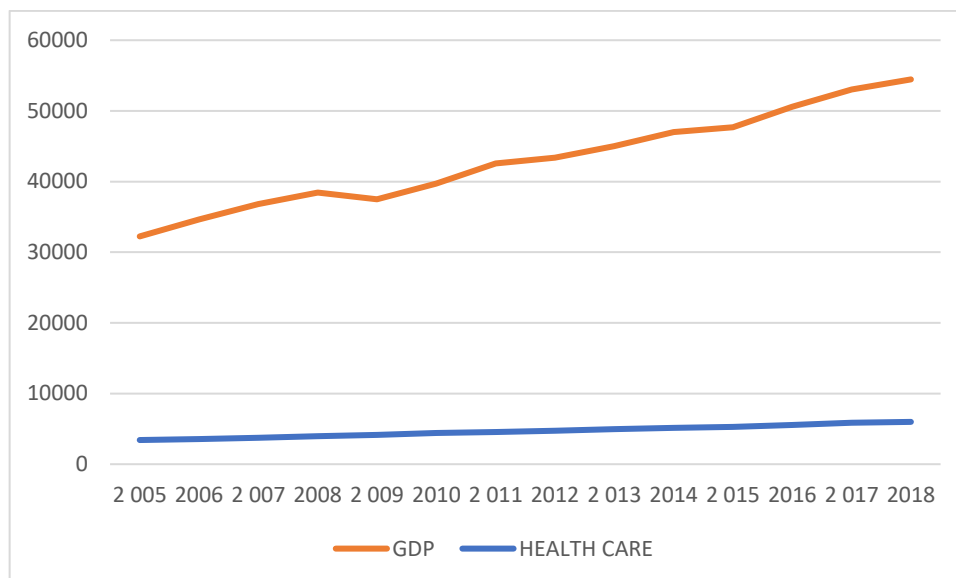
Health care expenditures are growing fastest in the Czech Republic. The lowest cost of health expenditure is in Poland in the years 2005–2016. Since 2017, however, the growth of health expenditure in Poland has stagnated. However, the expenditure for health in Poland is in fact too little. Health care costs are the lowest in Hungary since 2017 (see Figure 2).

The trend in GDP expenditure (see Fig. 1) in the Czech Republic can be observed. In 2008, economic growth came to a halt and the financial and subsequently economic crisis started. The following year, GDP values declined. Since 2013, there has been economic growth and economic recovery in the Czech Republic, which resulted in a rise in GDP values and a decline in the unemployment rate.



**Figure 2.** Health spending of the Visegrad Four in US dollars/capita in 2005 – 2018.

In opposite of these results is correlation coefficient between Health care expenditures and GDP of Germany, which is 0.3388, so these variables are not correlated and trends of development of GDP and Health care expenditures are not significantly similar. It can be seen on following Figure 3.



**Figure 3.** GDP (US dollars/capita) in the Germany in 2005 2018.

Health care costs are rising continuously in Germany (see Figure 3). Germany has the second highest expenditure on health care in relation to GDP in the European Union. The share of health expenditure in relation to GDP was 11.1% in 2016. Germany has the highest expenditure on health in the whole European Union. Expenditure on health in 2006 totaled EUR 242,121 million and in 2016 totaled EUR 351,701 million. The change between 2006 and 2016 is EUR 109,580 million in Germany. The second largest expenditure on health was France € 257,194 million in 2016. The change between 2006 and 2016 was only € 65,781 million in France. However, the share of health expenditure in GDP in 2006 and 2016 was the highest in France: 11.5%.

GDP development in Germany (see Figure 3) is also the same as in the Czech Republic. GDP growth stopped in 2008 and the economic crisis followed, but it was shorter than in the Czech Republic. In Germany, there was a faster recovery and economic growth.

Correlation coefficients were calculated for individual states of the Visegrad Group and for comparison of Germany. Germany was chosen because it has the highest healthcare expenditure from the European Union and is the dominant trading partner for the Czech Republic. On the foreign trade turnover of the Czech Republic, Germany participates in more than 29%.

### 3.2. Prognosis of health care expenditures in the Czech Republic

Prognosis of health care expenditures in the Czech Republic is following (similar growing trend will have all states of Visegrad Group).

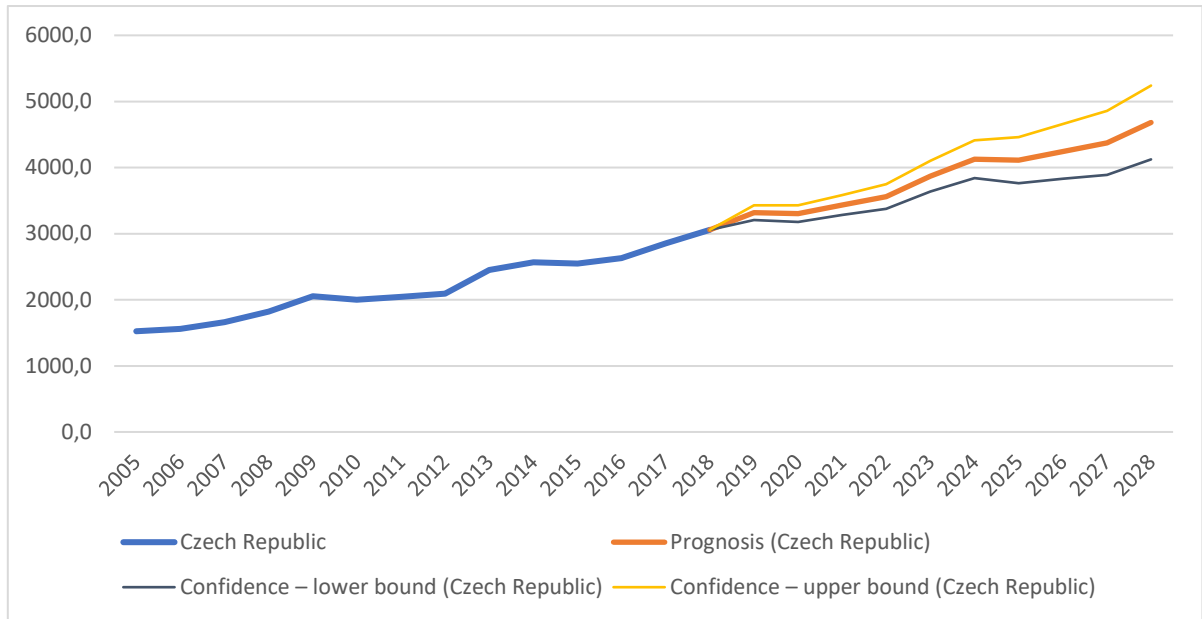
**Table 1.** Prognosis of health care expenditures (in US dollars/capita) in the Czech Republic.

<b>Year</b>	<b>Prognosis</b>	<b>Confidence – lower bound</b>	<b>Confidence – upper bound</b>
2010	2001,1		
2011	2041,9		
2012	2090,5		
2013	2448,5		
2014	2564,6		
2015	2545,5		
2016	2627,7		
2017	2850,4		
2018	3057,6	3057,6	3057,6
2019		3315,6	3204,0
2020		3301,7	3176,9
2021		3433,5	3283,2
2022		3560,5	3373,2
2023		3870,7	3637,1
2024		4126,7	3839,2
2025		4112,8	3765,2
2026		4244,6	3831,4
2027		4371,6	3888,0
2028		4681,8	4123,5

According to the forecast (see Table 1 and Figure 4), the growing trend in health expenditure will continue until 2028. This forecast reflects the economic situation as the population in the Czech Republic is aging. Average life expectancy increases.

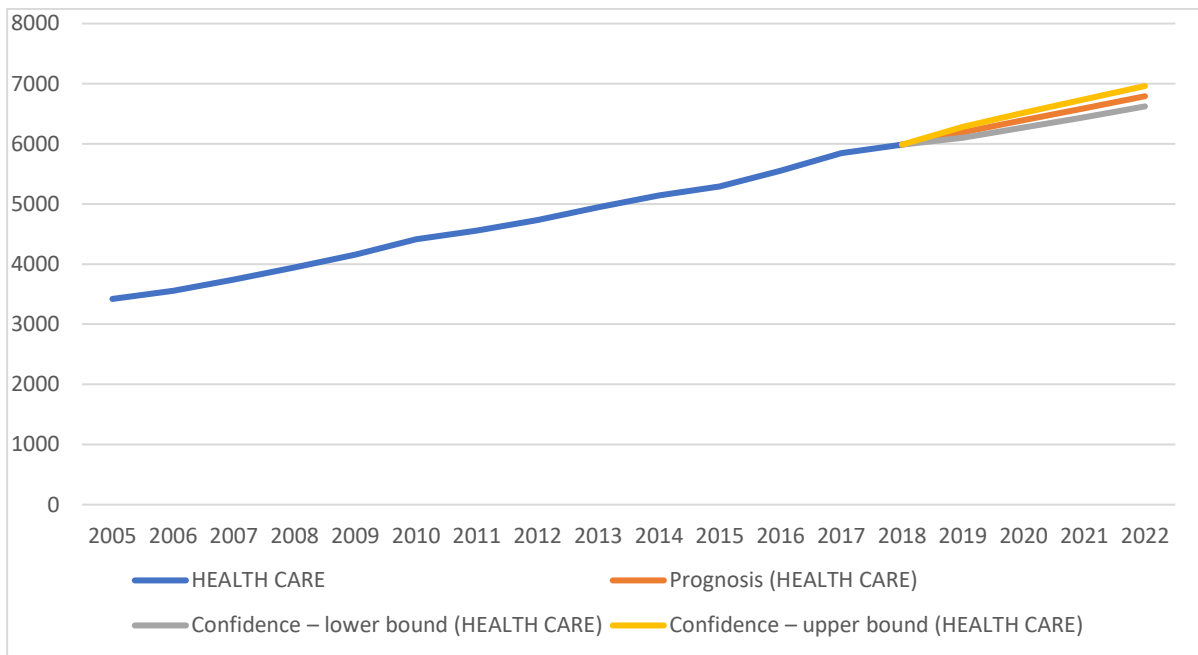
Next graph shows prognosis of health care expenditures for years 2019–2022. Graph includes also lower bounds and upper bounds for this prognosis.





**Figure 4.** Prognosis of health care expenditures (in US dollars/capita) in the Czech Republic.

For comparison is the same graph prognosis of health care expenditures for years 2019–2022 computed also for Germany. Figure 5 includes also lower bounds and upper bounds for this prognosis.



**Figure 5.** Prognosis of health care expenditures (in US dollars/capita) in Germany.

Regarding to the development of health expenditure in Germany in the years 2005–2018, the prognosis of further development of health expenditure is increasing. This forecast corresponds to GDP development and the current economic situation.

#### 4. Discussion

According to the forecast of the development of health care expenditures, further growth will occur in the following years. The question to be discussed is how this growth in health care expenditure will also be affected by the aging of the population that occurs in the countries surveyed.

An aging population is also pointed out by (Simmons 1986), which states that the increase in the elderly population has increased the demand for geriatric medicine.

Lambo (1993) attempts to bring into focus the linkages between the economy and the health sector and the proffer to policy makers and planners, what should be done in the future to minimize the negative impact of macro and sectoral policies on health.

Another important aspect influencing the development of health care expenditures will be medical technology and healthcare innovation. The advent of the fourth industrial revolution Industry 4.0 will also be reflected in medicine. Hedvicakova and Kral (2019) examined the impact of the Industry 4.0 initiative on individual sectors and the unemployment rate. Raftery and Powell (2013) identify features that might be of value to other health systems as they confront the challenges of rapid innovation and rising costs. Hedvicakova and Svobodova (2015) deals with the economic situation in the Visegrad countries. The Czech Republic has good economic conditions for further GDP growth, but it is a small open economy. Its economic situation is influenced by the economic situation in Germany.

Another issue to discuss is the correct measurement of healthcare costs. For example, Král and Hájek (2018) analyzed the cost expression.

## 5. Conclusions

The Czech Republic has the highest expenditure on health care from the Visegrad Group. It also has the highest GDP growth. Slovakia is second in terms of both health expenditure and GDP growth. Poland and Hungary have had similar health care expenditures over the past two years. They also achieve similar results in terms of GDP. Hungary is ranked 18th in the ratio of health care expenditure relative to GDP ratio from the EU countries in 2016. The Czech Republic ranked two positions less, with a ratio of health care expenditure relative to GDP of 7.1%. Slovakia has the same ratio. Poland has healthcare spending relative to GDP of 6.5% in 2016. Latvia, Luxemburg and Romania are only behind Poland. Romania has the lowest proportion of healthcare expenditure across the European Union: only 5%.

According to the forecast, health care expenditure is expected to grow in the coming years. Demographic developments confirm this forecast. Overall, the population of the Czech Republic has been growing over the long term. The population is aging. The highest increases in the population are concentrated in the age group 65+. In 2018, over 58,000 people moved to the Czech Republic, most in the last ten years. The balance of foreign migration is usually positive in the Czech Republic. A similar trend in the growth of health care expenditures is in other Visegrad countries.

The correlation coefficients for health care expenditures and GDP per capita was calculated for states of the Visegrad Group and Germany in years 2005–2018. All of these values are larger than computed coefficient for testing significance of correlation, so the trend of growth in health care expenditure and GDP is similar. Most correlated are these variables in Poland, where the computed value is 0.9905, which is very closed to one. Thus, the trend of health care expenditures and GDP per capita in Poland is almost the same. For comparison was the correlation coefficient computed also in Germany, where is smaller than coefficient for testing significance of correlation. It means, that trends of health care expenditures and GDP per capita in Germany are not similar.

All computed results are illustrated by graphs, that confirm the results.

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# Optimal Value of Current Ratio

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**Abstract:** This article deals with the optimal value of current ratio. The paper originated in response to two contradictory statements. The first one states that working capital should be positive, i.e. that current assets are higher than current liabilities. The second statement states that current assets should be paid from short-term sources and fixed assets from long-term sources. This would mean that current assets should be equal to current liabilities. The dependence of current ratio on business success expressed by indicators of profitability – return on assets (ROA) and return on equity (ROE) – was measured on a sample of over four thousand Czech companies. It has been found that for companies with inventory, the ROE rises up to the value of current ratio of 2.5, although the growth rate decreases with increasing liquidity, which means that it is more advantageous for them to have positive working capital, where the amount of assets exceeds the current liabilities 2.5 times. The dependences regarding the ROA and for companies with no inventory cannot be generalized according to the conducted research.

**Keywords:** current ratio; working capital; profitability

**JEL Classification:** G32

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## 1. Introduction

The article deals with research of current ratio as a ratio of current assets to current liabilities. On the one hand, it is stated that the ratio of current assets to current liabilities would be about 2, i.e. more precisely in the range of 1.5-2.5 (Altman 1993; Hrdý and Krechovská 2013; Meritum 2007), i.e. that working capital, defined as the difference between current assets and current liabilities, should be positive, or even that current assets should be double the current liabilities. On the other hand, there is the well-known golden rule of financial management that current assets should be covered by short-term resources and fixed assets by long-term sources (Brealey 2000; Brealey and Myers 1996; Myers and Rajan 1998; Myers 2001; Fazzari and Petersen 1993), therefore, current assets should be equal to short-term sources. Permanent current assets are an exception, for example a certain level of inventory which should be financed by long-term sources (Jindřichovská 2013), but this type of assets certainly cannot have a major impact in today's globalized world of just-in-time supplies. It follows from the foregoing that the question is whether it is more profitable for an undertaking to comply with the rule of appreciably positive working capital, where the ratio of current assets is twice the current liabilities or whether equality of current assets and current liabilities is more favourable.

Jindřichovská (2013) states that a company can reduce a risk of insolvency (low liquidity) only by reducing profitability and vice versa, because funds bound in current assets yield no or little return. Quasim and Ramiz (2011) and Quicklons (2011) also suggest that there is a trade-off between liquidity and profitability. Kubenka (2015) states that liquidity ratios may conflict with other key financial ratios. They can show antagonistic indices on the financial health of an analysed entity. For example, there may be a conflict between a low level of liquidity ratios with a high asset turnover ratio or a high profitability.

Kim et al. (1998) believe that optimal investment in liquidity is increasing in the cost of external financing which empirical tests on a large panel of U.S. industrial firms supported. This would mean that current assets should be financed from internal sources, which are essentially all of a long-term nature, which would deny the balance between current assets with short-term sources and fixed assets with long-term sources.

## 2. Methodology

This research has been developed because of fundamental discrepancies among the basic rules of financial management. It should show which approach to working capital size management is more profitable for a company. This means that the level of current ratio at which business profitability increases will be examined. Based on the findings, it will be deduced whether the equality of short-term current assets and liabilities is more favourable or whether the current assets should be about twice the current liabilities. In connection with this, the following hypotheses are set:

- H1a: For a company with inventory, it is more profitable to adhere to the principle of equality of current assets and current liabilities in terms of profitability expressed by Return on Assets.
- H1b: For a company with inventory, it is more profitable to adhere to the principle of twice as high of current assets as current liabilities in terms of profitability expressed by Return on Assets.
- H2a: For a company with inventory, it is more profitable to adhere to the principle of equality of current assets and current liabilities in terms of profitability expressed by Return on Equity.
- H2b: For a company with inventory, it is more profitable to adhere to the principle of twice as high of current assets as current liabilities in terms of profitability expressed by Return on Equity.

The basic sample for research includes 3,907 Czech companies, which account for inventory, i.e. they have all three components of current assets – stocks, receivables and money. For these companies, profitability is examined in 2018 depending on current ratio.

The secondary research involves 760 companies, which do not account for inventory, i.e. their current ratio is identical to the quick ratio, as current assets consist only of receivables and money. Thus, one component of current assets is missing, which also affects the amount of working capital and, potentially, the relationship of profitability to current ratio. These companies are therefore examined separately and the following hypotheses are verified:

- H3a: For a company with no inventory, it is more profitable to adhere to the principle of equality of current assets and current liabilities in terms of profitability expressed by Return on Assets.
- H3b: For a company with no inventory, it is more profitable it is more profitable to adhere to the principle of twice as high of current assets as current liabilities in terms of profitability expressed by Return on Assets.
- H4a: For a company with no inventory, it is more profitable to adhere to the principle of equality of current assets and current liabilities in terms of profitability expressed by Return on Equity.
- H4b: For a company with no inventory, it is more profitable to adhere to the principle of twice as high of current assets as current liabilities in terms of profitability expressed by Return on Equity.

The hypotheses with the letter “a” are intended to confirm the advantage of the principle of equality of current assets and short-term sources. The hypotheses with the letter “b” are intended to confirm the advantage of the principle of twice as high of current assets as current liabilities.

The data on current assets, current liabilities and profitability are taken from the data from the financial statements in the Commercial Register. Profitability is measured using both the most important indicators Return on Assets and Return on Equity (Kabajeh et al. 2012).

The data are examined using linear regression dependence:

$$y = ax + b, \quad (1)$$

where y is profitability and x is current ratio. Direct or indirect dependence and its strength is determined by the coefficient “a”. The coefficient “b” is an intercept.

Current ratio is examined in ranges. The first range is 0-0.4, which corresponds to the recommended cash position ratio values. The second range is 0.5-0.7, followed by a range corresponding to the quick ratio of 0.8-1.2, with current assets (approximately) equal to current liabilities. Other ranges are current ratio at levels of 1.3-1.5 and 1.6-2.5. The range 1.6-2 is the level at which the recommended value for current ratio is found, i.e. where current assets are approximately twice as high as current liabilities. The last range is a current ratio of more than 2.5.

It follows from the above that the hypotheses are determined by the current ratio ranges for values of 0.8-1.2 (for Ha hypotheses) and 1.6-2.5 (for Hb hypotheses).

### 3. Results

The progression of the function of dependence of profitability on current ratio is interesting for the sample of companies that account for inventory. On the contrary, the overall dependence is uncertain for the function of samples of companies not accounting for inventory.

#### 3.1. Results for companies with inventory

This subchapter presents the results of the calculated dependences summarized in Table 1 and further confirms or rejects the hypotheses H1 and H2.

As already mentioned, linear regression dependence (1) is investigated to determine whether the coefficient "a" is positive, expressing direct dependence, or negative, expressing indirect dependence. Furthermore, based on the magnitude of this coefficient, it is estimated whether the dependence curve is flatter or steeper, with a flatter curve showing low sensitivity to the change in current ratio, while a steeper curve reflecting a stronger dependence of profitability on the change in current ratio.

**Table 1.** Dependence of profitability on current ratio (companies with inventory).

Current Ratio Range	Coefficient "a" for ROA	Coefficient "a" for ROE
0-0.4	0.0497	0.0590
0.5-0.7	0.0099	0.0321
0.8-1.2*	0.0048	0.0217
1.3-1.5	0.0115	0.0013
1.6-2.5*	0.0053	0.0010
More than 2.5	-0.0010	-0.0062

\* Ranges for testing hypotheses

Concerning the hypotheses, the following confirmations or rejections are expressed from the observed dependences:

- H1a: For a company with inventory, it is more profitable to adhere to the principle of equality of current assets and current liabilities in terms of profitability expressed by Return on Assets. In the range where current assets approach the equality of long-term liabilities (current ratio is in the range of 0.8-1.2), the ROA increases. The value of the coefficient "a" is 0.0048, which is less than in the current ratio range 1.6-2.5, where the value is 0.0053. The hypothesis H1a is rejected.
- H1b: For a company with inventory, it is more profitable to adhere to the principle of twice as high of current assets as current liabilities in terms of profitability expressed by Return on Assets. In the range where current assets amount to twice current liabilities (current ratio is in the range of 1.6-2.5), the ROA also increases. The value of the coefficient "a" is 0.0053, which is more than in the current ratio range of 0.8-1.2, where the value is 0.0048. The hypothesis H1b is confirmed.
- H2a: For a company with inventory, it is more profitable to adhere to the principle of equality of current assets and current liabilities in terms of profitability expressed by Return on Equity. In the range where current assets approach the equality of long-term liabilities (current ratio is in the range of 0.8-1.2), the ROE increases. The value of the coefficient "a" is 0.0217, which is more than in the current ratio range of 1.6-2.5, where the value is 0.0010. The hypothesis H2a is confirmed.
- H2b: For a company with inventory, it is more profitable to adhere to the principle of twice as high of current assets as current liabilities in terms of profitability expressed by Return on Equity. In the range where current assets exceed twice long-term liabilities (current ratio is in the range of 1.6-2.5), the ROE indicator increases. The value of the coefficient "a" is 0.0010, which is less than in the current ratio range of 0.8-1.2, where the value is 0.0217. The hypothesis H2b is rejected.

### 3.2. Results for companies with no inventory

This subchapter presents the results of the calculated dependences summarized in Table 2 and further confirms or rejects the hypotheses H3 and H4.

**Table 2.** Dependence of profitability on current ratio (companies with no inventory).

<b>Current Ratio Range</b>	<b>Coefficient "a" for ROA</b>	<b>Coefficient "a" for ROE</b>
0-0.4	0.0028	-0.1556
0.5-0.7	0.0309	-0.3223
0.8-1.2*	-0.0067	0.1005
1.3-1.5	0.0640	-0.0501
1.6-2.5*	0.0422	0.0207
More than 2.5	0.0192	0.0054

\* Ranges for testing hypotheses

Concerning the hypotheses, the following confirmations or rejections are expressed from the observed dependences:

- H3a: For a company with no inventory, it is more profitable to adhere to the principle of equality of current assets and current liabilities in terms of profitability expressed by Return on Assets. In the range where current assets approach the equality of long-term liabilities (current ratio is in the range of 0.8-1.2), the ROA decreases. The value of the coefficient "a" is -0.0067, which is less than in the current ratio range of 1.6-2.5, where the value is 0.0442. The hypothesis H3a is rejected.
- H3b: For a company with no inventory, it is more profitable to adhere to the principle of twice as high of current assets as current liabilities in terms of profitability expressed by Return on Assets. In the range where current assets amount to twice current liabilities (current ratio is in the range of 1.6-2.5), the ROA increases. The value of the coefficient "a" is 0.0422, which is more than in the current ratio range of 0.8-1.2, where the value is negative -0.0067. The hypothesis H3b is confirmed.
- H4a: For a company with no inventory, it is more profitable to adhere to the principle of equality of current assets and current liabilities in terms of profitability expressed by Return on Equity. In the range where current assets approach the equality of long-term liabilities (current ratio is in the range of 0.8-1.2), the ROE increases. The value of the coefficient "a" is 0.1005, which is more than in the current ratio range of 1.6-2.5, where the value is 0.0207. The hypothesis H4a is confirmed.
- H4b: For a company with no inventory, it is more profitable to adhere to the principle of twice as high of current assets as current liabilities in terms of profitability expressed by Return on Equity. In the range where current assets exceed twice long-term liabilities (current ratio is in the range of 1.6-2.5), the ROE increases. The value of the coefficient "a" is 0.0207, which is less than in the current ratio range of 0.8-1.2, where the value is 0.1005. The hypothesis H4b is rejected.

### 3.3. Summary of hypothesis testing results

For both types of companies (both with and without inventory), the growth rate of ROA was found to be higher in current ratio in the range of 1.6-2.5 than in the range of 0.8-1.2. By contrast, the growth rate of ROE is higher in the current ratio range of 0.8-1.2 compared to the range of 1.6-2.5.

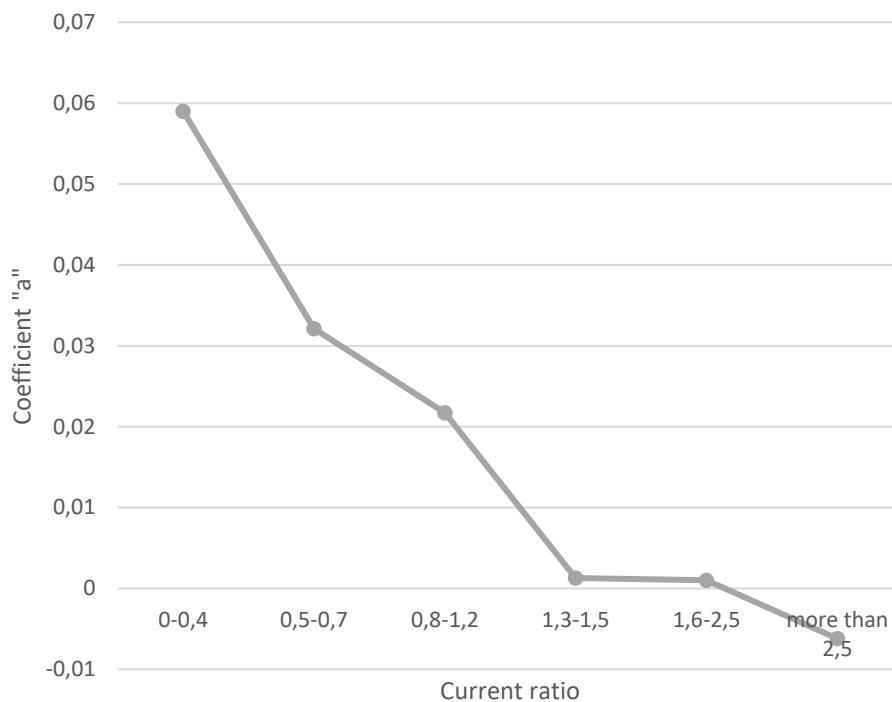
## 4. Discussion

From the above it can be stated that the ROA and ROE indicators achieve different results in the current ratio ranges. The profitability of equity increases when inventory, receivables and money are approximately equal to current liabilities. Conversely, with higher working capital, the growth rate of



this indicator declines. On the other hand, the return on assets increases more with significantly positive working capital.

It is generally stated that profitability decreases with greater liquidity. According to the research conducted, this relationship applies to current ratio of more than 2.5. In companies with inventory, the indicator of profitability of equity increases in all monitored ranges and decreases only in the last range. In Table 1, it is clear how the growth rate of ROE profitability with higher ranges is decreasing, but profitability is still increasing. It is no longer increasing in the current ratio range of more than 2.5, where it is decreasing.



**Figure 1.** The curve of dependence of ROE profitability expressed by coefficient "a" at the level of current ratio (on the sample of companies with inventory).

Figure 1 shows this trend. Growth rate of the ROE indicator declines steeply between the current ratio ranges 0-0.4, but the growth of this indicator continues up to the range of 1.6-2.5, or the ROE growth in this range is almost zero. With current ratio above 2.5, profitability of equity of ROE is declining.

## 5. Conclusions

The indicator of profitability of ROE equity is more sensitive to current ratio changes. It is found that ROE profitability declines only after exceeding the current ratio limit of 2.5. In this case, the additional unit of working capital no longer generates added profit for a company. The claim that the higher the liquidity, the lower the profitability is therefore refuted, or adjusted. Profitability for companies with inventory expressed by the ROE indicator is increasing up to the level of current ratio of 2.5, although at a slower pace. Thus, if a company with inventory moves at the current ratio levels of up to 2.5, it will continue to increase its return on equity, faster in the lower ranges of current ration, slower in the higher ranges.

Regarding the ROA profitability indicator and the sample of companies with inventory, it cannot be stated that there is a dependence in terms of current ratio, as well as in companies with no inventory. In this case, it can only be stated that the growth rate of ROA is higher with current ratio in the range of 1.6-2.5 than in the range of 0.8-1.2. By contrast, the growth rate of ROE is higher in the current ratio range of 0.8-1.2 compared to the range of 1.6-2.5.

The following recommendation follows from the above that current ratio of up to 2,5 is favourable for companies with inventory, as the return on equity increases to this level, and the lower current ratio, the faster growth of ROE. It is therefore more advantageous for these companies to have positive working capital, where the amount of assets is 2.5 times the current liabilities.

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# Sentiment Analysis of National Tourism Organizations on Social Media

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**Abstract:** Social media is probably currently the largest source of human-generated text content. User opinions, feedback, comments, and criticism points to their mood and sentiment towards different topics, especially destinations, products or services. The rapid rise in amount of data and constantly generated content require the need to automate both data acquisition and processing to identify important information and knowledge. Sentiment analysis provides the opportunity to detect opinion, feeling and sentiment from unstructured texts on social media. To analyze the sentiment Machine Learning with Google Natural Language API Client Libraries and Google Cloud SDK (Software development kit) was used. NTOs (National Tourism Organizations) social media have been chosen for analysis in which emotional messages can be expected to stimulate potential visitors to the destination. It was found that all selected NTOs add mostly positive posts and in the sample of two hundred contributions there are only seven with negative polarity of sentiment. There was a moderate correlation between customer growth and positive polarity in the contribution. The results show that creating stable positive descriptions for posts can be one of the key variables for the growth of the fan base and stimulation of potential visitors.

**Keywords:** sentiment analysis; national tourism organizations; social media

**JEL Classification:** O35; M31

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## 1. Introduction

The huge increase in popularity of big data on social media and social media in general makes it possible for the general public to express their opinions on a wide range of areas such as the state of the economy, enthusiasm or disappointment with a particular product, or to show pleasure in making a purchase (Shayaa et al. 2017).

Internet content has changed over the last few years, and so has the distribution of content. The shift was made possible by new technologies, new media and new communication tools. This change has led to a massive expansion of social media and a huge increase in short informal messages that are accessible to the public (Nakov et al. 2016). With the increasing number of different blogs, groups, forums, and social media as a source of online communication, it is now possible to analyze a huge amount of data that shows mood and feelings (Lyu and Kim 2016). Properly analyzing this data can significantly improve business efficiency (Hedvičáková and Král 2019).

Content on all possible social media is spreading very quickly just because users can freely share whatever they want. This is one of the reasons why the social media posts may have millions of reactions in a few days (Yoo, Song, and Jeong 2018). One of the ways marketers are currently trying to exploit this content and the response of users is sentiment analysis.

Sentiment analysis is the use of natural language processing and text mining to identify and extract subjective information from source materials, most often texts (Xiang et al. 2017; Alaei, Becken, and Stantic 2017). Finding these opinions can play a key role in understanding user, consumer or voter behavior.

This fact has recently brought great interest in analyzing sentiment and gathering opinions mainly from the text. Most current methods and approaches to sentiment analysis mainly use a number of positive and negative words in the text to reveal the polarity of sentiment (Dridi and Reforgiato Recupero 2019).

Sentiment analysis is used to gather opinions from different types of data (text, video or audio). It is most often text analysis that is frequently used for different areas of marketing, customer needs and customer service, including tourism. The mood or relationship of the customer or users in the examined articles is mainly analyzed by texts such as contributions, ratings and comments.

There are countless opinions on social media that express users' response to events, friend activities, products, or services. While these messages are short, such as on Twitter, up to 140 characters, the short messages can be used to identify a person's mood and feelings through classification, sentiment analysis, or machine learning. (Gaspar et al. 2016).

Most of the data available on social media is unstructured (Gaspar et al. 2016). According to them, approximately 80% of the total data in the world is unstructured, which makes this data difficult to analyze and extract valuable information from it.

Two very important techniques that can help detect emotions and opinions from data available on social media are:

- Sentiment analysis
- Opinion mining

If the mood and feelings of users are correctly detected, these findings can help solve problems in many areas such as elections, public opinion, advertising, marketing, healthcare, public satisfaction and, of course, tourism (Ahmed, Tazi, and Hossny 2015). They highlight, that one of the problems with sentiment analysis is that sometimes it is difficult to tell from the text what emotion the user is trying to convey. They further state, that sentiment analysis can also be used to define trust on social media for a brand or service.

Traditional statistical analyses and methods are not always suitable for big data analysis, precisely because the data is often unstructured. Methods associated with Big Data analysis unify specific tools to find similarities and patterns in large volumes of data. These methods include natural language processing, artificial intelligence, data mining or predictive analysis (Kirilenko et al. 2018).

Social media such as Twitter, Facebook and Chinese Weibo are the ultimate platforms for users to share comments, experience about a product, service, or even the entire business. Businesses are constantly trying to expand their offline and online network (Pochobradská and Marešová 2018). These social media are priceless for those who focus and understand the sentiment of the public (Wang et al. 2016). The main goal in case of sentiment analysis is to correctly classify user generated content (usually text) into either positive or negative polarity (Dhaoui, Webster, and Tan 2017). This was the main impulse for the creation of the sentiment analysis and the subsequent use of this analysis on social media. Sentiment analysis is an important research field today, which still faces many challenges due to the typical structure of social media and microblogs. These contributions are typically very short and full of noise unlike conventional texts such as newspapers (Dridi and Reforgiato Recupero 2019).

It is a bit surprising that even though sentiment analysis is increasingly being used for various purposes, it does not have as much attention among scientists for the overall use of sentiment analysis as an online marketing tool (Rambocas and Pacheco 2018). Over the past few years, sentiment analysis or online feedback have been increasingly used posts. Sentiment analysis uses the principles of natural language processing to identify attitudes and opinions about a specific product, description, or value. Thanks to the huge amount of information and data on the Internet, manual evaluation of sentiment is not a suitable option. Automating the process of collecting and evaluating data is the only practical solution to determine usable opinion from data available on the Internet. These evaluated data can then be used to improve decision making. Improved decision-making on sentiment analysis can be beneficial in many areas including financial market, marketing, e-commerce, politics, law, public decision-making and tourism.

Sentiment analysis has become a standard component of the social media analysis toolkit of marketers and customer relation managers in large organizations (Thelwall 2019). For its use from 2014 to 2019, a review study by Drus and Khalid (2019) demonstrates the prevailing lexicon-based approach. In tourism, the analysis of sentiment in social media is used to research the perception and evaluation of the quality of tourist services (Airport Service Quality – Martin-Domingo, Martín, and Mandsberg 2019) and analysis of tourist relations to destinations (Liu et al. 2019). Sentiment analysis

is also part of research into various features of review sites (e.g. Xiang et al. 2017), where sentiment analysis could also be used as a tool to detect false reviews (Kauffmann et al. 2019).

## 2. Methodology

The purpose of this research was to find out which sentiment NTOs use in their posts in social media and compare this sentiment with followers for the past two years. Facebook was chosen as the focus social medium because it is the dominant social network and contains the largest number of companies trying to promote their products and services. All analyzed posts in this work are from the social network Facebook. NTOs from the countries with the highest visitor numbers of international tourists were selected. According to UNWTO (2019), the top ten most visited countries in the world in 2018 were France, USA, Spain, China, Italy, Great Britain, Germany, Mexico, Thailand and Turkey.

Of the ten countries selected, Thailand is the only country that does not post on Facebook in English, and for this reason, another country has been added, namely Australia.

A Google product and library package called Artificial Intelligence and Machine Learning with Google Natural Language API (Application Programming Interface) Client Libraries and Google Cloud SDK (Software development kit) was used to analyze sentiment.

Algorithm for sentiment analysis is written in language Python in software PyCharm. The sentiment analysis goes through the inserted text and identifies the emotional opinion in the text, to reveal the author's opinion as either positive, negative or neutral. The sentiment analysis determines what polarity prevails in the text. Output variables from this method are score and magnitude.

The variable score points to the overall emotional state of the inserted text. Magnitude then shows how much emotional content is present in the text. The higher the magnitude, the usually higher the number of positive and negative words in the text. The Natural Language API shows the differences between positive and negative emotions in the selected text, but does not show specific emotions. For example, "annoyed", "sad" or "disappointed" are considered negative emotions. If the score of the pasted text is around zero (neutral), it may mean text with a low number of words expressing emotions, or it may mean mixed emotions with both positive and negative words in the text. Authors used magnitude values to uncover these cases, as truly neutral documents will have a low magnitude value, while mixed documents will have higher magnitude values. The example below shows some sample values and how to interpret them:

- Score 0.9 and magnitude 4.2 (Clearly Positive)
- Score -0.7 and magnitude 3.8 (Clearly Negative)
- Score 0.2 and magnitude 0.1 (Neutral)
- Score 0.0 and magnitude 5.4 (Mixed)

The original research plan consisted of analyzing the posts that are a clickable article (that is, not to analyze posts that are a video or image) and the text on the social media for the post, and then re-analyzing the sentiment in the article after clicking the post. After examining hundreds of contributions from selected NTOs, this procedure has been changed to study text on social media only, since most NTOs did not add ten posts in 2019 as an article. They focus mainly on photos and videos.

The text used to analyze sentiment will be twenty posts from each Facebook social network for each national tourism organization (these posts are usually shared in the same form on Twitter). The text used on social network will be analyzed. Total of 200 posts from 10 selected NTOs will be tested. Every character from post will be analyzed. Only links will be excluded from the sentiment analysis as they have no value for this test.

The following research question will be asked: Does the polarity of sentiment analysis affect subscriber growth on social media?

Pearson correlation in statistical software IBM SPSS Statistics will be used for statistical analysis.

## 3. Results

To determine the sentiment used in selected national tourism organizations, a total of 200 posts were analyzed. Analyzed was text attached to post on social media. Posts were selected using the

random selection method from all posts inserted in 2019 and are mostly image or video posts. These 200 posts were selected from a total of almost 2,500 uploaded posts.

One very positive, very negative and neutral short text will be presented to demonstrate the functionality of the algorithm.

**Clearly Positive**

Text: "The product is amazing! It solved my problem and I highly recommend it!"

Output: Sentiment: 0.9, magnitude 1.9

**Clearly Negative**

Text: "The movie was awful, the performances were terrible, and even the music was not very good."

Output: Sentiment: -0.9, magnitude 1.8

**Neutral**

Text: "The book is well written even though it has weaker passages, the main character is awesome too."

Output: Sentiment: 0.0, magnitude 0.0

The table below shows the selected countries with the largest number of international tourists and their number of fans as of 31<sup>st</sup> of December 2017 (column titled "Subs. in 2017"), followed by the number of their fans as of 31<sup>st</sup> of December 2019 (column titled "Subs. in 2019). The column labeled "Increase" shows the increase in the number of fans over the last two years. "Score" and "Magnitude" show the average sentiment of the twenty posts on Facebook in 2019 and the column "Char." shows the average number of characters in the post, including spaces of those twenty posts.

**Table 1.** Number of subscribers and sentiment of the posts for selected NTOs.

Country	Subs. in 2017	Subs. in 2019	Increase	Score	Magnitude	Char.
France	1,526,227	1,989,406	30%	0.58	1.12	105
Turkey	5,299	6,562	24%	0.75	0.88	227
China	23,524	27,869	18%	0.38	0.98	170
Germany	2,339,192	2,749,899	18%	0.48	1.22	154
Australia	7,612,922	8,343,652	10%	0.27	0.67	139
Italy	448,994	491,709	10%	0.62	1.30	208
Mexico	5,161,340	5,495,632	6%	0.47	0.69	108
USA	6,457,274	6,763,487	5%	0.44	1.74	233
Spain	1,745,456	1,816,522	4%	0.43	0.92	166
Great Britain	3,316,366	3,383,393	2 %	0.49	0.80	108

The table shows that all selected NTOs add positive polarity contributions on average. Of the two hundred contributions analyzed, only seven had negative polarity. Specifically, one weak negative contribution for Spain with a polarity of -0.1, two negative contributions for China with a polarity of -0.2, one negative contribution for Mexico with a polarity of -0.4, one negative contribution for Turkey with a polarity of -0.1, and two negative contributions for Australia with polarity -0.3 and -0.1.

Average of sentiment analysis score is 0.49 and average of magnitude is 1.03 across all analyzed 200 posts and all NTOs.

France had the highest fan growth over the last two years, with an increase of 30% and a sentiment value of 0.58, which is above average. In the second place in the growth of the number of fans is Turkey with an increase of 24% over the last two years and an average sentiment value of 0.75, which is also above average.

Other findings when examining posts include that each NTO has its own style of posting and is more or less adhering to it. For instance, France will never forget to put a positive word in its

contributions, and because of this, the value of sentiment polarity is one of the highest. Social contributions in the case of France are usually shorter in two lines. In contrast, the US has contributions longer, often around four lines. Spain posts are in two languages and contain a higher number of hashtags. China and Australia often make use of social Instagram posts from other users. Italy is very active on social media and adds several posts per day. On the other hand, Turkey is not so active and will only add a few posts a month. Great Britain almost always puts emoticons in the post.

Furthermore, the Pearson correlation coefficient for these variables was found, including the increase in the number of fans over the last two years, sentiment analysis score, magnitude, and the number of characters in the text, including spaces.

**Table 2.** Correlation coefficients for increase in fans over the last two years, sentiment analysis score, magnitude, and the number of characters in the text.

Correlations				
	Increase	Score	Magnitude	Characters
Increase	1	.451**	.025	-.006
Score		1	.166	.333
Magnitude			1	.593
Characters				1

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The table shows the correlation between the increase in a fan base and the sentiment polarity value of 0.451. This correlation is referred to as weak to moderate. Sentiment polarity of posts can therefore be one of the key variables for the growth in the number of social media fans, as this is the first thing that should interest users. It can also be seen from the correlations that magnitude and the number of characters in such short texts do not affect the growth of a fan base.

#### 4. Discussion

Social media are, as confirmed by the findings of a number of authors (e.g. Wang et al. 2016; Dhaoui, Webster, and Tan 2017), intensively used not only in the NTO's marketing but in majority of industries. The dominant social medium in the NTOs' marketing of the ten most visited countries is Facebook (Hruška and Pásková 2018).

This paper focused on the analysis of sentiment on social media posts and linking the polarity of sentiment to the growth of the fan base. According to the correlation, it was found that the polarity of sentiment has moderate influence on the growth in the number of subscribers. Of course, a number of other factors, such as the quality of posts, the quality of shared images and videos, could influence subscriber growth. The political situation, nationality, the size of the country, marketing and investment in tourism are also important (Ahmed, Tazi, and Hossny, 2015; Drus and Khalid 2019). Nonetheless, this research highlights the importance of the polarity of sentiment in contributions. The main social network where this research was conducted is Facebook, but NTOs often share posts from Facebook in the same wording on Twitter and sometimes Instagram (this is consistent with the results published by Hruška and Pásková 2018). It is therefore possible that the same conclusions will apply to other social media.

All countries add mostly positive contributions and out of 200 tested contributions only seven had negative sentiment. Another finding was a moderate correlation between the sentiment value in the post and the increase in the number of subscribers over the last two years. These findings suggest that, although the number of fans is certainly influenced by many variables, the sentiment of posts could play a very important role in the growth of social network accounts.

The method of analysis performed in this work is not suitable for detecting sentiment polarity from videos, but this is likely to be a development in the future. Social media users usually do not want to read anything, so there could be another focus on analyzing video sentiment, on YouTube, for example.

The limits of this work are that it targets only one factor (text added to social media post and its sentiment) and does not take into account other factors such as video quality or shared image quality. Moreover, the analysis was carried out on a relatively small sample of two hundred contributions. The further research could consist of analyzing a larger amount of posts, including the text inside the post, after clicking, and thus analyzing sentiment on longer texts in areas other than tourism. It would be advisable to use a grounded theory approach (Lai, 2015) for further research methodology with consistent definition of research objectives, type of social media, sample size and results interpretation.

## 5. Conclusions

This work analyzed the sentiment of social media posts on Facebook for countries (NTOs) with the most international tourists. The result of this work is finding that there is a moderate correlation between sentiment and growth in the number of fans of NTOs social media.

Concerning the most successful NTOs as for the increase in subscribers over the last two years on Facebook, France has the highest subscriber growth (30%) in the last two years, a sentiment score of 0.58, and its average number of characters in the post description is 105. In comparison, the average sentiment of all selected countries and posts is 0.49. Turkey came second with 24% subscriber growth, an even higher sentiment value of 0.75, and an average post length of 227 characters. China ranked third in the number of subscriber growth, with a lower sentiment value of 0.38, and an average post length of 170 characters, but also a smaller subscriber growth (18%). The research also found that France has added most of the posts that contain an article among all the selected countries. The other selected NTOs usually only add a combination of video and pictures. Another finding was that the last four countries in subscriber increases have less than the average sentiment value. Observation of accounts of selected NTOs has also revealed that they share user generated content (typically an Instagram photo or a YouTube fan video) on its social media, especially on Facebook. Selected NTOs usually add their own text to such posts, and so this factor should not have a big impact on the analysis in this paper.

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# Win-win Strategy for China's Environmental Regulation and Economic Development

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**Abstract:** During the period of structural adjustment of China's economic development, solving the problem of environmental pollution has become an urgent need to realize the coordinated progress of economic development and ecological environment. However, whether the process of implementing environmental regulation to govern the ecological environment will have an inhibitory effect on China's economic development has become a key issue that needs to be answered urgently. Based on the panel data of China's prefecture-level cities and listed companies from 2007 to 2017, this paper makes an empirical study on the relationship between the environmental regulation of prefecture-level cities and the development of China's listed companies. The results of mean regression and quantile regression show that the strengthening of environmental regulation has a significant positive impact on the total factor productivity of enterprises, and this promotion effect will gradually improve with the improvement of enterprise production efficiency. Therefore, there is no contradiction between strengthening the management and protection of the ecological environment and achieving the phased goal of China's high-quality economic development.

**Keywords:** environmental regulation; economic development; total factor productivity; listed companies

**JEL Classification:** O1; Q5

## 1. Introduction

Since the reform and opening up in 1978, China's economy has experienced rapid growth for more than 40 years, but this extensive growth is mainly achieved by sacrificing environmental resources. Therefore, while achieving economic prosperity, it has also brought about serious environmental problem. The report of the Nineteenth Chinese People's Congress pointed out: "China's economy has shifted from a high-speed growth stage to a high-quality development stage." High-quality development is an upgraded version of our country after more than 40 years of high-speed growth, which requires that the economic quality increase while the number of economies increases. This is an inevitable requirement for advancing the five new development concepts, breaking the current stage of economic growth, and realizing the sustainable development of China's economy on the premise that major social contradictions have changed. From an economic and environmental perspective, high-quality development is a state where economic development is in harmony with resources and the environment. Therefore, solving environmental pollution issues has become an urgent need for China's economic development and ecological environment to advance together. In March 2019, the second meeting of the Thirteenth National People's Congress of the People's Republic of China emphasized "all-round strengthening of ecological environmental protection and promoting the fight against pollution in accordance with law." Therefore, in the period of structural adjustment of economic development, whether environmental regulations can promote economic development is a key issue that needs to be solved urgently.

A few scholars have found that environmental regulation will inhibit the improvement of the quality of economic development and believe that there is an opposite trend between the two indicators (Greenstone 2014; Lei and Yu 2013; Xu and Qi 2017; Elrod 2017). At the same time, some scholars have concluded that there is a "inverted N" or "U" nonlinear relationship between environmental regulation and economic development (Li and Cao 2017; Wang and Feng 2018).

However, most scholars believe that environmental regulation can have a positive incentive effect on the improvement of the quality of economic development and further achieve a win-win situation of environmental protection and economic development (Yuan and Xie 2016; He 2018; Hering 2014; Tong 2019; Wang et al. 2016).

Xie et al. (2012) on the basis of distinguishing China's economically developed areas from the less developed areas, study shows that in China's economically developed areas, environmental regulation has a significant positive effect on economic growth, while in the less developed areas this promoting effect is not significant. Feng (2014) research believes that environmental regulation can promote China's economic growth, and under different environmental regulation intensity, the degree of impact of environmental regulation on economic growth is also different. Wu et al. (2016) took 280 key cities from 1992 to 2009 as the research objects, and took the environmental regulation policy of "two control areas" implemented in 1998 as a natural experiment. The results show that after the implementation of this environmental regulation, the per capita GDP and per capita industrial GDP of the "two control areas" cities have been improved to a certain extent, that is, environmental regulation has not restricted economic growth, but has achieved a win-win result of environmental protection and economic growth. Yuan and Xie (2016) based on the empirical research results of China's provincial panel data from 1999 to 2012 believe that technological progress is the main source of promoting industrial green total factor productivity growth. Kong Haitao, Yu Qingrui and Zhang fawn (2019) take 283 prefecture-level cities in China as samples, and the research finds that the improvement of environmental regulation level is conducive to the promotion of urban productivity, and this effect shows obvious heterogeneity among cities of different sizes and different innovation capabilities.

Based on the above analysis, the primary question to be answered in this article is whether the impact of environmental regulation on the economic development of listed companies in China is a stimulant or a suppressant. Secondly, will the extent of this impact be limited by the initial enterprise efficiency?

## 2. Methodology

The sample interval of this article is from 2007 to 2017, the data used are the operating data of Chinese listed companies and the environmental regulation data of 283 prefecture-level cities in China. Among them, the relevant data of listed companies comes from CSMAR Service Center, the prefecture-level city environmental regulation data comes from the China City Statistical Yearbook (2007-2019). Due to the lack of data in Tibet, Hong Kong, Macau, and Taiwan provinces, we have deleted the data of listed companies registered in these provinces. While linear interpolation was used to supplement a small number of missing values, in order to avoid the influence of outliers on the regression results, a 1% bilateral tailing process was performed on all continuous variables.

Among them, this article chooses to take total factor productivity(acftfp) as the measure of the quality of China's economic development (Jin and Shen 2018). Micro-level total factor productivity is measured mainly by the Olley-Pakes method (OP), Levinsohn-Petrin method (LP), and the ACF method proposed by Akerberg et al. (ACF). Among them, the OP method solves part of the problem of sample selection bias by using corporate investment as a proxy for productivity, and the LP method uses intermediate inputs to overcome the endogenous problem in the process of estimating Solow residual value, but because in these two methods labor input is a deterministic function of other variables, on the one hand, it is impossible to estimate the labor input coefficient, and on the other hand, there may be multicollinearity problems. With this in mind, using the ACF method to calculate total factor productivity is a more effective estimate of China's high-quality development. In specific calculations, this paper draws on the routine practices of Lu and Lian (2012), and uses the operating income, number of employees, and net fixed assets as the measurement of enterprise output, labor input, and capital investment. Cash paid for other long-term assets is used as an intermediate input indicator for the ACF method. Among them, operating income and net fixed assets were deflated using the ex-factory price index and fixed asset investment price index of the province, city, and autonomous

region where the registration was located, and the intermediate input index was converted into the 2007 constant price using the consumer price index.

When measuring environmental regulations (*enre*), taking into account the availability of data from 283 prefecture-level cities in China, and the one-sidedness of using the single index method and the evaluation & scoring method, this paper draws on Li and Zou Qing (2018), Dong and Wang (2019) thesis, using the comprehensive index method to measure the level of environmental regulations in prefecture-level cities. The specific operations of the comprehensive index method are: first, standardize the relevant basic indicators of environmental regulation; second, determine the weight of the basic indicators according to the entropy method, and further calculate the comprehensive index of environmental regulations based on the weights and standardized values. Based on the existing literature, this paper selects five basic indexes: industrial sulfur dioxide removal rate, industrial soot removal rate, comprehensive utilization rate of industrial solid waste, urban domestic sewage treatment rate, and harmless treatment rate of domestic waste.

In addition, the following control variables are selected in this article: ① The size of the enterprise (*scale*) is expressed as the total assets of the company after taking the natural logarithm; ② The purchasing power of the enterprise (*purch*) is measured by the year-end monetary funds after taking the natural logarithm; ③ The market value of the enterprise (*value*) is taken by the market value of the natural logarithm of the company; ④ The company's operating capacity (*profit*) is characterized by the company's return on assets; ⑤ The employee's salary ratio (*hire*) is calculated by the ratio of the listed company's payable employee's salary to the operating cost; ⑥ The concentration of corporate equity (*share*) is measured by the sum of the equity ratios of the top three shareholders of listed companies; ⑦ The age of the company (*age*) is calculated by subtracting 1 from the current year and the year of registration of the company. Among them, the scale of the enterprise, the purchasing power of the enterprise, and the proportion of employees' salaries are all converted into constant prices in 2007.

**Table 1.** Selection of control variables.

Variable	Index	Measure and calculate
<i>scale</i>	enterprise size	the total assets of the company after taking the natural logarithm
<i>purch</i>	purchasing power	the year-end monetary funds after taking the natural logarithm
<i>value</i>	market value	the market value after taking the natural logarithm
<i>profit</i>	operating capacity	the company's return on assets
<i>hire</i>	percentage of employee's salary	employee's salary/ operating cost*100
<i>share</i>	concentration of corporate equity	the sum of the equity ratios of the top three shareholders
<i>age</i>	enterprise age	current year-year of registration+1

**Table 2.** Descriptive statistics of variables.

Variable	N	Mean	St. dev	Min	Max
<i>acftfp</i>	24418	14.1710	0.9486	11.9488	16.8205
<i>enre</i>	24418	1.1534	0.1258	0.4600	1.3500
<i>scale</i>	24418	21.7606	1.2785	19.1928	25.6848
<i>purch</i>	24418	19.8309	1.3838	15.8700	23.6768
<i>value</i>	24418	22.4023	1.1401	19.2275	28.5332
<i>profit</i>	24418	0.0391	0.0564	-0.2072	0.1967
<i>hire</i>	24418	0.0338	0.0535	0.0001	0.3666

<i>share</i>	24418	49.0248	15.6865	15.8600	85.6400
<i>age</i>	24418	16.4051	6.9806	3	30

### 3. Results

#### 3.1. Construction of the economic model

Based on the above theoretical analysis ideas, in order to capture the actual impact of environmental regulations on the quality of economic development, this article builds the following basic measurement models:

$$dequality_{iwt} = \alpha_0 + \alpha_1 enre_{jt} + \beta X_{iwt} + v_w + v_j + v_t + \varepsilon_{iwt} \quad (1)$$

The set of control variables is:

$$X_{iwt} = \beta_1 scale_{iwt} + \beta_2 purch_{iwt} + \beta_3 q_{iwt} + \beta_4 profit_{iwt} + \beta_5 hire_{iwt} + \beta_6 share_{iwt} + \beta_7 age_{iwt} \quad (2)$$

Among them, the explained variable  $dequality_{iwt}$  represents the economic quality development of listed company  $i$  in industry  $w$  of region  $j$  during the  $t$  period, which is measured by the total factor productivity (acftfp) measured by ACF method.  $enre_{jt}$  is the core explanatory variable, indicating the level of environmental regulation in area  $j$  at time  $t$ .  $X_{iwt}$  is a set of other control variables that affect the economic development of an enterprise, including: enterprise scale (scale), enterprise purchasing power (purch), enterprise market value ( $q$ ), enterprise operating capability (profit), and employee compensation (hire), Corporate equity concentration (share) and corporate age (age).  $v_w$ ,  $v_j$ ,  $v_t$  are industry, regional and time dummy variables, respectively, reflecting industry fixed effects, regional fixed effects and time fixed effects.  $\varepsilon_{iwt}$  is a random perturbation term. The core coefficient concerned in this article is  $\alpha_1$ , and its direction and size reflect the direction and extent of the impact of regional environmental regulation on the quality of economic development.

The above basic econometric model focuses on examining the impact of environmental regulations on the quality conditions of economic development, which is essentially a mean regression and is susceptible to extreme values. In order to accurately characterize the complete statistical characteristics of the condition distribution and effectively capture the effect of environmental regulation on the quality of economic development in extreme regions, this paper further constructs the following quantile regression model:

$$dequality_{iwt}(\tau) = \beta_0(\tau) + \beta_1(\tau) enre_{jt} + \beta(\tau) X_{iwt} + v_t + \varepsilon_{iwt} \quad (3)$$

Among them,  $\tau$  ( $0 < \tau < 1$ ) represents the different quantiles of the conditional distribution, which are 0.1, 0.25, 0.5, 0.75, and 0.9 respectively; the core coefficient  $\beta_1(\tau)$  reveals that the level of environmental regulation affects economic development at different quantiles. Marginal impact of quality.

#### 3.2. Results of the benchmark model

In the benchmark regression section, the mixed OLS, fixed effect model, and random effect model are used to estimate the role and size of the environmental regulation level of Chinese prefecture-level cities in 2007-2017 on the development of local listed companies. Table 3 is the corresponding benchmark regression results. Model 1 reports the estimated results of controlling only time effects, regional effects, and industry effects. Every 1 unit increase in environmental regulation can increase the listed company's TFP by 0.248, and pass the statistical significance test of 5%. After controlling other enterprise characteristic variables, each unit of environmental regulation in the prefecture-level city in Model 2 can significantly change the TFP of listed companies in the region by 0.124. This shows that after excluding other factors that affect the efficiency of listed companies, the environment the positive effect of regulation on the high-quality development of enterprises is still significant. Further,

Model 3 and Model 4 are the estimation results using the individual time double fixed effect model, in which the estimated coefficients of environmental regulation (*enre*) are significantly positive at a confidence level of 1%; Models 5 and 6 report the fitting of random effects after control of time, region, and industry. The estimated coefficients of environmental regulation (*enre*) are all positive, but the coefficients fail to pass the 10% significance when the other factors are not controlled test. Therefore, this paper concludes that the strengthening of environmental regulations can significantly promote the development quality of listed companies in China.

Among the control variables, the regression coefficients of enterprise scale (*scale*), enterprise purchasing ability (*purch*), enterprise value (*value*), enterprise operating ability (*profit*), equity concentration (*share*) and enterprise age (*age*) are all significantly positive. That is to say, the expansion of corporate asset scale and monetary capital scale, the increase of corporate market value and return on assets, and the growth of equity intensiveness and operating life will cause the same factor changes in the total factor productivity of listed companies. The regression coefficient of the employee's salary ratio (*hire*) is significantly negative, indicating that an increase in the ratio of payable employees' salary to operating costs will inhibit the improvement of corporate efficiency. This may be because an increase in the proportion of employee compensation means an increase in the labor cost of the enterprise. While increasing the cost burden of the enterprise, this change will also have a crowding out effect on the labor demand of the enterprise, which will adversely affect the productivity of listed companies (Cong and He 2018).

**Table 3.** Results of the Benchmark Model: Impact of Environmental Regulations on the Development of Chinese Listed Companies.

Variable	Explained variable: total factor productivity of the ACF method					
	OLS		Fixed effects		Random effects	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>enre</i>	0.248** (0.116)	0.124* (0.0664)	0.728*** (0.154)	0.544*** (0.0784)	0.0377 (0.0679)	0.0927** (0.0429)
<i>scale</i>		0.340*** (0.0219)		0.278*** (0.0292)		0.308*** (0.0170)
<i>purch</i>		0.0664*** (0.0100)		0.127*** (0.0130)		0.0292*** (0.0060)
<i>value</i>		0.0883*** (0.0165)		0.0944*** (0.0225)		0.116*** (0.0137)
<i>profit</i>		1.747*** (0.105)		1.725*** (0.123)		1.850*** (0.0822)
<i>hire</i>		-4.039*** (0.175)		-4.551*** (0.236)		-3.815*** (0.193)
<i>share</i>		0.0023*** (0.0008)		0.0016* (0.0008)		0.0011 (0.0007)
<i>age</i>		0.0113*** (0.0015)		0.0138*** (0.0027)		0.0098*** (0.0019)
<i>_cons</i>	13.72*** (0.159)	2.988*** (0.155)	13.33*** (0.175)	2.658*** (0.185)	13.91*** (0.126)	3.929*** (0.233)
<i>v<sub>i</sub></i>	NO	NO	YES	YES	NO	NO
<i>v<sub>t</sub></i>	YES	YES	YES	YES	YES	YES
<i>v<sub>j</sub></i>	YES	YES	NO	NO	YES	YES
<i>v<sub>w</sub></i>	YES	YES	NO	NO	YES	YES
<i>N</i>	24418	24418	24418	24418	24418	24418
<i>R2</i>	0.200	0.668	0.025	0.595	0.1462	0.6544

### 3.3. Results of the quantile regression

The above basic econometric model mainly describes the positive promotion effect of environmental regulations on the quality of Chinese listed companies' economic development in the mean range, ignoring their tail status characteristics in extreme regions. Through statistical analysis, this paper finds that the skewness of total factor productivity of listed companies is 0.40 and the kurtosis is 3.09, showing a right-side thick tail distribution; while the skewness value of environmental regulations is -1.29, and the kurtosis value is 5.11, showing a typical Left-left thick-tailed distribution. In order to characterize the asymmetrical impact of prefecture-level environmental regulation on the quality of China's listed companies' economic development and effectively capture the tail characteristics of the TFP distribution of listed companies, this paper next uses quantile regression to control the time effect and estimates At the 0.1, 0.25, 0.5, 0.75, and 0.9 quantiles, listed companies' high-quality development of quantile equations affected by environmental regulations. The specific regression results are shown in Table 4. The fitting coefficients of environmental regulations (*enre*) are all significantly positive at a confidence level of 1%, which indicates that the environmental regulations of prefecture-level cities have a significant positive promotion effect on all quantiles of the quality of China's economic development. Furthermore, the coefficient estimation of environmental regulation (*enre*) at different quantiles is between 0.435 and 0.664, and its magnitude shows an upward trend with the increase of quantiles, which indicates that increasing environmental regulation in prefecture-level cities may more strongly promote efficient listed companies to improve development quality. At the same time, the regression results of most other control variables are consistent with the benchmark regression results. In a word, environmental regulation has a significant positive impact on China's economic development at different sub-sites, and its positive promotion effect on highly efficient listed companies is even stronger.

**Table 4.** Results of the Quantile regression: Impact of Environmental Regulations on the Development of Chinese Listed Companies.

Variable	Explained variable: total factor productivity of the ACF method				
	QR-10	QR-25	QR-50	QR-75	QR-90
Estimation	(1)	(2)	(3)	(4)	(5)
<i>enre</i>	0.435*** (0.0610)	0.482*** (0.0436)	0.536*** (0.0367)	0.596*** (0.0515)	0.664*** (0.0808)
<i>scale</i>	0.261*** (0.0172)	0.268*** (0.0123)	0.276*** (0.0104)	0.286*** (0.0146)	0.296*** (0.0228)
<i>purch</i>	0.118*** (0.0087)	0.122*** (0.0062)	0.126*** (0.0053)	0.131*** (0.0074)	0.136*** (0.0115)
<i>q</i>	0.105*** (0.0172)	0.101*** (0.0123)	0.0952*** (0.0104)	0.0892*** (0.0146)	0.0825*** (0.0228)
<i>profit</i>	2.294*** (0.132)	2.048*** (0.0945)	1.767*** (0.0797)	1.453*** (0.112)	1.101*** (0.175)
<i>hire</i>	-5.072*** (0.141)	-4.846*** (0.101)	-4.589*** (0.0848)	-4.302*** (0.119)	-3.981*** (0.186)
<i>share</i>	0.0014*** (0.0005)	0.0015*** (0.0003)	0.0016*** (0.0003)	0.0017*** (0.0004)	0.0018*** (0.0006)
<i>age</i>	0.0027** (0.0012)	0.0075*** (0.0008)	0.0130*** (0.0007)	0.0191*** (0.0010)	0.0259*** (0.0016)
<i>vt</i>	YES	YES	YES	YES	YES
<i>N</i>	24418	24418	24418	24418	24418

## 4. Discussion

In order to answer the key question whether environmental regulation can promote economic development during the structural adjustment period of China's economic development, this paper

uses mean regression and quantile regression as experiments to test whether environmental regulation can promote the development of Chinese listed companies. Compared with the existing research literature, this article mainly expands the existing research from the following two aspects: First, the existing literature tends to focus on the impact of environmental regulation on the macro level of China's economic growth. However, environmental regulation is a policy tool that works by directly acting on the micro-enterprise of an enterprise. Therefore, to clarify the impact of environmental regulation on macroeconomic development, we must answer the question whether it can promote the improvement of corporate productivity. Second, most of the existing literature is based on traditional mean methods to study the impact of environmental regulation on economic growth. This paper uses the panel quantile regression method to describe the relationship between environmental regulation and corporate productivity in different quantiles. The results show that environmental regulation has a stronger positive promotion effect on high-efficiency listed companies.

Although this article verifies the positive impact of environmental regulations on the economic development of Chinese listed companies, there are still some key questions that have not been answered, such as: What are the specific ways in which environmental regulations affect economic development? Does the role of environmental regulation in promoting economic development differ in different regions and industries? Therefore, this issue can be further studied in the future.

## 5. Conclusions

Based on the panel data of China's prefecture-level cities and listed companies from 2007 to 2017, an empirical study was conducted on the relationship between prefecture-level city environmental regulation efforts and the development of Chinese listed companies. The empirical results show that the strengthening of environmental regulations has a significant positive impact on the total factor productivity of enterprises, and this enhancement will gradually increase with the improvement of enterprise production efficiency. For this reason, this article puts forward the following suggestions: Strengthening the governance and protection of the ecological environment is not contradictory to the phased goal of achieving high-quality development of the Chinese economy. China is currently in a critical period of transition from the quantity era to the quality era. In the subsequent development process, it is unwavering to strengthen its determination to protect the environment, further strengthen environmental governance, put an end to the persistence of the undesirable growth form of "environment for growth" nationwide, and contribute China's strength to the world environmental governance.

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# Total Factor Productivity in the EU – Direct and Indirect Impact of Labor Market Institutions

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**Abstract:** Total factor productivity is an essential determinant of long-run growth. Given the dissatisfactory evolution of TFP in member states of the EU, determination of key factors of productivity growth is essential for better economic performance of member states. The goal of the paper is to quantify direct and indirect impact of labor market institutions and knowledge on total factor productivity growth in member states of the European Union with emphasis on their interactions. By means of least square dummy variables panel data regression, the impact of R&D, human capital and five institutions on total factor productivity growth is estimated. Empirical analysis is conducted on dataset covering observations for 28 member states over 1998-2016. Regression results approve the theoretically expected productivity enhancing effect of knowledge and indicate significantly negative impact of labor market institutions on TFP growth. Besides direct effects, labor market institutions negatively influence productivity growth via their impact on human capital and R&D. Therefore, policy measures that support knowledge accumulation and reform current institutional set up on labor markets are essential for boosting productivity growth in the EU.

**Keywords:** labor market institutions; total factor productivity; the European Union

**JEL Classification:** C33; I25; O43

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## 1. Introduction

Total Factor Productivity (TFP) is considered as key determinant of long-run growth and cross-country differences in income. It shows how productively all the inputs are used. Given the considerable slowdown in potential growth in member states of the European Union and persisting productivity gap between EU and US, the issue to enhance total factor productivity is in front of academic and policy debates. Among others, we can mention The Council's recommendation to create National productivity Boards (The Council of the European Union 2016). However, economic policy measures would not improve TFP and decrease productivity gap without determination of key determinants.

Since the emergence of endogenous growth theories, research and development (R&D) and human capital (HC) has been considered as two leading determinants of economic growth through their positive impact on productivity (Romer 1990; Lucas 1988). An evidence of productivity enhancing effect of R&D can be found in numerous empirical studies (Coe and Helpman 1995; Frantzen 2000; Bronzini and Piselli 2009; Edquist and Henrekson 2017, etc.). Later studies extended the analysis of impact of knowledge by inclusion of human capital in empirical analysis (Coe et al. 1997; Engelbrecht 1997; Männasoo et al. 2018, Barcenilla et al. 2019, etc.).

Persisting differences in performance among countries raised a claim that knowledge accumulation is an important but not only source of growth. New theories tried to explain growth through structural parameters, including those related to institution (Aghion and Howitt 1992; Acemoglu et al. 2010; etc.). Acemoglu and Robinson (2010) suggested that economic institutions are key sources of economic growth and prosperity because they shape incentives of economic agents to invest in physical capital, human capital and technology and influence organization of production. In the context of endogenous theories, institutions determine productivity growth mainly via their impact on innovations and human capital accumulation (Barro and Sala-i-Martin 1997).

As Freeman (1993) pointed out, recent research in labor market policies is dominated by two contradicting intuitions: distortionism (institutions impede economic growth) and institutionalism (institutions reduce costs, enhance productivity or moderate crises). A large body of current empirical

works is oriented on strictness of labor market regulations with predominantly negative conclusions about its impact on productivity (Bassanini et al. 2000, Gust and Marquez 2004, Bassanini and Venn 2008, Bassanini et al. 2009, etc.). A positive, but weak and sensible to model specification, effect of stricter regulation on labor productivity and TFP in the OECD countries was estimated by Nickell and Layard (1999) and Koeninger (2005). Later, Belot et al. (2007) suggested that stricter employment protection legislation leads to productivity gains if workers invest in firm-specific skills.

Even less studies exist in the case of other labor market institutions. Positive effect of minimum wage on long-run labor productivity and TFP was found out by Bassanini and Venn (2007). However, generous unemployment benefits system could reduce that positive effect of minimum wage by reducing the opportunity cost of remaining unemployed. Alternatively, an increase of minimum wage may lead to more efficient reallocation of sources and productivity gains (Del Carpio et al. 2015). Negative impact of generous unemployment benefits was found out by Dolenc and Laporšek (2013). At the same time, they suggested a positive impact of active labor market policies on productivity. The productivity enhancing effect of ALMP was supported also by Parello (2011) or Égert (2016). Therefore, an unambiguous answer on the role of labor market institutions in determining total factor productivity cannot be fined even in empirical literature. Moreover, empirical studies rarely consider more than one labor market institution leading to only partial conclusions about the impact of institutional set-up on labor markets. Further empirical research could enrich the current state of knowledge and serve as basis for appropriate policy recommendations.

The main goal of this paper is to quantify the direct and indirect impact of labor market institutions and knowledge on total factor productivity growth in member states of the European Union with emphasis on their interactions. More precisely, we are interested in the effect of research and development, human capital and five labor market institutions (active labor market policies, employment protection legislation, minimum wage, trade unions, unemployment benefits). Based on review of theoretical and empirical works, we suppose that the direct effects of labor market institutions on TFP is likely to be combined with indirect effects mainly via knowledge accumulation. Therefore, labor market institutions may increase or decrease the productivity enhancing effect of research and development and human capital.

The paper is organized as follows. After a short introduction to research question and its theoretical background, the second section describes methodology of the empirical analysis. The subsections present derivation of regression model, estimation methods and data. The section three includes empirical results and their interpretations. Consequently, discussion on research findings, limits of empirical analysis and proposals for future research are presented in section 4. Main conclusions are summarized in the last section.

## 2. Methodology

The main assumptions behind our empirical specification is an endogenous determination of total factor productivity. Therefore, TFP growth can be explained in line with endogenous growth theory as a product of knowledge accumulation and residual set of factors including institutions (Aghion and Howitt 2009). Moreover, we assume that the direct effects of LMI on TFP are combined with indirect effects as institutions influence knowledge accumulation via their impact on human capital and research and development.

### 2.1. The regression model

To derive the empirical model we apply, beside the aforementioned assumptions, a standard approach of production function with labor and capital as inputs and a parameter that reflects the state of technology. Assuming Hicks-neutral technological change, the production function has the following form:

$$Y_{it} = TFP_{it} L_{it}^{\alpha} K_{it}^{\beta} \quad (1)$$

where  $Y$  denotes total output,  $K$  stands for total factor productivity,  $L$  is labor input (number of hours worked),  $K$  is capital input (capital stock),  $\alpha_t$ ,  $\beta_t$  represents the shares of labor and capital

incomes in the total income (labor and capital compensation) and  $i, t$  are indexes for units and time. In turn, relying on current endogenous theories, total factor productivity is determined by research and development (R&D), human capital (HC), institutional variable (I) and other unmeasurable factors (A).

$$TFP_{it} = A_{it}R\&D_{it}HC_{it}I_{it} \quad (2)$$

As we are interested in a specific effect of selected labor market institutions on total factor productivity growth, our empirical model takes a form of productivity equation augmented by institutions as follows:

$$\Delta \ln TFP_{it} = \alpha_i + d_t + \beta R\&D_{it} + \gamma HC_{it} + \sum_l \delta_l LMI_{lit} + \mu_{it} \quad (3)$$

where the growth rate of total factor productivity ( $\Delta \ln TFP_{it}$ ) is explained by country- and time-specific effects ( $\alpha_i, d_t$ ) research and development (R&D), human capital (HC) and a set of five labor market institutions (LMI). The last term  $\mu_{it}$  is an iid error term.

Based on equation (3) we can estimate the average direct effect of included explanatory variables on productivity growth. However, our research question is oriented also to indirect effect of labor market institutions on TFP via their impact on human capital and research and development. To estimate these effects, we extend the baseline model (3) with pairwise interaction terms of R&D with LMI and HC with LMI, respectively. The interaction terms are modelled according to methodology of Bassanini and Duval (2010) as products of deviations of variables from their sample mean (over units and time periods).

In the case of human capital and one labor market institution, the augmented productivity equation takes the following form:

$$\Delta \ln TFP_{it} = \alpha_i + d_t + \beta R\&D_{it} + \gamma HC_{it} + \sum_l \delta_l LMI_{lit} + \theta_{HC} (HC_{it} - \overline{HC})(LMI_{it} - \overline{LMI}) \quad (4)$$

where *bar* stands for sample mean over countries and years. In this specification, coefficients can be interpreted as marginal productivity effect of corresponding variables, when all other co-variables kept constant at their sample means. The overall productivity effect of human capital is given by sum of parameter estimates  $\gamma$  (direct effect) and  $\theta$  (account for impact of LMI). Formally, partial derivative of TFP growth with respect to human capital variable is given as:

$$\partial \Delta \ln TFP_{it} / \partial HC = \gamma + \theta (LMI_{it} - \overline{LMI}^h) \quad (5)$$

For productivity enhancing institutions (positive sign of coefficient  $\delta_l$ ), if parameter estimate of interaction term  $\theta$  has positive sign, the marginal productivity effect of HC will be larger the larger the value of  $LMI$ . Then, the negative sign for the interaction coefficient  $\theta$  would provide an evidence of reform complementarity.

Similarly, the baseline model (3) extended by interaction of research and development and one labor market institutions becomes as follows:

$$\Delta \ln TFP_{it} = \alpha_i + d_t + \beta R\&D_{it} + \gamma HC_{it} + \sum_l \delta_l LMI_{lit} + \theta_{RD} (R\&D_{it} - \overline{R\&D})(LMI_{it} - \overline{LMI}) \quad (6)$$

Notice that we cannot include all possible interactions into single estimation as it will lead to substantial loss of degrees of freedom and raise the issue of perfect multicollinearity.

## 2.2. Methods of estimation and corresponding tests

In order to estimate equations (4) and its extensions (5) and (6) we use a panel data model with country and period fixed effects (LSDV).

By application of fixed effect estimator, we can control for country specific differences through individual intercepts and thereby solve the problem of omitted variables. In empirical analysis, we focus on specific set of member states of the EU and the interference is restricted on the behavior of these countries. At that case, is reasonable to assume the presence of unobserved (individual)

heterogeneity (see e.g. Johnston and Dinardo 1997). The correctness of this specification and its estimation is tested by Hausmann specification test (Hausman 1978).

Moreover, productivity growth can be sensitive to shocks that could have impact on all the European countries in a specific year. Therefore, we include time dummies in regression model to control for common aggregate shocks.

A potential issue in the case of institutional variables is endogeneity of regressors. It means, that the observed relationship between productivity growth and the institutional variable may reflect the impact of institution on productivity growth but also the reverse causality (from productivity change to institutional change). To control for endogeneity, we use lag values of institutional variables in interference. Another essential requirement is stationarity of time series. Before the estimation, we test the presence of unit roots for all explanatory variables.

To be aware the reliability of our interferences, we executed standard residual tests for heteroskedasticity (Panel Period and Cross-section Heteroskedasticity LR Tests), autocorrelation (Durbin-Watson Statistic) and normal distribution of standard errors (Histogram – Normality test).

### 2.3. Data

The empirical analysis is carried out on unbalanced panel data set that includes observations on 28 member states of the European Union from 1995 to 2017. We decided to not collect data from the first half of 1990s for two reasons. First, availability of data and their quality for this period are limited, especially in the case of new member states. Second, the early 1990s were marked by post-transitional shocks in certain countries (with substantial deviations from equilibrium conditions in the economies). However, due to large number of missing values, observations for 1995-1997 and 2017 were dropped out from the full sample. Therefore, the choice of sample period was determined by availability of data and the baseline estimation was executed on the sample covering period of 1998-2016 and re-estimated on the reduced sample 2004-2016.

In total, the dataset includes 7 regressors and total factor productivity growth as dependent variable:

- $\Delta \ln TFP$  - total factor productivity growth proxied by log difference of broad measure of TFP, calculated via growth accounting method
- HC - human capital proxied by population with secondary and tertiary education as percentage of total population aged 15-64
- R&D - research and development proxied by total R&D personnel and researchers as % of active population
- ALMP –active labor market policies proxied by participants in active measures (cat. 10-70) as portion of unemployed
- EPL – employment protection legislation proxied by strictness of employment protection on temporary contracts (index 0-6)
- MW – statutory minimum wage at monthly rate converted to PPS (via PPP, EU28=1)
- TU – trade unions proxied by union density rate (share of workforce with membership in trade unions)
- UB – unemployment benefits proxied by full unemployment benefits per unemployed person in PPS

The choice of the variables was determined by the followings: a) the research question, b) theoretical foundations, c) estimation techniques, d) availability of data. As we are interested in the impact of knowledge accumulation and labor market institutions on TFP growth, the dependent variable is explained by two variables for knowledge accumulation (HC, R&D) and five institutional variables (ALMP, EPL, MW, TU, UB) representing key labor market institutions. We use own estimations of TFP growth rates as we need the broadest measure of TFP (not accounting for the quality of labor and capital). Instead of human capital stock (usually proxied by average years of schooling), we prefer an alternative indicator, also frequently used in empirical literature, that represent accumulation of knowledge in line with the theoretical assumption of Lucas (1988). The similar is true

for research and development variable where we prefer indicator based on the number of employees in R&D departments to alternative one based on the number of patents. Note that we didn't apply R&D expenditures relative to GDP as we tried to avoid the problem of endogeneity by not including right-hand side variables expressed as a ratio of GDP (TFP growth is itself a portion of GDP growth). In the case of institutional variables, we use standard indicators proposed by theoretical and empirical works and available in international databases. As before, we did not use indicators based on expenditures relative to GDP for active labor market policies and unemployment benefits.

For more detailed information on data sources and main descriptive statistics consult Table 1. Note that we present descriptive statistics of reduced dataset 2004-2016 as majority of regressions were conducted on this sample (see the next section for more details).

**Table 1.** Dataset –references to source and descriptive statistics of reduced sample (2004-2016).

Variable	Data Source	Descriptive statistics				
		Mean	Median	Max	Min	Std. Dev.
$\Delta \ln TFP$	Own Calculation	0,005	0,009	0,162	-0,153	0,032
HC	Eurostat	71,03	74,30	88,00	26,00	12,58
R&D	Eurostat	1,031	0,908	2,264	0,292	0,506
ALMP	Eurostat	0,548	0,365	2,401	0,005	0,482
EPL	OECD.Stat	1,705	1,563	3,750	0,375	0,889
MW	Eurostat, WSI, MLWSI,	610,1	557,2	1640	0,000	455,2
TU	OECD.Stat, ICTWSS 5.1	29,95	23,65	76,44	4,487	19,19
UB	Eurostat	5127	2866	17088	113,2	4880

Note: Data for MW in Cyprus were obtained on request from Ministry of Labor, Welfare and Social Insurance.

The stationarity requirement of included time series was tested by panel unit root tests via Levin-Lin-Chu test (Levin, Lin and Chu 2002). The outputs indicated the presence of unit root only for minimum wage. For the rest of regressors, we could reject a null hypothesis of common unit root process at conventional significance level. As solution, first difference of levels of minimum wages were used in the regression models.

### 3. Empirical Results

The regression results of the baseline model (3) are presented in Table 2. The estimations were provided on the full sample (3a) and on the adjusted one with sample period reduced to 2004-2016 (3b). Comparison of adjusted  $R^2$  indicates that bigger portion of the variance in the total factor productivity growth is explained by regressors in (3b). Moreover, Durbin-Watson Statistic indicates positive autocorrelation in the residuals in the regression model (3a). Therefore, we interpret our findings in line with results from regression on adjusted sample.

The result of baseline model suggests that the number of employees in research and development departments, and human capital represented by the portion of total population with secondary and tertiary education have had significantly positive effect on the growth rate of total factor productivity. On the contrary, employment protection regulation, minimum wage and unemployment benefits have had significantly negative impact on the dependent variable. The remaining two labor market institutions have not indicated statistically significant effect at any reasonable significance level. It means that total factor productivity growth in member states of the EU over the period 2004-2016 have been positively influenced by knowledge accumulation, while at the same time strictness of employment protection on temporary contracts, level of minimum wage and generosity of national unemployment benefit systems impeded its growth rate.

The last three columns of Table 3 present the regression results for extended versions of the empirical model by including pairwise interaction terms for human capital (4) and research and development (6), respectively. Note that we conducted separate regressions for all possible pairwise interactions, but we present only those with statistically significant coefficient of interaction terms. The regressions were conducted on adjusted sample (observations for 23 cross-sections over 2004-2016).

**Table 2.** Regression results of baseline model and its extensions.

	(3a)	(3b)	(4a)	(4b)	(6)
cons	-0,095 (-2,227)	-0,158 (-2,381)	-0,226 (-3,431)	-0,154 (-2,338)	-0,194 (-2,912)
R&D	0,031*** (2,776)	0,0295** (2,062)	0,030** (2,171)	0,027* (1,858)	0,022 (1,500)
lag_HC	0,001 (1,229)	0,002** (2,059)	0,003*** (3,141)	0,027* (1,963)	0,002** (2,280)
lag_ALMP	-0,004 (-0,804)	-0,001 (-0,222)	-0,001 (-0,234)	-0,002 (-0,309)	0,002 (0,247)
lag_EPL	-0,005 (-1,45)	-0,012** (-2,168)	-0,016*** (-2,946)	-0,014** (-2,472)	-0,020*** (-3,169)
lag_d_MW	-7,87e-06 (-0,046)	-0,12e-03** (-2,112)	-0,105e-03* (-1,960)	-0,125e-03** (-2,242)	-0,107e-03* (-1,948)
lag_TU	0,001 (1,400)	0,001 (1,261)	0,001 (1,472)	0,001 (1,469)	0,003** (2,294)
lag_UB	-1,85e-06* (-1,819)	-3,42e-06** (-2,154)	-4,02e-06*** (-2,631)	-2,58e-06 (-1,556)	-2,77e-06* (-1,750)
lag_HC*lag_EPL	-	-	-0,001*** (-3,905)	-	-
lag_HC*lag_MW	-	-	-	-1,76e-06* (1,675)	-
R&D*lag_EPL	-	-	-	-	-0,034** (-2,545)
Observations	259	202	202	202	202
Periods	19	13	13	13	13
Cross-sections	23	23	23	23	23
Fixed effects	yes	yes	yes	yes	yes
R <sup>2</sup>	0,61	0,66	0,69	0,67	0,68
Adjusted R <sup>2</sup>	0,52	0,58	0,61	0,58	0,59
F Statistic	6,70	7,69	8,53	7,65	7,91
P-value (F)	0,00	0,00	0,00	0,00	0,00

<sup>1</sup> Note: 5 cross-sections (BG, HR, CY, MT, RO) were dropped out from regression due to large number of missing values for EPL; regressions provided by EViews 10.

The regression results of the model with pairwise interactions of human capital and employment protection legislation (4a) approves the previous findings on the statistically significant direct effect of 5 regressors on TFP growth - positive effect of R&D and HC and negative effect of EPL, MW and UB. Their effect size only slightly changed giving an evidence that the results of baseline model are robust to inclusion of pairwise interaction. The negative sign of coefficient for interaction term means that the marginal productivity enhancing effect of human capital will be larger the smaller the level of employment protection regulation. Therefore, an implementation of less strict regulations on temporary contracts would enhance total factor productivity growth both directly and indirectly through its impact on human capital accumulation.

The next pairwise interaction with statistically significant effect on TFP growth is combination of human capital and minimum wage (4b). As before, the inclusion of additional regressor have not

substantially changed the results for knowledge variables, except lower significance levels. In the case of labor market institutions, only two variables indicate significantly negative impact on TFP growth, namely EPL and MW. In comparison to corresponding estimates from the baseline model (3b), the negative effects of regulation on temporary contracts and year-on-year differences in minimum wages were estimated as slightly larger. The negative sign of interaction coefficient leads to similar conclusions as in the case of pairwise interaction of EPL with HC – the marginal productivity enhancing effect of human capital will be larger the smaller is an increase of minimum wages. It means that policy measures leading to increase in statutory minimum wages would impede productivity growth in the EU member states directly and indirectly via their impact on human capital accumulation.

In the case of research and development (6), only the pairwise interaction with employment protection legislation have been estimated as statistically significant with negative impact on TFP growth. However, the marginal direct effect of research and development did not indicate significant impact on productivity growth at any reasonable significance level. As before, we can conclude that stricter regulation on temporary contracts, in average, impedes productivity growth in the EU member states itself and after controlling for its interaction with R&D. Regarding the direct effects of institutions, besides EPL, MW and UB, trade unions proxied by union density rate also indicate statistically negative effect on TFP growth in 23 member states of the EU over the period of 2004-2016.

#### 4. Discussion

Our findings about the significant role of human capital and R&D in explaining total factor productivity growth approve the theoretical consensus on the productivity enhancing impact of knowledge accumulation. The results support the importance of policy measures to increase the portion of population with secondary and tertiary education and the number of employees in R&D departments in the EU member states. As long as these indicators can be considered as good proxies for knowledge accumulation embodied in human capital and research and development, policy measures of national authorities and the EU institutions would be oriented to improve the quantity and quality of human capital and R&D in the member states.

Building knowledge-based economies is even more important given the estimated negative impacts of labor market institutions on TFP growth in the analyzed sample. The empirical results suggest that the direct effects of strictness of employment protection on temporary contracts, year-on-year difference in statutory minimum wages, unemployment benefits per unemployed person and the share of workforce with membership in trade unions on TFP growth were significantly negative. These findings are in line with theoretical expectations about negative impact of wage-setting institutions (UB and MW), strict employment regulations and generous unemployment benefits, as well as, with our previous research findings. It implies that the current institutional set-up of European labor markets creates barriers to productivity growth and requires adequate policy measures to increase labor market flexibility. More precisely, the combination of less strict regulations on temporary contracts, minimum wage freeze (as wages are rigid downward), less generous unemployment benefit systems and smaller concentration of workforce in trade unions would enhance total factor productivity growth in the member states.

It is important to mention that we use strictness of employment protection on temporary contracts as proxy for EPL. The choice is determined by our preliminary results. They did not indicate statistically significance role of strictness of employment protection on regular contracts in explaining productivity growth (same findings can be found in Aiginger 2004). It can be explained by the development in the 21<sup>st</sup> century: a) only small-scale decline in the strictness of regulations on regular contracts in majority of the EU member states, b) rising differences between regulations for temporary and permanent contracts (see e.g. Sloane et al. 2013 for more detailed discussion on the topic).

Moreover, we found out that beside the direct effects of institutional variables, their indirect effect on knowledge accumulation are also decisive. According to the presented results, the direct productivity enhancing effect of knowledge variables represented by human capital and R&D are reduced by level of employment protection regulations on temporary contracts and year-on year



change in statutory minimum wages. Therefore, we can conclude that less strict regulation on temporary contracts and lower increase in statutory minimum wage would be also implemented in order to promote the positive effect of human capital/ R&D on TFP growth.

However, these findings have their limits and have to be interpreted with caution. Given the nature of panel data estimation method, the findings are valid only in average for the group of analyzed member states. The impact of selected variables and consequent policy recommendations would vary given the national contexts. Note that the analysis includes only 23 member states – 5 cross sections were dropped out due to large number of missing values for EPL. Therefore, we cannot make any conclusion for Bulgaria, Croatia, Cyprus, Malta and Romania. Moreover, any policy measure requires evaluation of its impact on other economic and social indicators. The main obstacle regarding the indirect effects of labor market institutions is that the pairwise interactions do not assess the impact of overall institutional arrangement. It is not possible to include all interaction terms into single estimation as it will lead to substantial loss of degrees of freedom and raise the issue of perfect multicollinearity. Finally, our empirical model was derived based on endogenous growth theories emphasizing the role of knowledge accumulation and extended by institutional variables. Given our research question, we analyzed the impact of labor market institutions and we abstracted from other potential institutional variables (property rights, product market regulations or ease of doing business are commonly proposed by current empirical literature).

Therefore, further empirical analysis is required. First, it would be useful to assess the impact of institutional arrangement on labor markets for the whole EU by re-estimation of the proposed empirical model with inclusion of only those institutions for which data are available for all cross-sections. Second, the impact of recommended measures on employment, unemployment, economic growth, etc. would be assessed. Third, methodology to investigate the impact of overall institutional set-up of European labor markets on productivity growth would be derived. Finally, the empirical model would be re-estimated by controlling for other institutional variables.

## 5. Conclusions

Total factor productivity is an essential determinant of long-run growth and overall economic performance. Given the dissatisfactory evolution of TFP in the EU member states, the creation of adequate policy measure to promote productivity growth is essential for better economic performance of member states. While the economic theory gives relatively straightforward answer on the role of human capital and research and development in determining productivity, theoretical views on the role of labor market institutions are unambiguous (on both direct and indirect effects).

The aim of the paper was to quantify the direct and indirect impact of labor market institutions and knowledge on total factor productivity growth in member states of the European Union with emphasis on their interactions. We supposed that labor market institutions may increase or decrease the productivity enhancing effect of research and development and human capital. The empirical results for 23 member states over the period 2004-2016 suggest that the effect of knowledge accumulation and labor market institutions on TFP growth is just opposing. While the direct impact of human capital (proxied by the portion of population with secondary and tertiary education) and R&D (proxied by the number of employees in R&D departments as percent of active population) has been estimated as positive; strictness of regulations on temporary contracts, year-on-year differences in statutory minimum wages, trade union density rates and unemployment benefits have had significantly negative effect on total factor productivity growth. Moreover, we found out that besides the direct effects, labor market institutions negatively influence productivity growth via their impact on human capital and R&D. Pairwise interactions of employment protection regulation with human capital and R&D, and minimum wage with R&D has been estimated as statistically significant with negative coefficients.

To sum up, policy measures that support knowledge accumulation and reform current institutional set up on labor markets are essential for boosting productivity growth and thus improving long-run economic performance of the EU member states. More precisely, the combination of less strict regulations on temporary contracts, minimum wage freeze, less generous unemployment benefit systems and smaller concentration of workforce in trade unions would enhance total factor

productivity growth in the member states. Moreover, less strict employment protection regulation and lower increase in statutory minimum wage would be also implemented in order to promote the positive effects of human capital and research and development on TFP growth.

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# The Economic Performance of Slovak Companies with Direct Ownership Links to Tax Havens

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**Abstract:** This paper aims to analyse the impact of transferring the registered offices of Slovak companies to tax havens at the level of the reported indicators of total assets turnover and EBITDA per total assets. A tax haven is generally defined as an offshore territory that imposes low or zero taxes with insufficient or low transparency, relatively low participation in multilateral exchanges of financial account information and with the possibility to use different and harmful tax structures. We divide tax havens into three categories, onshore, midshore and offshore jurisdictions. In our analysis, we use two databases. The first is the Bisnode database, which lists Slovak companies with the owner in selected tax havens. The second database is the datasets of the financial statements of Slovak companies for individual years prepared and provided by Finstat. As for the investigated period, we selected the year 2015 as it has the highest number of available data. Our results suggest that Slovak companies with direct ownership links to tax havens disclose statistically significant differences of median values in both total assets turnover and EBITDA per assets compared to those companies without links. Our output partially confirms the hypothesis that Slovak companies linked to tax havens report worse economic performances than that of their counterparts.

**Keywords:** EBITDA; foreign ownership; Slovak companies; tax havens; total assets turnover

**JEL Classification:** G30; H21; H26

## 1. Introduction and Literature Overview

In 2019, the number of Slovak companies that have their headquarters in a tax haven (equity linkage) reached a new record since these particular statistics started to be tracked. In the first half of the year, up to 4,914 Slovak companies were connected to companies from selected jurisdictions via direct ownership links (Bisnode 2019a). The use of tax havens is considered controversial and is mainly associated with aggressive tax planning internationally and the anonymity of the ultimate beneficial owner (UBO). We have seen, not just individual states, but also international groups and organizations have responded to the artificial transfer of taxable profits to tax havens since the outbreak of the last financial crisis. Since 2014, new rules have gradually been implemented including the Slovak Income Tax Act against the artificial transfer of taxable profit to jurisdictions with little or no taxation, e. g. exit tax, CFC rules, thin-capitalization rules or the obligation to follow the arm's length principles among the associated parties (both on a domestic and international level). At international level, the automatic exchange of bank information (FATCA or GATCA) is implemented. The individual actions of the BEPS project and many proposed EU directives focused on new approaches on how companies operating in selected sectors will pay corporate income taxes (e.g. a proposal for a council directive laying down rules relating to the corporate taxation of a significant digital presence and a proposal for a council directive on a common system of taxation for digital services, European Commission 2018a and 2018b). All of these measures are being taken with a clear goal, namely, to avoid the artificial transfer of taxable profits and money laundering. Given the trends in this area, it is surprising that the number of Slovak companies based in tax havens continues to grow. The same statistics in the Czech Republic indicate that the number of Czech companies based in tax havens has reached its lowest level since 2011 and this trend can be expected to continue (decreasing number since 2015) (Bisnode 2019b). Nevertheless Moravec, Rohan, and Hinke (2019) declared that the research outputs might be highly

influenced by the data source used as there are huge differences among numbers different sources provide. While the available tax optimization analysis in relation to tax havens is quite a lot, studies focusing on the economic performance of such companies are relatively low, even if their increased numbers are recorded.

This paper focuses on analysing the selected indicators of economic performance of Slovak companies with direct ownership links to tax havens compared with their counterparts. The formation company and its use of tax havens itself is not illegal and companies doing so can still find benefits resulting in a better economic performance.

The attitudes to and perception of tax havens have changed dramatically over the last few years. On one side there is no generally accepted definition of a tax haven, on the other side, more and more authors are providing characteristics or common indicators to mark a jurisdiction as a tax haven. According to Mara (2015), low taxation is not enough for a country to be a tax haven even though corporate income tax rate is indeed a significant indicator. Moravec and Kukalová (2014) show the influence of tax environment (personal, corporate, income and profit taxes) on the foreign direct investments' allocation. In our opinion, the most accurate measure of tax havens currently is the Financial Secrecy Index (FSI) (Tax Justice Network, 2018). The methodology is comprised of 20 so called secrecy indicators, which are divided into 4 main areas: ownership registration, legal entity transparency, integrity of tax and financial regulation and international standards and cooperation. The findings of Omar and Zolkafli (2015) confirm that multinational companies with a tax haven advantage engage in profit shifting more extensively than multinational companies without a tax haven link.

Su and Than (2018) consider the setting up of affiliated companies in tax havens as legitimate, but an ethically dubious business practice. Salaudeen and Ejeh (2018) have analysed ownership concentration and its effect on tax aggressiveness. According to their research (focused on Nigerian data), they uncovered that tax aggressiveness is insignificantly affected by the ownership concentration. Furthermore, their research suggests that managerial ownership has a significantly negative impact. This research indicates that tax aggressive strategies are linked to profitability. According to Desai and Dharmapala (2006), managers can use tax planning in the international environment to draw private interests and to increase the company's earnings. Chen et al. (2010) outline the extent of potential benefits and related costs that can affect tax aggressiveness of a company. The costs of a tax aggressive strategy primarily include the time and effort spent on aggressive tax planning activities, transaction costs of profit-shifting techniques and lower reported revenues.

In 2001, Shackelford and Shevlin (2001) already pointed out direct ownership structures (through equity) as an important determinant of aggressive tax planning. According to Boussaidi and Hamed (2015), ownership concentration strengthens tax aggressiveness. Driffield, Sun, and Temouri (2018) showed that there is an increasing but non-linear relationship between foreign equity ownership and productivity. They find that companies with larger foreign shares have better productivity. Durnev, TieMei, and Magnan (2016) examined how a firms' reliance on Offshore Financial Centres (OFSs - primarily jurisdictions located in small tropical islands/often marked as offshore tax havens) (either by registering or setting up subsidiaries in OFCs) affects their financial performance. They find that companies that are directly registered in an offshore jurisdiction are valued at 14% lower than onshore companies, while companies with subsidiaries in OFCs report an 11% higher valuation compared with companies that have the parent companies located onshore. Ozili (2018) investigated the potential association between tax evasion and financial instability. He found tax evasion can impact tax revenues. Therefore, Ozili found that tax evasion reduces the sources available for a state to manage its economy. Additionally, companies benefitting from tax evasion can use these sources to improve their own economic performance and financial stability. With the empirical results of research from Desai and Dharmapala (2009), we can see that tax avoidance has no significant impact on a company's value. However, the opposite situation could be observed for well-governed companies. They are also of the opinion that a simplified view on tax avoidance cannot be complete due to the problems identifying the relationship between shareholders and managers. Prochazka (2019) analysed the financial performance of Czech firms with different parent companies and found that the location of

the parent company together with the operating sector of the subsidiary had a significant impact on the economic performance and taxation level (effective tax rate).

## 2. Methodology

This article aims to assess the economic performance of Slovak companies with ownership links to tax havens based on selected ratios. As investigated indicators we chose total assets turnover and EBITDA per total assets. Total assets turnover ratio measures the company's revenue per total assets and can be used as an indicator of the company's efficiency in using assets to generate sales. The value of this indicator shall be at least 1 and we understand that the higher the value of the indicator, the more efficient the company is. When comparing this indicator between companies, it is advisable to take into account the depreciation rate of the assets and the depreciation method. Due to this fact we extend our analyses by EBITDA/total assets ratio. Since in this ratio finance and depreciation costs are added back to the net profit (EBITDA) it allows a more comparable analysis between companies with varying capital structures, tax rates and capital expenditures.

For this analysis, data was available for 179,299 Slovak companies since we have excluded companies that reported a missing or a zero value of total assets (the denominator of a chosen ratio). In addition, we have also excluded companies where at least one of the indicators was showing an outlier (1.1%), which could distort the results of statistical tests. We have data available for 2,107 Slovak companies with links to tax havens for 2015. As there is a relatively large difference between the tested number of companies due to matching the data provided by Bisnode with the data available from the database of Finstat (financial statements), we have reduced this large number (175,220 vs. 2,107) by randomly selecting 5% of the companies without links to tax havens. Thus, in our analysis we compare two samples of Slovak companies: 8,761 companies without links to tax havens available in the Finstat database and 2,107 companies with links to tax havens provided by Bisnode.

We have divided jurisdictions marked by Bisnode as tax havens into three categories:

1. ONSHORE COUNTRIES (ON): Liechtenstein, Latvia, Luxembourg, Monaco and the Netherlands;
2. MIDSHORE COUNTRIES (MID): Hong Kong, Cyprus, Malta, United Arab Emirates, United States of America; and
3. OFFSHORE COUNTRIES (OFF): Bahamas, Belize, Bermuda, British Virgin Islands, Gibraltar, Guernsey (United Kingdom), Jersey (United Kingdom), Cayman Islands, Marshall Islands, the Netherlands Antilles, Panama, Man Island, and Seychelles.

The categorization of the jurisdiction was made based on additional sources and reasons: a) on our previous investigations (e.g. Ištók and Kanderová 2018; Ištók and Kanderová 2019), b) academic attitude (e.g. Durnev, TieMei and Magnan, 2016) and c) we categorised the jurisdictions by primarily using the potential benefits and often utilising the foreign company on the first ownership level. The offshore jurisdictions are mainly used to secure the anonymity of the ultimate beneficial owner (UBO). Midshore jurisdictions are used mainly in aggressive tax planning strategies due to the many possibilities how firms can shift taxable profit to offshore jurisdictions and avoid or minimize the withholding taxes (existence of double taxation treaties and possibility to use the EU directives). Onshore jurisdictions are used mainly for the purpose of asset and investment protection and asset management. Corporate income tax optimization is also possible, but not so aggressive compared to the past (impossible to reach the effective tax rate (ETR) in somewhere around 2-5% like in case of midshore companies). The specificity of this category is the relative high costs needed to establish and manage the company compared to midshore and offshore categories.

## 3. Results

In the first part of the analysis we analysed whether the differences between median values of selected ratios are statistically significant from the point of view of companies' ownership jurisdiction through the Mann-Whitney test. We opted for the statistically significance level of 5%. The results of this test are shown in Table 1.

**Table 1.** Mann-Whitney test (sales and performance ratios).

		N	Mean Rank	Sum of Ranks
<b>Total assets turnover</b>	With links	2,107	4,415.340	9,303,120.500
	With no links	8,761	5,679.610	49,759,025.500
	Total	10,868		
<b>EBITDA per total assets</b>	With links	2,107	4,666.040	9,831,345.000
	With no links	8,761	5,619.310	49,230,801.000
	Total	10,868		
<hr/>				
<b>Test statistics<sup>a</sup></b>			<b>Total assets turnover</b>	<b>EBITDA per total assets</b>
	Mann-Whitney U		7,082,342.500	7,610,567.000
	Wilcoxon W		9,303,120.500	9,831,345.000
	Z		-16.643	-12.521
	Asymp. Sig. (2-tailed)		0.000	0.000

a. Grouping variable: company links to tax havens

Nonparametric Mann-Whitney test confirmed a statistically significant difference in median values of both ratios since the p-value is 0.000. The basic descriptive statistics of given indicators is provided in Table 2.

**Table 2.** Descriptive statistics (sales and performance ratios).

		<b>Total assets turnover</b>		<b>EBITDA/total assets</b>	
		With links	With no links	With links	With no links
N	Valid	2,107	8,761	2,107	8,761
	Missing	0	0	0	0
Mean		1.144	1.03	-0.0462	-0.5085
Median		0.2328	0.9978	0.0177	0.0769
Std. deviation		2.0708	4.78832	1.1618	25.49547

The arithmetic average has lower reporting ability compared to the mean since the variability of the ratios is relatively high, particularly within companies with no links to tax havens.

The total assets turnover ratio should be at least level 1. Based on our analysis, the median value of companies with no links to tax havens almost meets this condition. However, the median value of companies with links to tax havens reaches a value of 76.67% lower. Thus, companies with links to tax havens achieve significantly lower efficiency in using total assets to generate revenues.

According to Ištók and Kanderová (2019), Slovak companies that moved their headquarters to tax havens achieve a 41% higher median value of interest expenses per assets than businesses with no links to tax havens. Therefore, we assumed a less significant difference when comparing the medians of EBITDA per total assets. This assumption was not confirmed. In the case of this indicator, they achieve better results with no links to tax havens, namely 76.98%. Based on the analysis, it is clear that companies with links to tax havens use their assets less efficiently with respect to the depreciation rate of assets and the depreciation method, varying capital structures, tax rates and capital expenditures.

Subsequently, we analysed the impact of transferring the company to an individual type of tax haven (offshore, onshore and midshore) on the values of indicators of a companies' revenue and performance.

Results of Kruskal-Wallis test are shown in Table 3.

**Table 3.** Descriptive statistics (sales and performance ratios).

Ranks		N	Mean Rank
<b>Total assets turnover</b>	With no links	8,761	5,679.61
	OFF	368	3,575.4
	MID	862	3,986.73
	ON	877	5,189.07
<b>EBITDA per total assets</b>	With no links	8,761	5,619.31
	OFF	368	4,145.07
	MID	862	4,414.22
	ON	877	5,132.16
<b>Test statistics<sup>a</sup></b>		<b>Total assets turnover</b>	<b>EBITDA/total assets</b>
Chi-Square		373.195	191.912
Df		3	3
Asymp. Sig. (2-tailed)		0.000	0.000

a. Kruskal-Wallis test

b. Grouping Variable: company jurisdiction

On the basis of the Kruskal-Wallis test, there are statistically significant differences between individual groups of enterprises in both of the indicators examined. This is also partly confirmed by the different objectives, respectively first-class ownership among different categories of tax havens. Subsequently, we carried out a post hoc test to determine specifically where there are statistically significant differences between the lower tax jurisdictions compared with companies with no links to tax havens. In the implementation of the Mann-Whitney test, there is often a first-class error, a condition where we reject the null hypothesis of equality of mean values in a set, even if it is true. Therefore, according to Field (2015), the Bonferroni correction is needed. Using this correction, the original significance level of 0.05 has been reduced to 0.0083, as businesses are divided into four groups in this analysis.

**Table 4.** Mann-Whitney test (sales and performance ratios) – individual categories.

Jurisdiction		Total asset turnover	EBITDA/total assets
With no links - OFF	Mann-Whitney U	988,432	1,104.64
	Wilcoxon W	1,056,328	12,483.6
	Z	-12.614	- 8.75
	Asymp. Sig. (2-tailed)	0.000	0.000
With no links - MID	Mann-Whitney U	25,968.49	2,947,681.5
	Wilcoxon W	29,688.02	3,319,634.5
	Z	-15.181	-10.645
	Asymp. Sig. (2-tailed)	0.000	0.000
With no links - ON	Mann-Whitney U	34,970.61	3,482,421.5
	Wilcoxon W	38,820.64	3,867,424.5



Z	-4,394	-4,574
Asymp. Sig. (2-tailed)	0.000	0.000

Based on the test results, it is clear that statistically significant differences exist in all three tax havens compared with those with no links to tax havens. At the same time, based on indicator Z, we can say that the smallest differences are achieved by companies in onshore jurisdictions.

**Table 5.** Descriptive statistics (sales and performance ratios) - individual categories.

Jurisdiction		Total asset turnover	EBITDA/total assets
ON	Valid	877	877
	Missing	0	0
	Mean	1.4713	0.0183
	Median	0.6268	0.0558
	St. Deviation	2.24077	0.71184
MID	Valid	862	862
	Missing	0	0
	Mean	0.9297	-0.0775
	Median	0.1596	0.0041
	St. Deviation	1.88731	1.49317
OFF	Valid	368	368
	Missing	0	0
	Mean	0.866	-0.1262
	Median	0.0794	0
	St. Deviation	1.95574	1.1343

Descriptive statistics of individual performance indicators in given categories of jurisdictions are shown in Table 6. A significantly larger number of enterprises are located in onshore and midshore jurisdictions, with only 17.46% of the companies surveyed having a direct owner in offshore jurisdictions. At the same time, the median value of the ratios examined by us in offshore jurisdictions have the greatest differences in businesses with no links to tax havens. Specifically, for total assets turnover ratio, up to 92% worse and 100% for total assets in EBITDA.

The obtained results may be due to the purpose for which the companies choose their owners from the offshore category at the first ownership level. With a direct link to an offshore jurisdiction, tax optimization options are relatively limited given the existence of withheld taxes. The main benefit of using an offshore company is UBO (ultimate beneficial owner) anonymity. At the same time, if we look at the calculation of performance indicators examined by us, it is clear that in the denominator both are total assets. The value of total assets affects the resulting median values.

According to Ištók and Kanderová (2018), the Slovak companies after the transfer of the registered office to a tax haven report statistically significant lower median values of land and structures per assets (they are getting rid of these types of assets).

Enterprises in midshore jurisdictions are 84.2% inferior in total assets turnover ratio and 94.7% worse off in EBITDA per total assets. Enterprises in onshore jurisdictions are 37.2% worse off in total assets turnover and 27.4% in EBITDA per total assets ratio. Therefore, our assumption has been fulfilled at least to a certain point, as onshore jurisdictions are also used to increase investment protection, which is expected to help generate revenue in the future and increase the company's revenue.

Subsequently, we compared selected performance ratios in selected sectors. We focused on selected sectors where the number of companies in the given sector exceeded 5% of the total number of firms.

The results of total asset turnover analysis are shown in Table 6.

**Table 6.** Median value differences in total asset turnover by sectors.

Sector	With links	With no links	Z	Asymp. Sig. (2-tailed)
Real Estate	0.2698	0.8154	-6.148	0,000
Law, consultancy and acc.	0.8713	1.7546	-5.087	0,000
Mediation	1,3112	4.3774	-1.897	0.058
Wholesale	1,7598	-1.886	-1.339	0.181

Significant differences between companies with and without links to tax havens exist for real estate and law sectors, counselling and accounting. Conversely, in the mediation and wholesale sectors, the differences are statistically insignificant. The difference in the median values of this indicator in the given sectors is quite large, but the fact is due to the variability of data and the different number of companies in each file. In particular, in the real estate sector, companies with a link to tax havens achieved a 66.9% lower median of total assets turnover and 50.3% in the law, consulting and accounting sector. Interestingly, companies with no links to tax havens in the wholesale sector have achieved lower median values of total asset turnover, while even being negative. Table 7 shows the analysis of selected sectors of EBITDA per total assets.

**Table 7.** Median value differences in EBITDA/total assets by sectors.

Sector	With links	With no links	Z	Asymp. Sig. (2-tailed)
Real Estate	0.0296	-1.2907	-3.612	0,000
Law, consultancy and acc.	-0.0769	-0.1098	-7.238	0,000
Mediation	0,0096	-0.06	-1.949	0.051
Wholesale	-0,1338	-3.0301	-1.523	0.128

Analysis of EBITDA per total assets pointed to statistically significant differences between the real estate sector and the law, consulting and accounting sector. Interestingly, in both of these sectors, the medians of the indicator reach lower values for companies with no links to tax havens than those with links to tax havens. On the contrary, for the mediation and wholesale sectors, the differences are not statistically significant, but it is clear that companies with no links to tax havens achieve better values for the indicator.

#### 4. Discussion

To the best of our knowledge we provided the first empirical study focused on the comparison of economic performance among Slovak companies with ownership links to tax havens compared to those companies without these links. The main limitation of our results is that we only investigated the year 2015 and therefore, the database Bisnode contains only a few jurisdictions specified as tax havens. On the other hand, the results are so significant that we can surmise some tendencies in the behaviour of selected Slovak companies regarding the selected area of economic performance. From one point of view we have tested only one year. However, this year is very important from the perspective of international taxation of Slovak companies. Since 2014 and 2015, many changes were implemented on both a national (mainly amendments of the Income Tax Act and Tax Procedure Code) and international level (e.g. introduction of BEPS project). Therefore, the use of aggressive profit-shifting channels became partially or even at times significantly limited. We examined available data

from companies already following the new "substance over form" conditions. We can therefore assume that from the investigated year there are many Slovak companies using tax havens not only for aggressive tax planning purposes, but also in order to support their economic performance. This has also been indicated by various authors. We are of the opinion that tax havens should also be investigated from the perspective that there may potentially exist benefits not only to the taxpayers but also to the governments and it is important to investigate any direct links between tax havens and unethical or illegal activities. While most studies related to the benefits of tax havens primarily focus on foreign direct investments (FDIs), the economic performance of companies often remains unnoticed.

Our results are essentially in line with Driffield, Sun and Temouri (2018), who showed there is an increasing but non-linear relationship between foreign ownership and productivity. Our findings are further similar to those of Durnev, TieMei and Magnan (2016), who confirmed that the financial performance of a company is based on the registering or setting up of subsidiaries and parent companies in Offshore Financial Centres (OFCs). What is also interesting is the comparison between our results and that conducted by Prochazka (2019) on Czech data due to the similar economic conditions in both the Czech and Slovak republics. Both our study and Prochazka's provide evidence that the domicile of the parent company and the operating sector of the subsidiary have a significant impact on the economic performance of the subsidiaries located in both Slovakia and the Czech Republic.

In our opinion, we partially contributed to the discussion raised by Ozili (2018), that of the link between tax evasion and financial instability. Our results confirmed that companies operating in certain sectors can potentially use the saved taxes (costs, sources) to improve their financial stability or economic performance (e.g. wholesale sector). Our assumptions were also confirmed in the breakdown of tax havens into the three selected categories. The best results were observed in the onshore category. As was already mentioned, these jurisdictions are used to protect assets and investments and improve asset management (partially with some tax planning incentives). Clearly the worst results were observed in offshore jurisdictions. Offshore jurisdictions on the first ownership link are mainly used to obtain the anonymity of the UBO, which according to our results is most likely linked with activities not supporting a higher economic performance. In our opinion, future research (not only focused on Slovakia and the conditions there) should be focused on a more detailed analysis of the relationship between ownership links to tax havens, potential investments or use of saved taxes (costs) and companies' productivity and performance. The selected economic performance indicators belong to often used when assessing also the financial health of the companies.

## 5. Conclusions

Our analysis of the selected ratios showed that Slovak companies with ownership links to tax havens demonstrated a worse economic performance compared with Slovak companies without links to selected foreign owners. Our analysis for 2015 showed that Slovak companies with direct ownership links to tax havens reported lower median values of total assets turnover by 76.67% and lower median values of EBITDA per total assets by 76.98% compared with their counterparts. The differences in the median values have been proven by the Mann-Whitney test. Our results further confirmed that the statistically significant differences are amongst all three selected types of tax havens compared with those without the link to tax havens. The smallest differences were observed in the onshore category. On the other side, Slovak companies with foreign owners from the offshore category reported worse median values of total assets turnover ratio by 92% and in the case of EBITDA per total assets ratio worse still, by even 100%. On the contrary, we find the obtained results differ among the tested sectors. The median values of selected performance ratios are not automatically worse for all sectors. For example, Slovak companies with ownership links to tax havens operating in the wholesale sector report higher median values of total assets turnover compared to their counterparts.

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# New Trends in Sectoral Taxation – Digital Taxes

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**Abstract:** Digital economy changes not only behavior of managers and companies but also how states are governed. Expansion of digital services brings new possibilities of taxation and governments respond, otherwise they would face a drop in tax revenues. Whereas the modern economy tends to be more global, this digital tax issue is also considered by international organizations, e.g. OECD or the European Union. Both initiatives are based on international agreement how should be taxed the revenues from digital services. The size of the company is a basic assumption of digital taxation. It is important to mention that these international solutions tend to apply conditions which are more suitable for bigger countries because they have larger impact in these organizations. On the other hand, digital taxation mostly affects American companies therefore it is appropriate to discuss digital taxation with US politicians. All that confirms the experience of France which itself has applied their version of digital tax. The Czech Republic is one of the other countries which discusses the possibility of new digital tax. Overall, the tax systems have to be changed to reflect new types of services. There is no best solution but international organizations offer a suitable platform for discussions.

**Keywords:** sectoral taxation; digital taxation; tax burden

**JEL Classification:** H25; H26; F23

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## 1. Introduction

Companies face taxation in different parts of their activities: they have to pay classical income tax but also consumption taxes or social contributions. Some of these taxes, concretely some of consumption taxes, are connected with certain field, so the prices are increased because of them. In recent years, also the special income taxes have risen up. These special tax regimes are often connected with certain sector of the business. Special taxes for banks and digital tax are most frequently discussed topics in the Czech Republic. From this perspective, it is important to mention that there are also other tax regimes around the world. IP boxes are example of another special tax regime which are for the different purposes. As the digital taxes have the purpose to tax the income more (increase the tax burden), IP boxes tend to lower the tax burden because their essence is lower tax rate (or tax deduction) for income from intellectual property.

Common attribute, which is connected with all special tax income regimes, is mobility. When the activities or assets have greater mobility, companies can relocate them around the world. Banks commonly use tax havens for international tax planning which allows them to reduce their tax liabilities. Banks use several financial instruments to profit shifting, e.g. loans and interests. Intangible assets allow transfer them also into different countries. Therefore, companies with research and development activities can easily use mobility of intangible assets and place wherever they want. The payments for the use of these assets between subsidiaries (or parent company and subsidiary) can be managed in addition to place them to the country where the lower tax burden is. Similar possibilities have also companies at digital market because their services can be offered to customers from different parts of the world. Hand in hand, mobility and globalization bring new possibilities for companies how to use tax planning and also bring new possibilities for governments to tax certain activities.

These new possibilities rest in digitalization of economy. The business activity (but also the activity of companies and people) moves to the internet where large part of modern life takes place. Naturally, companies which provide digital services gain profits and, because of globalized digital economy, have headquarters in different countries. And this is an issue which gave rise to digital taxes.

Digital service companies can easily avoid taxes and tax systems (respectively governments which they make up) have to react on the new situation.

This paper includes brief introduction about sectoral taxation. The third chapter is focused on digital taxation and the views of international organizations. There are also introduced digital taxes in France (in force) and in the Czech Republic (discussed). The fourth part of the paper is dedicated to the discussion of introduced or implemented digital tax legislation and this part leads to some of the conclusions mentioned in the last chapter.

## 2. Taxation and Different Sectors

As it is mentioned above, there are several different tax regimes, which target different companies. IP boxes brings lower tax rate or some tax deduction (which results in lower effective tax rate as well) for income which can be briefly labeled as innovative. Which profits can be taxed within IP box differs not only on legislation of specific country but also on the view of tax office there. Nowadays, IP boxes are implemented in standard EU countries (e.g. Belgium, France, Italy), in EU tax havens (Luxembourg, Netherlands, Ireland) but also outside EU, e.g. in Turkey (Asen 2019a). The situation gets even more interesting in Spain because there are different regimes based on the location (e.g. better conditions in Basque country) (Asen 2019a). It is worth to mention that the Czech Republic is the only Visegrád country without any patent box. Effects of the IP boxes are interesting, too. IP boxes have been used for transfer of intellectual property based on better taxation conditions (Gaessler et al. 2018, Köthenbürger et al. 2018). In these terms, modified nexus approach will help to ensure that within IP box are taxed only profits connected with newly generated patents (Köthenbürger et al. 2018). Patent boxes do not address certain sector but it is obvious that from them can get advantages only companies with innovation activities which are connected only with some sectors.

On the other side, there are tax regimes which are addressed (in terms of taxation) against companies from certain sectors. Nowadays, there are discussed several special taxes, e.g. for banks and for companies which operate in the digital market. Especially, taxation of the financial sector has been observed for last years. European Commission (2010) shows several instruments for additional taxation of companies from financial sector. Generally, there are two regimes which can be used for taxation: Financial Transaction Tax and Financial Activities Tax (European Commission 2010). It can be stated that the first one *“tax is one of several names for a tax on financial assets”* (Miller and Tyger 2020). On the other hand, the *“Financial Activities Tax would be levied on the sum of profit and remuneration of financial institutions.”* (European Commission, 2010) Both these ways, tend to gain taxes before the companies shift profits to tax havens what is common practice in the financial sector (Jedlička and Jedlička 2018). There are also financial sector taxation in practice because some countries have applied this specific type of taxation. From the perspective of the Czech Republic, all neighboring countries and Hungary (as one and only Visegrád country which is not neighboring) have or had some sort of special financial taxation. In Slovakia, there is tax on deposits (originally at the level of 0.4%, now 0.2%) (Krček and Smetanková 2019). Special tax for financial institutions in Poland is levied not only on banks but also on insurance companies and the calculation is based on the value of assets (Velvyslanectví České republiky ve Varšavě 2016).

There are also studies which try to measure the impacts of sectoral taxation, in above mentioned cases special taxes on banks. The special tax for financial sector seems to be the most common sectoral tax and governments applied them mainly after financial crisis (Twarowska 2016). Schwarz et al. (2019) mention mainly negative impacts of special tax levied on banks. Hungary can be seen as pioneer of sectoral taxation because its government applied not only special taxes for banks but also special tax on energy service or telecommunication tax (Krček and Smetanková 2019). Taxation of energy suppliers is at the level of 31% (EY, 2019). Overall, special tax regimes are broadly applied and this applications goes against other tendencies resting in simplification of tax legislation.

## 3. Digital Taxation

Current economy is more and more based on digital services. Many services including TV or music streaming move to the digital market. The problem of the digital market, when it comes to the

taxation, is the residence of the companies which provide particular services. On the global digital market, companies can have headquarters wherever their managers want and have the clients from all over the world. Basically, digital services can be provided from country with the lowest tax burden. The situation is different from other sectors because production requires also qualified workforce, quality suppliers or resources. Digital services use the digital network and this type of infrastructure is developed in most parts of the world. Therefore, the taxation becomes more and more important, from the perspective of investment location. Companies can easily choose between tax legislations and lower their tax burden. From the perspective of the managers, it is new opportunity how they can plan companies' tax liabilities in order to reduce them. Olbert and Spengel (2017) see challenges for governments within digitalization of the economy, when it comes to the taxation. Digital economy has different attributes than traditional economy from earlier years.

The basic problem of the digital services is the residence. Profits are taxed in the country of residence and when a company resides in different country, the taxation of its profits is not possible in the country where the profit has been made. Whereas the economic activity moves to the internet, governments can have significant tax revenues fall. There are several options to solve this issue from the perspective of the governments, based on the current research, Dourado (2018) mentions these five following:

- To apply special tax for companies from digital sector.
- Improvements within BEPS project from OECD – permanent establishment does not cover digital transactions.
- To give up international solutions and add powers to individual countries.
- To apply tax based on destination.
- To extend “*formula based transfer pricing regime*” so it covers the digital sector.

These five above mentioned attitudes can be seen as general ones to the digital taxation. Kemmeren (2018) mentions that European Commission can have three opportunities to change the situation with taxation of digital companies. First one consists of tax on turnover, the second is withholding tax on transactions which are digital, the third is levied on revenues from digital activities (Kemmeren 2018).

### 3.1. Digital taxation and the EU

Recommendations for European Commission are decisive because EU tend to tax digital services and have an intention to make the taxation fair (European Commission 2018). Their justification emphasizes the current situation about the tax legislation that current taxation mechanisms are not suitable for digital economy. This can be confirmed by a brief review of the tax legislations, especially the tax treaties. The most of the tax treaties were established many years ago and there are no specific parts about digital services, so the EU initiative makes sense. The problem of taxation rest in value creation when it comes to the digital economy. In the digital economy (within digital services), the value can be created from the activity of the customers on the internet (respectively within the digital service) and especially the use of these data for advertising gain profits (European Commission 2018). The multinational corporations have headquarters in different country, the profits (e.g. from the advertisement) are not taxed in the country of the origin. This issue has broader impact when the tax havens are also considered.

Within its research, the EU complements the debate with data which confirms the shift of the economy to its digital version. On the one hand, the share of digital services has increased over last several years but on the other hand, the tax burden within the EU is very different when they are compared companies from traditional sectors and from digital ones (European Commission 2017). The effective average tax rate of companies from digital sector is about ten percentage points lower than the ones of other companies (European Commission 2017). Therefore, the digital tax can have equalizing effect on the business environment. The companies from different sectors face different levels of tax burden and the European Commission sees uneven business conditions in it. However, this situation is not unusual because different taxes, which have impact only on the part of the



companies, are almost in every tax system. For example, different levels of VAT or consumption taxes are often connected only with companies from certain sector. Another question is, if it is right that digital companies pay less taxes.

European Commission has suggested that each member state can tax the digital company when it overcome one of the following thresholds (European Commission, 2018).

1. Revenues from digital services are larger than 7 million Euros in a member country.
2. There are more than 100,000 users of the digital service in a member country.
3. There are more than 3,000 online business contracts.

It is worth to mention that these thresholds can be questionable for many EU countries. From the perspective of small member states, the thresholds can be high and they can have disadvantage over larger member states.

The second proposal of the European Commission is characterized by an interim tax on the digital revenues (European Commission 2018). This solution can be seen as temporal until the international tax system will be adequate and takes into account modern digital economy. The proposal has also thresholds: revenues above 750 million Euros worldwide and above 50 million Euros in the EU.

### *3.2. Digital taxation and OECD*

OECD is another international organization which deals with the digital taxation. The advantage of every initiative from OECD over one from the EU is the presence of USA. Especially, when it comes to digital services, the agreement with the USA has a key role. Concretely, the Action 1 from the BEPS project addresses the problems connected with the digitalization of the economy (OECD 2020a). The view of the OECD rests in the assumptions of the obsolescence of tax systems. New technologies hand in hand with new types of services brings new ways of tax avoidance. The OECD addresses the biggest issues of the digital services taxation, e.g.: taxation of the companies without physical presence, the location of tax liability and its level.

The last initiative of the OECD rests in the two pillars of the solving the digital taxation (OECD 2020b). The first one deals with taxing rights and addresses the issue of profit allocation (OECD 2019). The second pillar calls for implementation of rules which stop using tax planning structures within digital services (OECD 2019).

Overall, the tendency of OECD is to make the international legislation suitable to modern digital economy in terms of taxation. More precisely, OECD wants to make such an agreement, where governments can agree about international digital taxation. It is worth to mention that above mentioned two pillars are basic assumptions of the current work so there are only partial results. The OECD claims that this work will meet set deadline 2020.

### *3.3. Digital tax in France*

Some countries have already introduced their versions of digital taxation and two of them are now in force, this is the case of France and Hungary (Asen 2019b). Not only countries from Europe (Asen 2019b) but also countries from other parts of the world apply or consider digital taxes (The Straits Times 2019). Large companies which operate on the French market have to pay digital taxes if their activities fall into the defined area. Large companies are those which have worldwide revenues above 750 million Euros and their local (in France) revenues exceeds 15 million Euros (Boksenbaum 2019). Another important attribute of the legislation is the information about definition of the sector, respectively which activities are considered as digital. First of all, the companies which provide communication between users of certain service have to pay this tax. The second group of companies are characterized by advertisement on the internet. On the other hand, the companies which sell products online or provide digital content are not subject of the digital tax (Boksenbaum 2019). The tax basis consists of worldwide gross revenues which are reduced by the share of taxable services located in France (Boksenbaum 2019) and the tax rate is at the level of three percent (Asen 2019b).

This type of taxation was widely discussed especially from the side of the United States of America because the digital tax mainly affects the American companies. The USA have also

investigated the digital tax in France because their interest is to protect the American companies and from the perspective of US politicians, such a digital tax acts discriminatory against US multinational corporations (Office of the United States Trade Representative 2019). Lighthizer (2019) in report on French digital tax explains why it is discriminatory. He points out the retroactive application, application to revenues and not to profits and the taxation of the revenues which are not connected with the physical presence in the country. These are the major problems which are seen by the USA. The report also mentions ways how can the USA defend, e.g. applying duties.

### *3.4. Digital tax in the Czech Republic*

The Czech Republic is another country which wants to apply digital tax (Vláda ČR 2019). The Czech intention assumes that the digital services that are subject of taxation are following: targeted advertising campaigns, utilizing a versatile digital interface, providing user data (Vláda ČR 2019). Also, the digital tax for companies operating in the Czech Republic covers only multinational corporations with a high level of revenues. In this context, those with revenues above 750 million Euros are considered as large companies (Vláda ČR 2019). It is worth to mention that this attribute is the same also in French legislation (Boksenbaum 2019), both probably based on the European Commission's (European Commission 2018). Beside the global threshold, there is also national one which corresponds to the amount of 100 million Czech crowns (Vláda ČR 2019). Proposed tax liability is 7% of the digital revenues (Vláda ČR 2019).

There is also first basic study with discussions about the effects of digital tax implementation. Ondroušek (2019) mentions that there are three groups of companies that would be affected by new regulation: large multinational corporations from digital sector (these are targets of digital taxations); companies with high level of revenues and some of the digital services which are not their core business; large companies which want to implement digital services for customers. Especially the companies, which are about to move some services on the internet, can be penalized only for better services. From this point of view, digital taxation can have negative impact on economic and technological development. Ondroušek (2019) further states that there are likely negative impacts on consumers, more specifically price increases in the costs of using digital services.

## **4. Discussion**

The situation of the digital taxation is relatively complicated. It is really inefficient if every country from global economy change its legislation in a different way because then the taxation of digital companies will take place on two levels and it arises to double taxation. The profits will be taxed in the country, where the digital services are provided but also in the country of residence. As the economy is global, the taxation of digital services should be based on international agreement. This agreement should solve the problem of possibility of double taxation and hand in hand with solving the situation of tax revenues, which are nowadays generated in different countries than the economic activity is located.

As the international consensus is out of sight, countries applied their own solutions rest in national legislations. There are several issues which are connected with new digital taxes when it is applied at the national level (Asen 2019b). The first problem is how the tax authorities can get them to admit revenues. Sometimes, especially when it comes to digital services, can be complicated to distinguish where the digital services are provided. The second important issue is thresholds in such a legislation. Multinational corporations can easily divide their company into several entities and after that the newly established companies do not exceed the critical value from the legislation. The problem of division into several companies can be solved by system of CCCTB (Common Consolidated Corporate Tax Base) and hand in hand with CbCR (Country by Country Reporting). When the multinational corporations have to refer how they operate in concrete countries, there is ability to know the proportion of revenues in every country. This proportion can be used for distribution of the profits for tax purposes. As a result, the (digital) company will declare adequate part of the profit and it will be taxed based on tax legislation in every country.

Another problem can be seen in different attitudes to the definition of digital services. Naturally, the tax legislation can have each country different and it is principle of tax competition. On the other hand, when it is applied new tax, the situation for the managers of companies is even more complicated when the essences of digital tax are different in every country. Therefore, it is important to make an agreement based on the international platform. The most important attribute of such an agreement is the presence of the USA. As the most of digital companies originally comes from the USA, their politicians tend to defend US investments and act against the digital taxes (Lighthizer 2019).

From the perspective of the Czech Republic, the international agreement have some disadvantages. First of all, the influence of such a small country does not reach the ones of superpowers. Therefore, the construction of digital taxation may be not suitable for the interests of the Czech Republic. Close attention should be paid to threshold and its definition in relation to the concrete country. The threshold can be at the level which is suitable for large countries as France or Germany but too large for small countries. Then this type of threshold will lead to injustice between the countries because the same multinational company will pay digital taxes in some countries but in the smaller ones their revenues will not be taxed as a digital income.

Overall, the international solutions are more appropriate, but they should consider also the interests of smaller countries. The main goal of international solution is fair taxation so there should be no threshold expressed in absolute numbers which are connected with the country. The absolute numbers thresholds should be used only for verification of the company size. This will ensure that multinational company which operates in several countries will be taxed in all of them, e.g. in France and also in the Czech Republic.

Another issue of every sectoral taxation can be seen in higher prices for customers. This is a problem with which governments or international organizations cannot do much. When they tend to tax digital companies more, negative impact on customers cannot be excluded. This is another effect which government or OECD have to consider. The digital tax should be set wisely because when people have to pay for digital services more (or start to pay when the service is now for free), they will be very dissatisfied. From this perspective, there is public pressure to tax multinational corporations from digital sector more, but there is no way how to justify that the customers will pay the higher taxation through increased prices.

Further research should focus on real effects of digital taxation on companies and prices or market overall. As the tax burden of digital service companies is lower than the others, the evaluations of the effects of digital taxation on the effective average tax rates of companies (or the digital sector) would be beneficial. Another aspect, which is worth to consider in the research, consists in tax avoidance and use of tax havens after implementation of new digital taxes. As the new regulation usually brings new possibilities of tax avoidance (and some of current possibilities make impossible), analysis of tax planning schemes would be also appropriate.

## **5. Conclusions**

Modern economy needs modern tax legislations. Nowadays, digital services are those which increase their share at the market. Therefore, also the taxes should change and reflect changes in economy. Digital taxation is one of the important effects of such a shift. There are several ways how digital taxation can be implemented and therefore it is important to discuss the positive and negative effects of each.

As the multinational digital companies originally mostly come from the USA, the platform of OECD is the best solution of these discussions. The presence and agreement with the USA can be seen as critical because the economy power of USA is enormous. The economic war would be harmful for every country, so the US signature is a key for the smooth application of the digital taxes and with them connected legislation. Individual initiatives of each countries within the digital taxation can cause multinational companies many issues because of different basement of each legislation. Governments should take advantage of organizations to create a reasonable multilateral agreement which outline basic assumptions of digital taxation.

This agreement should take into account also negative effects of digital taxation, especially price increases and development restrictions. It is unacceptable that the price increase would be paid by customers and it is also inappropriate to discourage companies from investing in digital channels with the aim of improving services.

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# Visegrad Group from the Perspective of Investment's Taxation and the Role of Depreciation Methods

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**Abstract:** Taxation have significant impact on selection of investments' location. Visegrad Group countries are from the same region and they compete for similar segment of investors and this causes tax competition between them. The largest investors in this area are companies from the Netherlands, Luxembourg, Germany and Austria. Investors prefer lower tax burden therefore the position of these countries can differ based on the tax conditions. Tax burden within this study is measured by Devereux and Griffith's effective average tax rate (EATR) for cross-border investment. The EATRs in countries from Visegrad Group are generally relatively close expect the situation of the investment in Hungary, which provides the best conditions thanks to the lowest statutory corporate tax rate. Tax treaties and depreciation methods cause other differences between the tax burdens. Especially, the investors from Austria have disadvantage for cross-border payments from Visegrad countries, except payments from the Czech Republic. The situation of the Czech Republic demonstrates the importance of depreciation methods, which have significant role in the case of closer statutory corporate tax rates and similar tax treaties. Use of accelerated depreciation in the Czech Republic brings about half percentage lower effective tax rate than the standard depreciation method.

**Keywords:** tax competition; tax planning; foreign direct investment; effective tax rate

**JEL Classification:** H25; H26; M29

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## 1. Introduction

Tax legislation belongs to one of the most important attributes of business environment. Companies' business activities are affected by level of taxation and enormously high tax burden can discourage companies from realizing the investment. Overall, managers of companies tend to avoid paying taxes to increase the profits of investments. On the other hand, government's role is, at the first sight, the opposite. Governments want to collect taxes as much as it is possible in particular situation because taxes are the basic revenue, by which functioning of country is financed. The term situation has very broad scope. One limitation is described by Laffer curve: increase of tax rate does not automatically result in higher tax revenues. Current economic situation is the second important issue, which influences the form of legislation. The last basic problem, which governments solve, is economic growth. Very high tax burden reduces economic activity and profitability of businesses. Companies can stop doing their business or use other countries to reduce their tax liabilities. This can be made by simple relocation of their activities or more sophisticated profit shifting. Nowadays, use of tax legislation of several countries is frequently discussed topic.

Depreciation method is one of the most important aspects which influences overall tax burden. Therefore ability of more beneficial depreciation method is another issue which can improve overall attractiveness of particular location. When it comes to foreign direct investment (FDI), the depreciation methods can have a decisive effect on the location selection because investments are connected with large amount of assets. This paper deals with taxation of the investment and is also focused on the role of the tax depreciation. In the first part of it, there is literature review with statement of a problem. Following part is dedicated to the methods used with the paper. Results are shown in the third chapter and are followed by discussion and conclusion.

The situation of FDI in new EU countries and other transition economies, was studied by Mádr and Kouba (2014). They focused on political instability in selected countries and its effect on inflow of FDI. They used two regression analyses with the total tax rate as an explanatory variable. They found that the dependence of political instability on FDI is not provable (Mádr and Kouba 2014). On the other hand, results show that some of the variables can have effect on the FDI, especially presence of one-color government can have positive effect on FDI inflows. The situation of Visegrad group countries is relatively similar from the perspective of political instability, therefore they have similar potential of attracting FDI from this point of view.

Jáč and Vondráčková (2017) used survey and regression analysis for identification of factors affecting investment's location. This analysis aimed investors which invest in the Czech Republic. Investors are of the opinion that the tax system in the Czech Republic is too complicated (Jáč and Vondráčková 2017). For the results of hypothesis focused on tax burden, they found that the level of tax burden does not have statistically significant effect on level of FDI (Jáč and Vondráčková 2017).

Taxation as an important part of business environment is also in the centre of interest of international organizations, like EU or OECD. Paper from Yoo (2003) deals with taxation of foreign investments in selected countries between years 1991 and 2001. As the measure was selected EATR developed by Devereaux and Griffith (1999; 2003), Yoo (2003) selected effective tax rates for cross-border investment which calculation "results in a matrix of bilateral effective tax rates among OECD countries." (Yoo 2003) The results of effective marginal tax rates on inward FDI show that there was significant decrease of tax burden in 90s (Yoo 2003). There is relatively high tax burden on investments in Japan or USA. Effective tax burden of countries from Visegrad Group in 2001 were very competitive and often lower than of other OECD countries. On the other hand, every single bilateral relation is unique therefore should be evaluated individually. However, Ireland is the country, which provides lower tax burden for investors than other countries. Tax burden in Ireland is often lower by about 10 or more percentage points (Yoo 2003).

One of the European Commission's studies is from Elschner and Vanborren (2009) and shows overview of tax regimes in the EU and other developed countries. There is accented the comparison of old and new EU member states in this study. Results show that the tax burden in the EU is smaller than in countries like Japan or USA (Elschner and Vanborren 2009). For the tax competition within EU, it is important that the EATRs for the new member states are lower than these for old EU members are. (Elschner and Vanborren 2009). Another difference between these two groups of countries is related to types of assets when "in the old Member States, intangibles is the most tax-favoured asset, while for the new Member States it is machinery." (Elschner and Vanborren 2009) They have also analyzed development of tax burden in the EU between 1998 and 2007. EATRs have decreased in average across in all monitored countries but the lowering trend were stronger in new EU countries (Elschner and Vanborren 2009). For the Czech Republic, the effective tax burden used to be lower there than in countries with investments there, e.g. Germany.

Study from Bellak and Leibrecht (2009) focuses on effect of tax burden on the level of FDI. This study covers seven EU countries and USA for location of parent company and eight countries from Central and East Europe as host country with subsidiary. The aim was to find, if "a high corporate tax burden acts as a deterrent to FDI flows" (Bellak and Leibrecht 2009). The point of this hypothesis is that higher taxation make investments less profitable, so the companies try to maximize their investments profitability by minimizing tax liabilities. They used "generalized panel-gravity model with various location factors added." (Bellak and Leibrecht 2009) Dependent variable was "bilateral net-FDI-outflow in millions of euro from home country to" another concrete country (Bellak and Leibrecht 2009). It is important to mention that they used a bilateral effective average tax rate (BEATR), which assumes situation of the company from home country with subsidiary in certain country. For the results of its model, tax burden has an impact on investment size in particular country. For average, "a one percentage-point decrease in the effective tax rate increases net-FDI-outflows ceteris paribus by about 4.30%." (Bellak and Leibrecht 2009) The decrease in the effective tax rate is related to BEATR, which assumes an investment of company from certain country to another host country. These results confirm the assumption, that tax burden is an important factor for business investment decision making.

FDIs reaction on taxation in China has been an issue, which An (2012) studies. Concretely, he studies new corporate tax law in China, which is in force from 2008. This law has created similar taxation conditions for domestic and foreign corporations, mainly by termination of preferential tax treatment of foreign corporations (An 2012). His study is based on “a difference-in-differences approach” (An 2012). His paper aims reaction behavior of multinational companies, respectively their managers, and tried to find if this legislation changes results in decrease of foreign companies’ investment activity in China. His results show the importance of level of taxation because foreign companies invest in lesser extent after mentioned legislation change (An 2012). There is more significant effect on corporations from Hong Kong, Macau and Taiwan (An 2012). This study confirms the importance of tax burden on level of investments in particular country. This article shows corporate tax burden differential as important factor for location of companies’ investments.

When the special taxation condition is discussed, there must be mention the role of depreciation methods. Šimović and Žaja (2010) show that from the perspective of transition countries, accelerated depreciation can consider as effective way to provide tax incentives. Their study is focused on Balkan countries and two of them offered accelerated depreciation for the companies and also other countries provide beneficial depreciation regimes. Accelerated depreciation is considered also by Nuță and Nuță (2012) as an effective tool for attracting managers to invest in another country. From the perspective of accelerated depreciation, it is important how much tax reduction the advantage from the possibility of using it brings.

This paper focuses on countries from Visegrad Group. Further studies show that new EU countries have specific position when it comes to taxation. There arises one important question: how these countries stand against each other in terms of tax burden in 2018. The article aims differences in tax legislation related to cross-border investments in selected countries as position on market of tax competition. Further, the depreciation methods are analyzed as an important part of tax legislation, more concretely, this article looks at the situation of the depreciation legislation in the Czech Republic in more detail.

## 2. Methodology

Devereux and Griffith (1999; 2003) model of EATR is selected as method for this study. Their approach assumes hypothetical investment of the company and includes the calculation of tax burden. They have developed formulas for several types of investments. Most importantly, they distinguish domestic investment and international investment. For addressing tax competition, the tax burden of international investment is important. They have introduced (as in the domestic case) effective marginal tax rate (EMTR) and EATR. This study is focused on calculation of EATRs for international investment. Some authors call them as bilateral effective average tax rate (BEATR) (Bellak and Leibrecht 2009) or EATR on FDI (Yoo 2003).

EATR for international investment is based on several assumptions, which has to be mentioned for the best interpretation of results. First of all, it assumes two types of companies, that resident in different countries (Devereux and Griffith, 2003). The first company is represented by “a parent firm located in the “home” country  $j$  which undertakes investment in the “host” country  $n$  through a wholly-owned subsidiary.” (Devereux and Griffith, 2003) Shareholders of parent company are from the same country  $j$  as the firm. International corporations invest in different countries via subsidiaries and they transfer their profits with use of dividends to the parent company and shareholders. The calculation of EATR for international investment (BEATR) is shown by following formula (1) (Devereux and Griffith 2003):

$$BEATR_n = \frac{R_n^* - R_n}{E(1 + \pi_n)p_n/(1 + i)} \quad (1)$$

For the expressions in (1):  $R_n^*$  equals to the net present value (NPV) of the investment to the shareholders in the case of absence of taxation;  $R_n$  stands for NPV in the case of taxation;  $E$  stands for exchange rate;  $\pi_n$  represents inflation in the host country  $n$ ;  $p_n$  equals to financial return;  $i$  is nominal interest rate.

The NPV of the investment in the absence of taxation has relatively simple formula; all symbols from formula (2) has the same meaning as in formula (1) (Devereux and Griffith 1999; 2003):



$$R_n^* = \frac{\{E(1 + \pi_n)(1 + p_n) - (1 + i)\}}{1 + i} \quad (2)$$

The calculation of NPV in case of taxation is more complicated. First of all, as it is in real economic environment, also Devereux and Griffith model assumes different types of financing the investment. There are three different sources, from which the company can cover the investment's costs: retained earnings ( $R_n^{RE}$ ); new equity or new debt financing of parent company ( $F$ ); new equity or new debt financing of subsidiary ( $F_n$ ) (Devereux and Griffith 1999). Therefore, there is the following formula (3):

$$R_n = R_n^{RE} + F + F_n \quad (3)$$

Whereas the presence of taxation is considered in this section, there are several features of tax legislation which affect the NPV. First of all, there are statutory corporate tax rates for the home country ( $\tau_j$ ) and the host country ( $\tau_n$ ). There are also withholding tax rate on dividends, which pays the parent company ( $c_j$ ) and the subsidiary ( $c_n$ ). Term  $\gamma$  is also associated with tax legislation and reflects "the tax discrimination between new equity and distributions";  $\gamma = (1-m_a)(1-c)/(1-z)(1-s)$ , where  $m_a$  stands for personal income tax rate levied on dividends;  $c$  equals "the rate of tax credit available on dividends paid",  $z$  "is the accruals-equivalent capital gains tax rate" and  $s$  "imputation credit on dividends received by the ultimate shareholder from the parent." (Devereux and Griffith, 1999, 2003). This measure is oriented on personal taxation in the home country of parent company where its shareholders are located. This parameter has the same value comparing the investments in two different countries, therefore this study assumes no personal taxation as it is done by Yoo (2003). Value of  $\gamma$  is then set to unity.

When it is assumed a subsidiary in host country with parent company as owner in different country, the taxation of dividends has significant impact on NPV. Expression  $\sigma_{jn}$  reflects actual tax rate related to dividend flows from subsidiary (in country  $j$ ) to the parent company (in country  $n$ ) (Devereux and Griffith 1999). This tax rate can have different values according to the tax legislation of country, see Table 1.

**Table 1.** Tax rate on dividends (Devereux and Griffith 1999; Yoo 2003).

$\sigma_{jn} =$	Treatment of dividends payments
$c_n$	Exemption
$\max\left\{\frac{\tau_j - \tau_n}{1 - \tau_n}; c_n\right\}$	Credit with limitation
$\tau_j(1 - c_n) + c_n$	Deduction

Whereas the parent company can lend to subsidiary, it results in interest payments. These interests are, of course, subject of taxation. Therefore there is expression  $\omega_{jn}$ , which represents "overall tax rate on interest payments from the subsidiary to the parent." (Devereux and Griffith 1999) This rate can have values from Table 2, where is "withholding tax rate on interest payments made by the subsidiary ( $n$ ) to the parent" (Devereux and Griffith 1999).

**Table 2.** Tax rate on interests (Devereux and Griffith 1999; Yoo 2003).

$\omega_{jn} =$	Treatment of interests payments
$\bar{\omega}_n - \tau_n$	Exemption
$\max\{\tau_j; \bar{\omega}_n\} - \tau_n$	Credit with limitation
$\tau_j(1 - \bar{\omega}_n) + \bar{\omega}_n - \tau_n$	Deduction

The calculation – formula (4) – for "the economic rent generated by a perturbation in the capital stock financed by retained earnings" (Devereux and Griffith 2003):

$$R_n^{RE} = \gamma(1 - \sigma_{jn}) \left\{ -(1 - A_n) + \frac{E(1 + \pi_n)\{(p_n + \delta)(1 - \tau_n) + (1 - \delta)(1 - A_n)\}}{1 + \rho} \right\} \quad (4)$$

For not mentioned variables,  $A_n$  stands for depreciation allowances,  $\delta$  for economic depreciation rate and  $\rho$  shareholder discount rate. In the case of FIFO method for valuation of inventories, the calculation has one modification shown in formula with assuming that exchange rate is unchanged during period (set as unity) (5) (Yoo 2003):

$$R_{INV}^{RE} = R_n^{RE} - \frac{\gamma_j(1-\sigma)}{(1+\rho)} \times \frac{\tau_n \pi_n}{(1-\tau_n)(1+\pi_n)} \quad (5)$$

Calculation of depreciation allowances ( $A_n$ ) depends on tax legislation adjusting depreciation, which usually differs from one type of asset to another. Overall, there are two basic depreciation methods, which are commonly used in legislations: declining balance schedules and straight line schedules. Formula (6) for straight line depreciation.

$$A_{SL} = \frac{\phi_n \tau_n (1 + \rho_n)}{\rho_n} \left[ 1 - \frac{1}{(1 + \rho_n)^N} \right] \quad (6)$$

In formula (6)  $\phi_n$  is rate of tax depreciation,  $\rho_n$  stands for economic depreciation rate of selected asset and  $N$  represents period of tax depreciation. In the case of declining balance schedules, the formula is following – formula 7 (Yoo 2003):

$$A_{DB} = \frac{\phi_n \tau_n (1 + \rho_n)}{\phi + \rho_n} \quad (7)$$

Different sources of financing result in different effects on tax burden. Therefore, this model takes into account financing strategy of the group. For the parent company, there are three different types of financing: by retained earnings, by new equity and by debt. Next Table 3 shows additional cost depending on source of financing.

**Table 3.** Additional rent depending on parent's source of finance (Devereux and Griffith 1999; Yoo 2003).

$F =$	Source of finance
0	Retained earnings
$\frac{-\rho(1-\gamma)(1-\tau_n\phi_n)}{1+\rho}$	New equity
$\frac{\gamma(1-\tau_n\phi_n)(\rho-i(1-\tau_j))}{1+\rho}$	Debt

The subsidiary can be in similar situation as the parent company. It can use for financing retained earnings, new equity (as the parent company decides) and debt from the parent company. Following Table 4 shows again the additional costs.

**Table 4.** Additional rent depending on subsidiary's source of finance (Devereux and Griffith 1999; Yoo 2003).

$F_n =$	Source of finance
0	Retained earnings
$\frac{\gamma\sigma_{jn}}{(1+\rho)}(1-\tau_n\phi_n)[E-(1+\rho)]$	New equity
$\frac{\gamma(1-\tau_n\phi_n)}{(1+\rho)}\{\sigma_{jn}[E(1+i(1-\tau_n))-(1+\rho)]-E\omega_{jn}i\}$	Debt

### 3. Results

Studies, which deal with EATR for cross-border investment, are originally based on similar assumptions. The assumptions for following calculations are presented in the Table 5 and 6 with addition that the investment is composed of 25% of the buildings, 25% of the machinery, 25% of the inventories, 12.5% of the patents and 12.5% of the software. For the rate of inflation, same value for all

countries has been used (Yoo 2003) (Spengel et al. 2016). These economic parameters have the same value for every country because this study evaluate only the tax burden conditions, not economic conditions of selected countries. When it is used same values for these variables, the calculations are not affected by different economic conditions and describe the taxation conditions more clearly.

**Table 5.** Basic assumptions of calculations 1 (Yoo 2003; Spengel et al. 2016; OECD, 2017).

<i>Parametr</i>	<i>Symbol</i>	<i>Value</i>	<i>Background</i>
Rate of inflation	$\pi = \pi_n$	1.1%	Average OECD in 2016 (OECD, 2017)
Real interest rate	$r$	5%	Yoo (2003); Spengel et al. (2016)
Pre-tax rate of return	$p$	20%	Yoo (2003); Spengel et al. (2016)

Devereux and Griffith model of investment calculates with real (or true) economic depreciation of assets. This economic depreciation differs across selected assets because e.g. industrial building has longer expected life than transport equipment. Assuming economic depreciation rates are presented in following Table 6.

**Table 6.** Basic assumptions of calculations 2 (Spengel et al. 2016; OECD, 2017).

<i>Type of asset</i>	<b>Rate of economic depreciation</b>	<b>Background</b>
Building	0.0720	Baldwin et al. (2005)
Machinery	0.1750	Spengel et al. (2016)
Patent	0.1535	Spengel et al. (2016)
Software	0.3333	Baldwin et al. (2005)

There has to be reviewed legislation of each of selected countries. This study covers countries from Visegrad Group as locations of investment. Depreciation methods used within countries and their corporate tax rates are presented in the Table 7.

**Table 7.** Depreciation and valuation of tangible assets in selected countries (EY 2018; PWC 2019; Getsix 2019).

<i>Country</i>	<b>Corporate income</b>	<b>Buildings depreciation</b>		<b>Machinery depreciation</b>		<b>Inventory</b>
	Statutory tax rate	SL rate	Period	SL rate	Period	Valuation
CZE	0.0720	1.4%/3.4%	1/29	11%/22.25%	¼	FIFO
HUN	0.1750	3%	33.33	14.5%	6.9	FIFO
POL	0.1535	2.5%	40	20%	5	LIFO
SVK	0.3333	5%	20	16.67%	6	Avg cost

There is one more option in the case of depreciation of assets in the Czech Republic. This option is called accelerated depreciation and is not one of the classical approaches to depreciation. On the other hand, the declining balance schedule has similar character as accelerated depreciation in the Czech Republic but the rate of depreciation is not the same in every year. Whereas this is a specific case of depreciation, the calculation of depreciation allowances has a specific formula (8) created on basis from Spengel et al. (2016):

$$A_{Acc} = \phi_1 \tau + \frac{\phi_2 \tau}{1 + \rho_n} + \frac{\phi_3 \tau}{(1 + \rho_n)^2} + \dots + \frac{\phi_N \tau}{(1 + \rho_n)^{N-1}} \quad (8)$$

Every single year has its unique depreciation rate, therefore it cannot be expressed as it can be for straight line schedules in formula (6) and for declining balance schedules in formula (7). The first year's depreciation rate is calculated simply by dividing the one by number of years, when the asset can be depreciated. Depreciation rate for the following years can be expressed by following formula (9):

$$\phi_n = 2(1 - \sum_{i=1}^{n-1} \phi_i) * \frac{1}{N - n + 1} \quad (9)$$

This study also considers the investment into intangible assets; presented by software and patent. Table 8 shows the tax depreciation of these assets in selected countries. The situation in Slovakia is complicated because there are no rules for tax depreciation of intangible assets. Within the calculations it is expected that the depreciation for tax purposes corresponds with economic depreciation of assets.

**Table 8.** Depreciation of intangible assets in selected countries (EY 2018; PWC 2019; Getsix 2019).

Country	Software depreciation			Patents depreciation		
	Method	Rate	Period	Method	Rate	Period
CZE	SL	33.33%	3	SL	16.67%	6
HUN	SL	50%	2	SL	50%	2
POL	SL	50%	2	SL	20%	5
SVK	In line with accounting depreciation			In line with accounting depreciation		

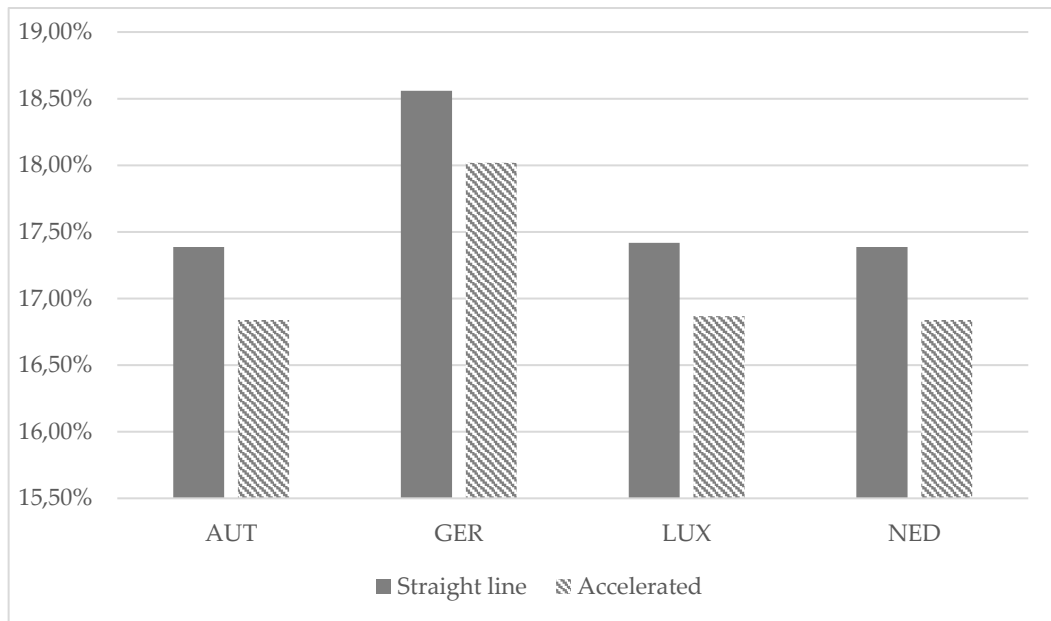
There were selected four countries, which represent home countries of parent companies: Austria, Germany, Luxembourg and Netherlands. This choice is consistent with the biggest amounts of FDI in the Czech Republic presented by country of origin (ČNB, 2017) and also with other historical amounts of FDIs in all V4 countries because the four selected countries belong to the biggest investors in Visegrad Group (UNCTAD, 2018). Treatment of dividends is shown in Table 9.

**Table 9.** Dividends treatment and tax rates in selected “home” countries (EY 2018).

Country	Treatment	CZE	HUN	POL	SVK
AUT	Exemption	0%	10%	5%	10%
GER	95% exemption	0%	0%	0%	0%
LUX	Exemption	0%	0%	0%	0%
NED	Exemption	0%	0%	0%	0%

For the treatment of interest payments, all countries use credit. The most of the bilateral relation has 0% tax rate levied on interest payments. (EY 2018) The 5% tax rate is levied only on interest flows from Poland to Germany or Austria. Statutory corporate tax rates are the last tax legislation feature, which is included in calculation. Corporate tax rates are following: 25% in Austria, 30% in Germany, 26.01% in Luxembourg and 25% in Netherlands (KPMG 2019). It is important to mention that tax rates in Germany and in Luxembourg depends on the location, so the rate is not applicable on all situations. Furthermore, there is progressive taxation in Netherlands and in Luxembourg. In case of the Netherlands, the higher from the rates is applied.

First calculation within this study is EATR for cross-border investment in the Czech Republic in the case of different selection of depreciation methods. This calculation compares two cases: one with selection of classic straight line depreciation method and the second with use of accelerated depreciation. BEATR is calculated for all four selected home countries of parent company and the results are presented in Figure 1.



**Figure 1.** Comparison of depreciation methods' effects on EATRs in the Czech Republic.

Previous graph shows that the selection of depreciation method has significant impact on effective tax burden of the investment. Use of accelerated depreciation method for tax purposes decrease BEATR by about a half percentage point. Accelerated depreciation brings an advantage in time value of money. Whereas the accelerated method allows high tax depreciation in first years when the time value of money is higher than in following years, the effective tax burden considering Devereux and Griffith model is lower. This case of the Czech Republic shows the importance of depreciation methods for company taxation. Legislation in the Czech Republic is the only one within Visegrad Group, which brings choice of depreciation method for the companies. The results of calculations for every bilateral relation which follows methodology from Devereux and Griffith are presented in Table 10.

**Table 9.** Dividends treatment and tax rates in selected "home" countries.

<i>Country</i>	<b>AUT</b>	<b>GER</b>	<b>LUX</b>	<b>NED</b>
CZE ACC	16.84%	18.02%	16.87%	16.84%
CZE SL	17.39%	18.56%	17.42%	17.39%
HUN	16.26%	9.85%	8.57%	8.54%
POL	20.47%	18.22%	17.08%	17.05%
SVK	25.19%	19.63%	18.50%	18.47%

The results of cross border EATR for selected countries show that Hungary's legislation offer the lowest effective tax burden for all locations of the parent company. EATR for Hungary in the cases of location of parent company in Germany, Luxembourg and Netherlands is half opposite to the situations for investment in other countries. In the case of investment from Austria, Hungary still leads the Visegrad Group but the difference between BEATR in the Czech Republic and in Hungary is about 0.6 percentage point. The highest effective tax burden is in Slovakia, where the value of BEATR is the least advantageous in all monitored cases. Overall, the Czech Republic offer better conditions than Poland and Slovakia but there is a lot higher effective tax burden comparing to Hungary.

#### 4. Discussion

The huge gap in BEATRs between Hungary and other countries is caused by 2017's reduction of statutory corporate tax rate. The rate for 2016 in Hungary were at 19%, which is the same rate that is currently in the Czech Republic. According to results from Spengel et al. (2016), the Czech Republic offered better taxation condition than Hungary in 2016. Legislation change in Hungary has caused this difference and Hungary has become the country with the lowest effective tax burden in this area.

Almost identical value of BEATRs for investment from Austria to Hungary and to the Czech Republic is caused by different treatment of dividend payments to home country of parent company. These values show the importance of tax treaties between countries. Dividend payments from Hungary to Austria are taxed by 10 %; on the other hand, the same payments from the Czech Republic are not subject of taxation. Similar effect applies to other two countries: Poland and Slovakia. The Czech Republic has the best position in Visegrad according to tax treaties because none of the cross-border payments are subject of taxation. Despite this advantage, even in the case of investment from Austria is the Czech BEATR higher than value for Hungary.

Position of Hungary within the tax competition is even better than it is shown by the Table 10. Some companies can benefit from IP (intellectual property) box, which rests in 50% deduction (Koka and Kocsis 2016). For this purposes the company has to follow the legislation and this tax regime can be used only for qualified income and qualified expenditures. Basically, it addresses company's own IP activities. Hungary's orientation on IP demonstrates also depreciation legislation dealing with intangible assets. The depreciation there is the quickest in the range of Visegrad Group countries, what also affects the tax burden. Despite the stricter legislation, which is now connected with IP boxes tax advantage can be for certain group of companies significant (Jedlička 2018).

According to the depreciation methods, their importance is documented by Figure 1 and Table 10. The legislation in the Czech Republic offers two methods, from which the accelerated one is the better choice for lower tax burden. It is important to mention that the half percentage point difference is calculated for the case of combined investment which is in line with previous research demonstrating the importance of accelerated depreciation (Šimović and Žaja 2010; Nuță and Nuță 2012). The change of depreciation method has effect only on half of investment (for buildings and machinery). The real difference counting only with one asset is almost one and half percentage points for buildings, according to intermediate calculations. The ability of using an accelerated depreciation in the Czech Republic is also the reason of better results of BEATR then for Poland. Statutory corporate tax rate is the same in both countries (19%) therefore the different tax burden is associated with depreciation methods and tax treaties. Standard straight line depreciation method in the Czech Republic is less beneficial than the one in Poland and the BEATRs with using SL method is higher for the Czech Republic (it is not the case of Austria as parent's location due to different treatment of dividend payments).

There is one more view, which is important to consider when the results are discussed. The legislations of countries, from which the investment come, are also important for tax burden. In this case, results show that Netherlands and Luxembourg offer the best conditions as for parent companies. Netherlands and Luxembourg are considered as tax havens and multinationals often reside there (Berkhout 2016). Therefore huge amount of investments flows from these two countries into Visegrad Group. Globalisation causes that for example originally German company can have residence in Netherlands and invests in the Czech Republic. The multinational company makes not only the decision, where to invest, but also where to set the location of parent company.

Used method has some limitation because it is based on the tax legislation. There are also used special contracts between investors and governments which similar method cannot cover. These tax incentives cannot be integrated into used model and therefore the BEATRs reflects only regular conditions for investment in certain country. Further studies can focus on effects of taxation policy on real investment activity of multinationals with analysis of the importance of tax burden on investments in Visegrad Group. Countries of Visegrad group have relatively similar legislation but there are several differences which can play a key role in selection of investment's location. The depreciation method is one of the most important factors, which significantly influences tax burden and can have large impact within the tax competition. For better understanding of investment activities in this area, focusing on situation in different industries would be also beneficial.

## 5. Conclusions

This paper documents the differences between tax burdens of investments in different countries of Visegrad Group. Within this union, Hungary offers the best conditions for cross-border investments. Their legislation is also the one most targeting intangible assets and also offers preferential tax regime for intellectual property activities. The Czech Republic has the most beneficial tax treaties in Visegrad Group. Tax treaties has been played a key role and still there are some differences. On the other hand, tax treaties between the countries from the EU offer usually similar conditions in different locations.

Legislation of the Czech Republic is unique for the availability of two depreciation methods for tax purposes. Findings related to depreciation conditions in the Czech Republic are very important in current situation of tax burden in selected countries. Whereas the treatment of cross-border payments tend to be similar, the reduction or increase of tax burden can be made, besides changing statutory corporate tax rate, also by change of depreciation methods. Financial managers should monitor changes in legislation not only from the perspective of tax rates but also consider the effects of the depreciation on taxation.

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# Research into Partial Problems in Building Brand Image in Selected Small and Medium-sized Enterprises of Chemical Industry in the Czech Republic

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**Abstract:** While the importance of brands in the current B2C and B2B markets continues to grow, the issue of brand management and brand image building in small and medium-sized enterprises has not been consistently mapped. These types of businesses are faced with specific problems in their efforts to promote their brands, which need to be better understood and analysed. The primary qualitative research was carried out in the form of in-depth structured interviews with managers of three lines of business dealing with the processing and production of chemical products within three different Czech companies. The aim of the research was to analyse the current situation in selected companies in terms of creating and using brands, perception of the value and importance of brands as well as ways of creating the desired brand positioning and image. The research has made it possible to identify several general problem areas in brand management, the solution of which would probably make it possible to improve the brand image, both in the enterprises under review and in similar small and medium-sized enterprises.

**Keywords:** branding; brand image; chemical industry; small and medium-sized enterprises (SMEs)

**JEL Classification:** L6; M21; M31

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## 1. Introduction

Brands have always been an important means of identifying and differentiating products and companies, especially in B2C markets. As a result of globalization, hypercompetition, competition between similar products and services, the increasing demand of consumers and the high pricing pressure (Kotler and Pfoertsch 2006) the brand has grown in importance in recent years not only on B2C but also on B2B markets. There, the interest in brand building is also boosted by the problems caused by significant mergers and acquisitions (Tetrevova 2004; Vlckova 2016), the high impact of many activities on the whole society and increased interest in brands and corporate reputation among customers (Lindgreen et al. 2010). Despite the generally growing interest in branding, the attention of many researchers is focused on large companies trading in global markets (Hirvonen et al. 2013; Juntunen 2014; Agostini et al. 2015). However, the importance of brands in small and medium-sized enterprises cannot be underestimated. As some studies confirm, e.g. Berthon et al. (2008), Spence and Hamzaoui Essoussi (2010), Odoom (2016), while the basic principles of brand management are more or less the same for all types of businesses, the local presence of small and medium-sized enterprises and their limited resources bring certain specifics that are linked to specific problems. The aim of our primary research was also to expand knowledge in this area.

The fact that the issue of brands has still not been resolved is already evident when we try to formulate its basic definition. The most cited brand definition is the definition of the American Marketing Association, which says "a brand is a name, term, sign, symbol or design, or a combination of these, intended to identify the goods or services of one seller or group of sellers and to differentiate them from those of competitors" (Kotler and Keller 2006). While this definition can be considered the most popular, it is often criticized because it focuses too much on brand elements without taking into

account the wide range of associations related to brands (Keller et al. 2008; Kornberger 2010). Therefore, the definition of the American Marketing Association in 2016 was slightly reworded: "A brand is a customer experience represented by a collection of images and ideas; often it refers to a symbol such as a name, logo, slogan, and design scheme" (Kladou et al. 2017). This definition seeks to create a link between the earlier emphasis on symbolic elements of the brand (name, logo, slogan, design) and the current preferred broader concept emphasizing how customers experience the brand (images, ideas). In this context, the value concept of the brand is increasingly important, as described in e.g. De Chernatony (2009). The author claims that the brand can be understood as a set of functional and emotional values that promise a unique and enjoyable experience while representing a dynamic interface between the actions of the organization and their interpretation by customers. Also, Batey (2008) defined the brand as a set of associations on attributes, benefits and values. It can therefore be accepted that "a brand is a label, designating ownership by a firm, which we experience, evaluate, have feeling towards, and build associations with to perceived value" (Brakus et al. 2009). As research shows, significant identifying elements of the brand, such as name, logo, slogan, URL (Uniform Resource Locators), representative and jingle (Kotler and Keller 2013) must be designed to uniquely identify the brand and form a set of positive associations that are reflected in the brand value (Kladou et al. 2017; Fajardo et al. 2016). Krake (2005) emphasizes the importance of the right set of brand elements in building the brand image of small and medium-sized enterprises.

As already indicated, effective brand management leads to improved brand image and value growth. According to Aaker (1991), brand value can be derived not only from brand image but also from brand associations, brand loyalty and brand awareness. The validity of this assumption has been verified by, among others, Sasmita and Mohd Suki (2015). The authors found that the perception of brand value by the young generation in Malaysia is based primarily on brand awareness and image, especially in relation to ecology (green brands). At the same time, it was found that associations and customer loyalty also played a role in brand evaluation. Several other studies have shown that the main dimensions of brand value in relation to B2B products are perceived quality (image) and brand loyalty (Michell et al. 2001; van Riel et al. 2005). Michell et al. (2001) and van Riel et al. (2005) emphasize that brand awareness and brand associations are relevant only in some specific industrial markets, but most B2B markets have shown that brand associations do not play a significant role in terms of brand value (van Riel et al. 2005). Associations and image are then the dominant dimensions in brand evaluation in B2C markets.

Building the desired image and appropriate associations requires that the company gain an extraordinary, unique place in the minds of its customers for its brands. It is based on the specific positioning of brands, which must be based on the uniqueness of all attributes of consumer value added where it is possible to achieve business uniqueness. (Kotler and Keller 2013). Only in this way can the customer establish a trust-based relationship with the brand and the brand itself represents guarantee for the customer in terms of all expectations he/she has in relation to all product parameters (Rosenbaum-Elliott 2018). Recent research has shown that customers who have a positive perception of the brand are also more willing to buy it, actively seek for it (Chan et al. 2013; Flek et al. 2012), talk more about it (word-of-mouth) and are willing to pay more for it (Han and Kim 2010). Many experts also agree that the brand generates more confidence in the correctness of purchasing decisions, improves the reputation of the company, offers more space for building and maintaining a competitive advantage, can increase barriers to market entry, enable better differentiation of companies according to product quality, leads to better financial performance of the company and serves as a basis for developing long-term relationships between companies that lead to a lasting competitive advantage by building a likeable, strong and positive brand image among many actors involved in the purchasing process and all other stakeholders (Sincic Coric and Jelic 2015). This is true for large as well as small and medium-sized enterprises. The importance of the brand, its proper management and effective building of its image is therefore indisputable for the company's success.

The aim of our research was to analyse the current situation in selected companies in terms of creating and using brands, perception of the value and importance of brands as well as ways of creating a desired brand positioning and image. The research has made it possible to identify several general problem areas in brand management, the solution of which would probably make it possible

to improve the brand image, both in the enterprises under review and in similar small and medium-sized enterprises.

## 2. Methodology

Primary qualitative research was prepared and implemented to identify current methods of brand management and profiling in small and medium-sized enterprises operating in the chemical industry. The research was carried out by the method of structured individual interviews based on the prepared interview scenario with senior managers of the respective sales and marketing departments. In order to find out the necessary information, it was necessary to prepare about 5 working meetings in each of the surveyed companies, with each meeting taking about 1.5 hours (Fialova 2017; Krejčík 2018).

Three Czech companies operating in the production and processing of chemical products were chosen for the research through deliberate judgment selection. Such lines of business were chosen for the analysis of the brands that correspond to the position of small and medium-sized enterprise on the Czech market.

## 3. Results

### 3.1 Characteristics of examined brands and criteria of selection of their elements

Table 1 provides a basic overview of the companies surveyed and the selected brands within the selected lines of business. Based on the wishes of the monitored companies, specific brands or company names will not be published in the paper. From the point of view of the research objective, a specific identification of monitored companies and brands is not even necessary.

**Table 1.** Basic definition of examined groups of brands.

Company/Characteristics	Company 1	Company 2	Company 3
Business sector	Food and chemical industry	Research and development of hyaluronic acid, pharmaceutical, cosmetic and chemical industry + nanotechnology	Household chemicals, cosmetics and chemicals for professional cleaning
Line of business analysed	Agricultural division - market leader in the field of special fertilizers and other products intended for plant nutrition and stimulation.	Veterinary products - products aimed at the treatment of joints, wounds and problems in the oral cavity.	Household chemicals and cosmetics
Number of product brands analysed	11	5	7
Target market	Industrial customers (B2B markets)	Final consumers (B2C markets)	Final consumers (B2C markets)
Hierarchy of brands within the analysed line of business	Business brand Individual brands - 11 Two individual brands are grouped - they include 2 and 7 model brands	Business brand Umbrella brand – 1 Five individual brands One of the individual brands includes 2 model brands	Business brand Umbrella brand – 1 Three individual brands – each includes several model brands

A more detailed analysis of the monitored brands within the surveyed enterprises requires an analysis of the brand elements used by the companies. The research results in this area are summarized in Table 2.

**Table 2.** Identification of brand elements used by the companies.

Company/brand element	Company 1	Company 2	Company 3
Logo, Symbol	11 brands (100%)	5 brands (100%)	7 brands (100%)
URL	11 brands (100%)	5 brands (100%)	7 brands (100%)
Representative	0 brands (0%)	1 brand (20%)	0 brand (0%)
Slogan	5 brands (45%)	0 brands (0%)	1 brands (14%)
Jingle	0 brands (0 %)	0 brands (0 %)	1 brands (14%)

All examined brands bear their name, which is then graphically rendered in the form of a logo. In all cases, the brand names are relatively short, usable also on international markets and often refer to product characteristics (its composition and use). Most logos for each brand are created as a colour representation of the brand name. The most commonly used colours are green, blue-green and blue. The reason is the obvious desire of companies to create positive associations between brands and the natural and ecological mindset of the company and its customers. Product brands do not use any supporting graphics in the logo. The brands of the companies are accompanied by a small artistic representation - in the case of the first company these are green leaves in the first letter of its name; in front of the second company logo is an artistic abstraction, and logo of the third company is portrayed as a golden seal. In addition to the brand name, company 2 umbrella brand logo also displays silhouettes of a cat, a dog and a horse. One of the individual brands of company 3, which includes an environmentally friendly range of products, is placed on a green leaf.

All monitored brands have their URL address with a link to their own website with a detailed Czech description of the product. In the case of first two companies, there are also language versions, which are a simplified version of the Czech website. The website is in English, German and, in the case of the first company, in Russian.

Interestingly, almost half of brands of the first company are complemented with an advertising slogan. This is particularly surprising because of the fact that this company markets its production in an industrial market where the use of slogans is rather exceptional. The company justifies the use of slogans with a desire to make the brands more visible and to delineate a specific place for them in their own assortment and in relation to the competition. Only one of the monitored brands currently uses the jingle for its identification, while the same brand also uses the slogan. The reason for their use is the introduction of a new product line and, together with it, a new brand that carries information on the introduction of new environmentally friendly products. Spots on both radio and TV were used within their campaign. By investing in this brand, the company also wants to differentiate itself from the competition and attract customers with something new. This company also uses slogans for other brands, which are prepared for more intensive promotions, but are not actively used for now. A representative in the form of a fictional animal supports only one brand. The reason for using the brand representative was to target a **specific** group of end consumers.

When thinking about the design of individual brand elements, it is necessary to consider to what extent they meet the requirements for the ideal design of a brand element, which is shaped by its memorability, meaningfulness, accuracy, adaptability and degree of protection. (Keller et al. 2008) Of course, it is often impossible to achieve them all. Therefore, in our research we tried to determine the degree of importance that the respondents attribute to each of the recommended criteria when designing different brand elements. The results are summarized in Table 3. The evaluation used a scale where 1 represents the most important criterion and 5 the least important criterion.

**Table 3.** Average scores of importance of the recommended criterions.

Brand element/criterion	Name	Logo	URL	Representative	Slogan
Rememberability	1,3	1,3	3,0	1,0	1,5
Meaningfulness	1,7	2,3	2,7	5,0	1,0
Portability	2,3	3,0	1,3	2,0	3,5
Adaptability	4,0	3,3	1,3	3,0	3,5
Protection	2,7	2,0	3,7	4,0	2,0

Table 3 shows that the monitored companies agree that the most important parameters when formulating the brand name are rememberability, meaningfulness and its portability. Similarly, for a slogan these are meaningfulness and rememberability, but on the third position it is protection. As for the logo, the companies agree on the importance of its memorability and the possibility to protect it against copying by their competitors. Portability and adaptability are most important for URL of the brands.

### 3.2 Value and importance of brands for the companies

**Company 1** focuses its agricultural production on the B2B market, where traditionally the importance of brands is not as great as on the B2C market. The brand is especially important for the company because it represents the product in the market where it is sold and generates profit. The company does not invest too much money in the promotion and targeted building of brand image. The exception is a specific (Nitrogen Fertilizer) brand, which has been chosen as the company's flagship. Thanks to the extraordinary quality, but also the great marketing support from the company, a competitive advantage has been created for this brand based on an exceptional image and a very positive reputation. The success in the market enables further development of the brand and contributes to the good name of the whole company and thus of its other products too. The brand has also built a reputation on foreign markets and so a foreign distributor has decided to distribute the product under the given Czech brand.

Thanks to their efficiency and characteristics, the company products associated with the brand must solve a specific customer problem, meet customer expectations and thereby generate customer satisfaction and loyalty. Although the company does not systematically monitor customer satisfaction or loyalty, they believe that based on personal contacts with customers they can claim that their customers are satisfied with the business brands and that they are loyal. According to the managers, customer satisfaction and loyalty are then an expression of the brand value. The brand is a guarantee of quality and seriousness for customers. Thanks to quality brands, the company experiences a better negotiating position in relation to suppliers and customers.

The financial value of individual brands at this company has never been determined, but recently, an expert has determined the value of an entire company, which could be a good starting point for valuing both company brands and individual products.

**Company 2** offers its veterinary products in the B2C market where the brand can play a big role for both customers and businesses. According to the marketing manager, the brand value is *"a certain idea of how big the role is that the brand plays in business success"*. In this line of business, all products are sold under different brand names, so a brand-free product would be absolutely uncompetitive in this area. This company therefore considers brands to be a natural business tool, which appears to be absolutely essential for this category of products. Business brands naturally facilitate trading and customer communications. The company can also target specific customer groups directly with each brand. Although the company does not systematically monitor the value of its brands or the satisfaction and loyalty of its customers, it agrees with the claim that the value of the brand depends on customer satisfaction and loyalty. The company representative perceives the importance of brands in this line of business especially from the perspective of the customer, who can, thanks to the brand, clearly identify the manufacturer and product, perceive it as a guarantee of high quality and efficiency and can express his/her own personality through it. As manufacturing and sales of veterinary products is a minor business within the company, employees receive less financial support for this product category and, as a result, low brand awareness, which they are currently trying to address through increased promotion.

**Company 3** focuses its production of household chemicals and cosmetics on the B2C market, where, as mentioned above, the brand has a significant potential impact on both customers and the business itself. Similar to the second company, the products in the field of household chemicals and cosmetics are sold under different brand names, without which the products in the competitive environment, they face, could not stand up. For the company, the brand represents an opportunity to differentiate itself from the competition, not only visually or by design, but also by the perceived

quality and innovation delivered with the brand. The company uses both established brands and creates also new ones. The well-established long-term brands are subject to both visual changes in the form of a more modern design and changes in the quality delivered. Within these established brands, the company invests most in the main umbrella brand, with its sub-brands targeting selected market segments. The success of the umbrella brand helps the success of its umbrella sub-brands. New brands in the company are mostly associated with targeting new markets.

The company monitors customer satisfaction and loyalty programmatically, but not in relation to the brand. Therefore, it does not monitor the value of its brands programmatically, it can estimate it, as for the first company, from the value of the whole company or from basic financial indicators, which can be used to monitor the trend of interest in these brands. The company also agrees with the claim that the value of the brand depends on the satisfaction and loyalty of the customers, who can perceive it as a guarantee of the quality supplied and can also express its own personality through it.

### 3.3 Positioning and image of the examined brands

**The first company** aims its agricultural production at small and large farmers, where, according to the company's representative, the basic positioning and image of its brands do not actually differ from each other. With each brand used by the company, the customer should imagine the highest possible quality in which the company invests heavily in terms of the composition of individual products (it owns about 20 patents in the Czech Republic). Therefore, the company builds the extraordinary and unique value of its brands mainly based on the extraordinary characteristics and composition of its products while trying to use an appropriate price (as low as possible) to keep the required margin to achieve the desired economic results.

**The second company** target market for this product line is pet owners, animal factory farmers and veterinarians. Due to the specificity of the products, according to the representative of the company, the basic positioning and image of the individual brands do not differ from each other and can be summarized under the positioning of the Active Animal brand as a whole - premium veterinary products with the highest efficiency guaranteed by the company team. The premium character of the products is underlined by their high price.

The target market of **the third company** for a given product line are the households. Brands differ mainly in the function of household products. Due to the highly competitive environment, however, the basic positioning and image of the individual brands does not differ from each other and the brand value is built primarily by delivering extra features and high product quality, durability and reliability in accordance with customer requirements, while delivering unique style and design. At the same time, the company is building significant value in the brand image by reducing the cost of purchasing and disposing of the product.

The use of specific attributes of extraordinary consumer value of brands offered by individual companies is summarized in the following Table 4.

**Table 4.** Use of specific value attributes to create specific positioning in the surveyed companies.

Company / value element	Company 1	Company 2	Company 3
Extraordinary product properties	Yes	Yes	Yes
Exceptional durability or reliability of the product	Yes	Yes	Yes
Unique style and design	No	Yes	Yes
Unique assortment of accompanying services	Yes – for leaf fertilizers	Yes - consulting	No
Exceptional service quality	Yes – for leaf fertilizers	Yes - consulting	No
Price	Rather lower	High	Medium
Reduction of other costs associated with the purchase, use and disposal of the product	No	No	Yes

#### 4. Discussion and Conclusions - Problematic areas of brand management in the surveyed companies

In the framework of brand management research in the companies surveyed, our goal was also to identify possible deficiencies and problematic elements that the companies experience. Our intention was to discover possible suggestions for improvement that could inspire other similar SMEs. The basic deficiencies in brand management identified by our research include:

- **Inconsistency in brand design** – The logos of the first company brands appear inconsistent, which is contrary to the recommended idea of unified corporate design. This is also the case with company 2, where the design of the logos presented on the website and on the packaging of the actual products differs. The varying appearance of the logos of the brands under review can result in confusing customers and creating an inconsistent image, which is certainly contrary to the intentions of the companies. A unified design supports the impression of sophistication, professionalism and contributes to the positive image of the whole company. On the other hand, as pointed out in the third company, by leaving the established individual brands, the company would lose a significant continuation of the positive reputation of these brands built in the past (over 50 years). For this reason, in an effort to unify, a business brand is always attached to individual product brands.
- **Insufficient use of slogans** – We believe that the companies surveyed do not make sufficient use of the potential of using brand slogans. Especially in consumer markets we see room for formulating slogans to the brands that would clearly and distinctly present the desired brand positioning and thus penetrate much deeper into the minds of consumers. Even first company, which uses slogans for some of its brands, could work with them more comprehensively - to clarify the rules for selecting slogans and to analyse the existing slogans for their aptness and intent. However, the fact that they are small and medium-sized enterprises can play an important role. As the third company said, it is financially challenging to raise the slogan to the general public and inefficient for development of online shopping.
- **Confusing and unclear arrangement of brands within the company** – For some brands, a large number of subgroups seem to be somewhat confusing. It may also be considered unnecessary to establish "umbrella" brands unless they are properly communicated. This problem can be seen in the company 2, where the customers, according to the interviewee, cannot accurately distinguish between the brand of the company and that of the product line. The basic recommendation here is to make the structure of brands more comprehensible, simplify it as much as possible and communicate it accurately and clearly.
- **Unsystematic monitoring of brand satisfaction, loyalty and familiarity** – The monitored companies ascertain customer satisfaction and evaluate customer loyalty and brand awareness on the market rather intuitively and unsystematically. We believe that regular analysis of these indicators would help the company not only to improve its products and services, but also to select appropriate communication tools and strategies. The results of these findings would in a way also reflect the value of brands and contribute to a better allocation of resources within the brand portfolio of companies.
- **Neglecting the tracking and use of associations in connection with brands** – We believe that businesses, especially in the consumer market, should better monitor and exploit the associations evoked by brands. The brand should be able to evoke clear positive associations (feelings, thoughts, ideas) in connection with the product. However, this area of psychological influence of the brand is rather neglected by the companies surveyed.
- **Failure to use all the possibilities of increasing customer value in creating brand positioning** – In building a unique image, the company should use all the possibilities of differentiation within all elements of consumer value added. Nevertheless, it can be noticed that the first company focuses its attention elsewhere than on the style and design of their products, and shortcomings are also evident in some services. Remedying these problem areas could significantly increase customer value and thus contribute to strengthening the competitive position of brands. A major

drawback of all the companies surveyed in positioning is the temporary inability to help customers to reduce other costs associated with the acquisition, use and disposal of products.

It is clear that our research is only a general insight into the very broad issue of brand management in small and medium-sized enterprises in the Czech Republic. We believe that its results will contribute at least to opening a deeper discussion on some problematic areas and inspire the professional public to conduct more comprehensive investigations.

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# Earnings of Startups in Different Stages of Development

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**Abstract:** It is very difficult to find new place in economy for startups. They represent a new stream of thinking and have the potential not only strengthen innovative capacity of the economy, but also to significantly increase its competitiveness, create new jobs in high value-added sectors. Even a small amount of ambitious and successful initiatives can do it through new technology or management innovations. Finding finance is significant for these companies and the use of earnings management is one way to attract new investors. The reason for the choice of the topic is the author's interest in the issue and the possibilities of its further elaboration and expansion. The aim of the article is to summarize the financial possibilities of start-up companies in different phases of their life cycle of start-up companies. The analysis and comparison method were used in the writing, which deeper examines the individual alternatives of financing the company and at the same time highlights the pros and cons. The advantage of this article is a summary of the options which companies can use to gain financial opportunities. The conclusion summarizes the various alternatives that start-ups can use and highlights the best financing options.

**Keywords:** startup; financing; earnings; life cycle of startup

**JEL Classification:** H32; M21; P32

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## 1. Introduction

Startup refers to a newly created project or start-up company often at the stage of creating a business plan. For the first time, the term became popular in the time of Internet fever between 1996 and 2001, when many online businesses of this type were established overseas, especially in Silicon Valley. It is experiencing its renaissance nowadays, when it is used to refer to any new project that has been launched. Startup can be created in any industry, but most often they are technology or Internet businesses. They are defined by low start-up costs, greater business risk compared to mainstream businesses, potentially higher returns if startup becomes a regular business. An enterprise ceases to be a startup when it becomes profitable or a merger or acquisition object.

One of the founders of Warby Parker Neil Blumenthal described start-up as a company trying to solve a problem whose solution is not obvious and whose success is not guaranteed. By definition, the confidence in these firms is very low (Robehmed 2013).

Another well-known definition was given by Eric Ries in his book *The Lean Startup*. He claimed that start-up is a human-made institution that serves to create a new product or service under conditions of uncertainty. As this definition suggests, Eric Ries in his book stresses that the principle of start-up is an innovation for which creative people are essential able to work in uncertainty and team. A team of people who want to lead a functioning start-up must be constantly modern, innovative and open to new opportunities and ideas. The customer buys not just products are important, which the customer initially buys, but also the experience, feelings and experiences that the company can do to provide (Ries 2011).

According to Steve Blank, the start-up business model of a formed organization is created to search for repeatable and scalable business models. The main business goals can be revenue, profits, users, or clicks mouse. The goal of startup can be almost anything you and yours are on investors agreed. Star up may not be primarily profit oriented, but to make the business model repeatable and capable of further development. First of all, it is necessary for the project to be able to spread to other

areas for the purpose of obtaining a solid market position, but also expansion into new markets. All of this is needed mainly because of providing new, ideally stable resources (Blank and Dorf 2012).

Start-up is a new business with high growth rate. It can provoke global transformation of the whole industry. It is the possibility to improve the skills of experts from a variety of industries, from technicians and scientists to marketers and marketing workers to commercialize radically new ideas. Start-up also brings a great deal of innovation and can reach global dimensions (Senor and Singer 2009)

The initial definition of start-up in Slovakia was given by a document under the title "Concept for support of start-ups and development of start-up ecosystem in the Slovak Republic", which was established in 2015 as a common vision Ministry of Finance of the Slovak Republic, Ministry of Economy of the Slovak Republic and Ministry education, science, research and sport of the SR. According to this document startups are business initiatives with high growth and innovation potential. they can support economic growth in the long term and also attract foreign investment. They also help to develop high value-added industries, regional and global competitiveness and employment creation of skilled labor force. They are an important part of country building process which aim is to create image of an innovative economy.

KPMG in its annual, thematic focus publications, defines start-up as a young company that uses new and innovative technology, destroys current business models and has a positive influence for global growth.

Start-up distinguishes yourself from other companies in general by being innovative company with a scalable business model. It is a company that is located in the opening phases of business is associated with high growth potential. On the other hand, it is also associated with a high risk of failure.

Venture capital impacts the development of new firms. Venture capital is related to a variety of professionalization measures, for example human resource policies, the adoption of stock option plans, the hiring of a marketing VP (Hellmann 2002).

Behavioral financing examines investor decision-making and the impact of psychology on financial decision-making by professionals. On this basis, it is possible to use the fuzzy logic method, which is useful for solving problems of financial management and problems of financial decision-making. The method is also applicable in financial management, especially when human influence and the occurrence of language variables are necessary (Valaskova et al. 2019).

Maurya (2012) divides start-up companies throughout their life cycle into three stages. The first stage is the Problem/Solution Fit. This stage investigates whether the market even has a problem that needs to be solved. In this case, the idea is not the most important element. It is important to assign the solution to the associated problem, as well as to see if the start-up wants to develop something that the customers/users need. The second stage is Product/Market Fit. It answers the question of whether the implemented idea is really what the users need. The third phase is Scale. It consists of expansion and growth of start-up companies, which leads to an increase in the number of employees, to an increased market shares or to higher income. After the second phase, the main aim of entrepreneur is to spread the business.

## **2. Methodology**

The article is focused on the evaluation of financial possibilities of startup companies in various stages of their development. In this article, analysis method was applied, individual phases of the company life cycle were investigated together with specific possibilities how startups could be financed. The analysis used information from scientific articles contained in the Web of Science Core Collection, conference articles, books as well as publications and articles from various economic journals. The reason why this topic is discussed is timelessness – our goal is to focus on research objectives in this area in the future. The start-up community in the Slovak Republic is not very developed and it is necessary to raise awareness of the issue. The contribution of the paper lies in the overall evaluation of the individual financing alternatives as well as the determination of the advantages and disadvantages of these options.

### 3. Results

Startups need a large inflow of funds right from the start for supporting product development and later marketing. At this stage they have nothing to guarantee, and so they are for the bank as a loan applicant completely unsatisfactory. Startup works in conditions of uncertainty and risk, it comes up with something new and does not know if it is on the market will work or how the situation develops. Therefore, they are much more appropriate alternative financing options with which the founder does not risk lose; personal property. As startups are unconventional in their life cycle, they are also unconventional forms of financing. There are already several options for how it can startup to get the necessary finance, at different stages of development. Every development phase is associated with a different level of risk and groups are identified according to investors and funding opportunities. The financial health of a company is important for raising funds. An overview of the company is also provided by absolute indicators obtained from the financial statements (Bartosova and Kral 2016).

#### 3.1. Life cycle of start-up

The start-up finance cycle is linked to the business idea development cycle. Investors purposefully differentiate the different phases of the startup and consider the size and risk of the investment accordingly. Startups go through several rounds or phases of funding. They raise capital from venture capitalists (VCs) because banks are not usually willing to provide high-risk loans. Capital is therefore collected in several rounds and is provided based on the following assessment: probability of success, credibility of the concept, growth of customer base and others.

The life cycle of organizations is understood in five phases: establishment, growth, stabilization, crisis and extinction. Startups, however, differ from traditional companies in many aspects and therefore cannot be used this classic life cycle. Generally, we can divide the startup life cycle into three main phases, which are the deployment phase, the seed phase and the creation phase.

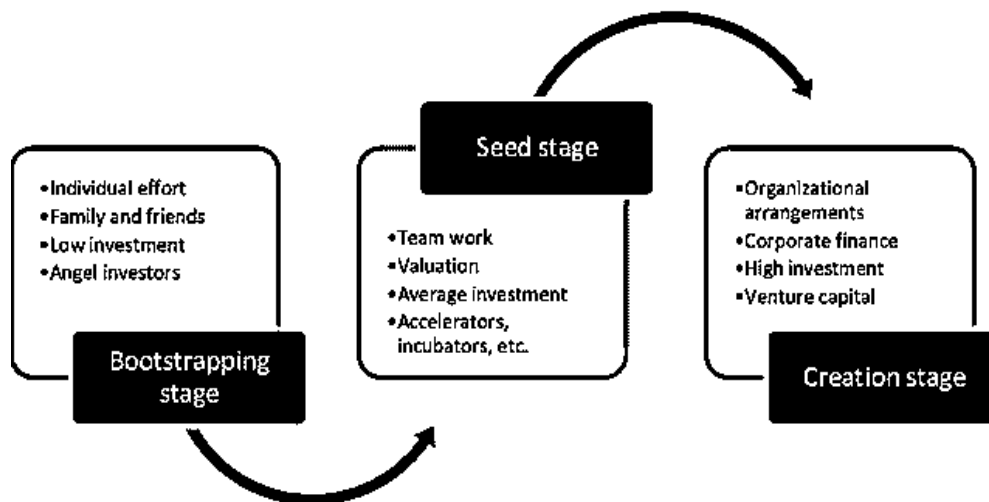


Figure 1. Start-up life cycle (Kawamorita and Salamzadeh 2015).

In bootstrapping stage, the entrepreneur stimulates some important business activities to turn the first idea into a business. In stage of seed there is important to start with team work, development, coming into market, finding new investors. The last stage - creation means that company sells its product, take on new employees. For some company, corporate financing is the best choice (Kawamorita and Salamzadeh 2015).

Many experts come up with their own interpretation of start-up lifecycle. It is worth to mention model of the six phases of the life cycle according to Max Marmer, founder of Startup Genome. Six phases are called discovery, validation, effectiveness, scalability, maintenance and sales or recovery:

- discovery is the first phase and is represented by an innovation, it is the idea that underlies the entire start-up. Beside stock this phase also consists of something that is called the minimum viable product (MVP). This means that a new product is pared down to a minimal version. After figuring out if the product goes well with the public, the set of features can be completed.
- Validation is known as the second phase and it is the connection from hypothetical product or process to real product, process. Therefore, the proposed innovation must be feasible. If startup proves that it can be innovative in practice, then there is the possibility to focus on efficiency of production or service.
- Effectiveness is the phase when advice from specialists and studies are very evaluated. It is important to perform market studies and also ask for advice at a good investor.
- Scalability phase means fast and easy business growth across the world. All the principles and functions of the company should therefore be easily transferable and feasible. After that it is possible to hire and train new employees.
- Maintenance deals with the long-term sustainable growth of the company, mastering the market threats and successful expansion to other countries.
- The last phase is defined by Sales. If start-up works properly and has a promising future ahead, the founders could sell this business and earn quite interesting amount of money. In a dynamic market environment, it is then necessary again follow the development and constantly innovate your products or services (Unconvention 2018). Steady development of every company is ensured by harmonization and synchronization of all its activities. For the company that offers products is necessary not only to determine the key parameters of sales channels, but ensure high profitability of every product, because this affects profitability of the whole enterprise (Shpak et al. 2016).

Company life cycle is mostly depending on the development of a product or service as start-up brings something new. Life cycles from multiple sources resemble each other. What is more important in case of start-ups is the speed at which different phases take place and alternate each other. Not each life cycle of start-up companies is always successful and can quickly end with the termination or go bankrupt. Due to great global competitiveness and complexity of individual companies, it is currently very difficult to predict the risk of bankruptcy (Kovacova and Kliestik 2017).

### *3.2. Forms of start-up financing*

It is very important for every company to attract investors when launching the business, but also keep them interested during whole life cycle. Start-ups also seek funds that can provide them external opportunities. There is a relationship between efficiency of investments and the quality of accounting information, which can be measured by earnings management practices. Chief financial officers believe that earnings management can influence investors and increase value of their companies (Jong and Mertens 2013). Companies try to manage earnings in order to increase their price. But for private equity funds it could be very costly (Sosnowski 2018). For investors business performance is very significant. The term economic profit is used in economic theory to determine business performance. The Economic Value-Added indicator is used to measure this economic profit (Salaga et al. 2015).

Family, Friends and Fools (FFF) are the people who take the greatest risk by investing in a particular entrepreneur's idea. FFF belongs to a special category as start-ups receive financial support in the form of pocket money from them. Moreover, they do not expect anything in return. Angels are usually professional investors who generally invest their own money to enable an entrepreneur to create the first versions of their product. This type of investor usually does not require any entrepreneur to participate in the management of the company, as this will be done by investors who enter the game later. They do not ask for a chair on the board or proper attention (Olah 2017).

Business angels. Entrepreneurs, mostly former, who have enough financial resources and experience and want to pass them on to junior entrepreneurs. They invest in the medium to long term. EBAN, European Business Angels Network, brought the survey of angel investors and their investments in startups in Europe. Investments from business investors increased by 8.7% in 2013 compared to 2012. Not all countries of the European Union are included in the survey, and so the data

are not entirely accurate, only approximate. In 2013, there were 271 000 business angels. United Kingdom is the country with the largest network of business angels, Slovakia was not included in the report. The highest percentage of investment from angels goes to start-ups in the start-up phase, up to 54%, 22% of the investment goes into the seed phase (European Business Angels Network 2019).

Venture capital funds. Venture capital is used for financing the beginning of the company, its development, expansion. Hazardous capital is primarily a partnership between an entrepreneur and an investor. This investment is not a one-off provision of funds but several years process (Slovak business agency (Slovak Business Agency 2018).

Venture capital takes two basic forms - the seed capital funds provide to young people a promising project without sufficient resources. The second form is risk investment. It is used by companies that have already started to implement the project, but lack additional funding. In addition to funding, they also need experts to advise companies (Zaborsky 2001).

Seed financing, which is used to finance prototype development new product financing of market research and processing business plan, management team, business creation. It is the most risky investment, bringing profit after 7 to 12 years, required return on investors is 80 to 100%. Only 1 - 2% of businesses are dedicated to it providing venture capital.

Start-up capital is to finance the start-up of a business or a limited business. It is assumed that there is a product or service management team and the results of market research are known. Production is being prepared and sales are evaluated. An investor can facilitate market entry and shorten the period until a business becomes profitable. The return required by the investor is 35 - 50% (40 - 70%), the payback period is 5 - 10 years. Approximately 5% of venture capital firms are involved.

Initial development financing means that funded is a company that operates only to a limited extent, currently not making a profit. but has the potential to achieve it. the future is expected to develop such an enterprise. It does not receive a bank loan because it has no possibility to guarantee it. Certain predictions Given a more certain prediction of investment results, funding is less risky. The investor requires a return of approximately 30% (30-40%), the expected return is 4 to 7 years.

Bridging (mezzanine) financing is a resource that stands at the interface between equity entry and credit. It is used to temporarily finance acquisitions and other special operations before the transaction is otherwise financed in the long-term (Frenakova 2011).

For startups there are also several different ways to get the necessary financial resources. These may be public resources, for example in the form of grants, subsidies and funds from the state or the European Union. The state sphere represents, for example Slovak business agency, which provides a micro - loan program called Innovation and Technology Fund. The European Union is represented by the JEREMIE Fund, the distribution of which is carried out by private undertakings.

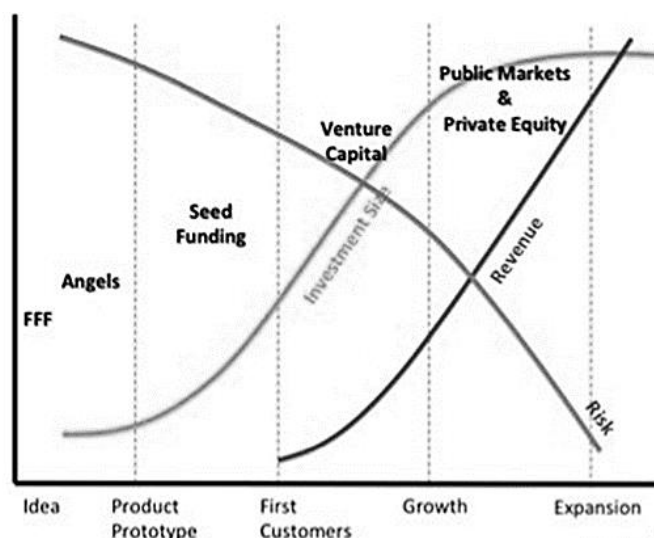


Figure 2. Phases of financing in company's lifecycle (Kiska 2014).

Crowdfunding is one of the alternative forms of funding that connects those who have the money to borrow or invest with those who need the funds to finance a project. Crowdfunding campaigns work on the principle of collecting smaller individual contributions from higher number of people, crowd, mostly through the Internet. Projects are usually aimed at financing relatively smaller targets, but there are exceptions.

#### 4. Conclusion

This paper explains and conceptualizes start-ups by elaborating their lifecycle. General lifecycle includes three main stages, which are bootstrapping stage, seed stage, and creation stage. A lot of authors explain their own phases of lifecycle. In this article we focused on six phases - discovery, validation, effectiveness, scalability, maintenance and sales. Investors are very important for startup because they provide financial possibilities during whole life cycle. The choice of individual financing and possibilities for startup companies depend on the individual company and it is also important to consider at which stage of the life cycle the company is. For the different stages of development, specific opportunities how to obtain funds are preferable. In the future we might elaborate each above-mentioned financing possibility in details and study its usage in different countries. We would like to stress that comparison of financing available in various countries is still missing.

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# Views of Future Travel and Tourism Experts on Social Media in Tourism

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**Abstract:** Social media have become important in a wide range of areas, including tourism. There are several classifications of social media. The main objective of the present paper is to determine the way future experts in the area of travel and tourism assess and use travel-related social media. Specifically, what they like and/or dislike about various features of popular travel-related social network sites, which social network sites are popular among them, what kind of information they usually look for, how active they are in creating user-generated content, what patterns of behaviour they display before, during and after the trip. Respondents were divided into two groups. The first one analysed and assessed travel-related social media or network sites, whereas the second one participated in a questionnaire survey looking into their utilization of travel-related social media. The results suggest that future experts favour travel-related blogs and reviews, travel advice and tips, accommodation and tickets, maps and GPS (Global Positioning System) services.

**Keywords:** social media; social networking; travel; tourism

**JEL Classification:** O330; Z320; Z390

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## 1. Introduction

Social media in tourism is an emerging research topic (Zeng and Gerritsen 2014). Social media in general have been enjoying a dramatic rise in their popularity of late, e.g. Fotis et al. (2012). Some authors, like Kaplan and Haenlein (2010) insist that there is very limited understanding of the term social media and aim to clarify how it differs from the terms Web 2.0 and user-generated content. To them, Web 2.0 represents the ideological and technological foundation, and user-generated content is the sum of ways in which people make use of social media. With this in mind, the definition of social media is as follows: "Social Media is a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User-generated Content." (Kaplan and Haenlein 2010, 61)

Kaplan and Haenlein (2010) make a six-category classification of social media: blogs, social networking sites (for instance, Facebook), virtual social worlds (Second Life), collaborative projects (Wikipedia and social bookmarking apps like Delicious), content communities (YouTube), and virtual game worlds (World of Warcraft). Nonetheless, e.g. Fotis et al. (2012) mention that Kaplan's and Haenlein's social media taxonomy is not the only one and that it neglects certain types of social media such as microblogs or Internet forums. The latter authors propose the following taxonomy: blogs, photo and video sharing websites, microblogs, wikis, social networking sites and travel review sites.

Other authors distinguish between social media and social networking. For instance, Zeng and Gerritsen (2014) maintain that whereas social media are tools or means of communication, social network is the use of these tools. The same authors count among the former, i.e. social media, social networking sites, consumer review sites, content community sites, wikis, Internet forums and location-based social media and add that social media have become an important tool for promoting tourism industry in a lot of countries. Sahin and Sengün (2015) claim that social media users are influenced by other users' comments and draw a conclusion that tourism enterprises should be present at social media sites, create their own official accounts and hire staff to maintain them. Others, like Liburd and Christensen (2013) even strive to integrate social media in tourism education as they believe that discussion forums, blogs and wikis facilitate learning activities.

Boyd and Ellison (2007) describe social networking sites as web-based services allowing individuals to construct a public or semi-public profile within a bounded system; articulate a list of other users with whom they share a connection; and view their list of connections. The rise of social media and social networking coincide with the advent of Web 2.0 (e.g., Liburd and Christensen 2013; Ali and Frew 2013), which enables almost unlimited sharing and accessing information in the form of texts, pictures and video recordings. As Jansson (2018) states, social media make it possible to instantly follow, share, rate and discuss various content. There is a wide range of social networks. For instance, (White 2012) suggests that there are seven main types of social networks, i.e. social connections, multimedia sharing, professional, informational, educational, hobbies and academic. In the field of tourism, Werthner and Ricci (2004) emphasize that whereas other industries remain traditional, the travel and tourism industry has embraced e-commerce and online transactions in this area are continuously increasing. Sahin and Sengün (2015) advise that the tourism sector should utilize social media and their development in marketing and point out that potential tourists usually search the Internet for travel information in order to make their travel plans. The same authors add that tourists' decisions are strongly affected by other users' comments on social media, in particular those who travel to a destination for the first time. Fotis et al. (2012) emphasize the impact of social media on holiday travel planning and discuss how it works before, during and after the trip. They contend that social media are used in particular after holidays for experience sharing and add that user-generated content is perceived as more trustworthy than official travel information. Sahin and Sengün (2015) as well as Kiráľová and Pavlíček (2015) claim that social media have also become significant in developing destination marketing and communication strategies. Moreover, tourists and travellers, particularly young adults, often search for and use social networking sites when planning their holidays and travels (Lange-Faria and Elliot 2012). Travel information search is dominated by Facebook and Twitter, which are not primarily travel-related social networking sites. Nevertheless, our experience with teaching students of Management of Travel and Tourism at Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic, shows that future travel and tourism experts are aware of the fact that there are platforms specialized in this area and they use a variety of websites in their search for relevant travel information.

There are a lot of authors who assess various Web 2.0 sites, often travel-related ones. For example, Ali and Frew (2013) made a list of the most widely used Web 2.0 sites. Its leaders Facebook and YouTube (with 800 million users each) are trailed by Qzone (480 million), followed by Twitter (300 million), next comes Renden (160 million), then there is a business-oriented site LinkedIn (120 million), followed by V Kontakte, or VK (111 million), which is an equivalent to Facebook in post-Soviet countries. The above-mentioned list (Ali and Frew, 2013) includes several social networking sites specialized in travel and tourism. Among others, WAYN (10 million), Couchsurfing (2.9 million), Travelbuddy (1.6 million), and Travellerspoint (0.3 million). Another ranking makes a list of the top five travel and tourism sites (The Five Best Social Networking Sites for Travel, 2018), namely Facebook, Twitter, WAYN, Airbnb.com and TripAdvisor. (Sahin and Sengün 2015) declare that as of 2014 the most popular social media sites were Facebook, Twitter, Instagram, YouTube, and LinkedIn. They also provide a ranking of the top ten social media platforms based on the statistics of active users: "Facebook (1.184 billion), QQ (Tencent) (816 million), Qzone (632 million), WhatsApp (400 million), Google+ (300 million), WeChat (272 million), LinkedIn (259 million), Twitter (232 million), Tumblr (230 million), Tencent Weibo (220 million)" (Sahin and Sengün 2015, 776). Jansson (2018) counts among mainstream platforms used also for tourism purposes Facebook, Flickr and Instagram, whereas Fotis et al. (2012) mention TripAdvisor as the leader among travel-related consumer review sites.

Apple tree communications (2019) found out that the overall most popular platform among tourists is Facebook but there is an interesting category, namely influencers, where the most popular platform for tourists is Instagram with visually attractive feeds. Instagram users are usually young people, which partly explains why this platform is becoming remarkably successful.

The aim of the present paper is to show the way social network sites are used by future travel and tourism experts, which social network sites are popular among them, what kind of information they usually look for, and how active they are in creating user-generated content. It also suggests some patterns of their behaviour before, during and after the trip.

## 2. Methodology

There were two parts of research. In the first one, a group of 40 Management of Travel and Tourism students was to write a seminar paper on a selected travel-related social network site. This was meant as a qualitative pilot research, which aimed at finding and assessing the existing options for those who want to gather travel-related information from social network sites. The list of the sites was based on the aforementioned rankings in expert literature.

The other part of research aimed at finding out how another group of 62 Management of Travel and Tourism students use the Internet, in particular travel-related social network sites, for traveling purposes.

Of course, the number of respondents is limited by the number of students of Management of Travel and Tourism at Faculty of Informatics and Management. On the other hand, both groups of respondents are tourism experts-to-be and, at the same time, they belong to the generation using the Internet from an early age.

In the first part of research, forty Students of Management of Travel and Tourism at the Faculty of Informatics and Management, University of Hradec Kralove analysed and assessed social network sites with an emphasis on their travel-related content. The qualitative analysis approach was employed. The main objective was to find out what various popular travel-related platforms have to offer and how they do it.

The instructions were as follows. Forty respondents were asked to select a social network site from a list prepared by their teacher who based it on expert literature. Each respondent was to analyse and assess only one platform. As the respondents attended two different study groups, they presented their findings in front of about half of the other respondents. The assignment was to describe the selected social network site in the following way. First, the respondents selected the site from the list provided by the teacher. Then, they were to describe the homepage in detail and find out whether or not there are any cross-references to other similar sites. Another task was to list features like photo-sharing, communication with other users, etc., that the site offers to its users. They also were to determine what information filters, if any, the site uses, and list what kind of user-generated content there is, i.e., text, pictures, other. There was a subjective part as well, namely, whether or not the site is user-friendly. The respondents were also asked to contact a representative of the site and ask them for further information about the number of users and the mission of the platform, and other more detailed information. Last but not least, the respondents were to make a SWOT analysis of the site, and assess it. Furthermore, the respondents were asked to make a list of platforms they personally use. Last but not least, they were to summarize what they had found out and present it in class.

On completing the first part of research, the attention moved to the actual ways in which future travel and tourism experts use various platforms. The second part of research was quantitative. Sixty-two respondents answered six open questions in a questionnaire aiming at determining the ways they use the Internet in connection with traveling; what they consider the most valuable travel-related content; their utilization of the Internet before, during and after the trip; and what social network sites they see as most helpful. The respondents could provide more than one answer to all questions.

## 3. Results

### 3.1. Analysis and assessment of travel-related platforms

The first part of research was the qualitative pilot research analysing and assessing travel-related social media or network sites. It brought the following results. In general, most of the assessed platforms provide similar services. Namely, they offer reviews, advice, accommodation, tickets, and more. The content is often user-generated and some of the platforms declare that travellers are the best source of information, which is the credo of World66 (<http://www.world66.com/>). This part of research aimed at making an overview of options that travellers have on travel-related platforms and to make future experts in tourism aware of their potential.

The respondents first presented the way that individual platforms look like and work. Later, all students in class discussed the presented site. These debates resulted in determining the most interesting

platforms from the point of view of students of Management of Travel and Tourism. Their favourites are Foursquare, TripAdvisor, and Wikitravel.

Of course, the best way to find out more about platforms is to use them on one's own. On the other hand, it is useful to mention some basic features of the most highly esteemed platforms. Basically, Foursquare and TripAdvisor provide their users with information about places and activities in a selected destination. The Foursquare user can save their favourite places, find other interesting ones, and plan their trips. The user's list of places can be shared with other users. Trip Advisor enables their users to be either active or passive. Both platforms enable their users to write reviews and share photographs. Wikitravel provides its users with information about destinations, flight tickets, accommodation as well as tickets to enter local attractions.

In general, platforms providing information about destinations were viewed positively, whereas platforms like Couchsurfing or Stay4free generate clearly differing opinions. Some students find such platforms extremely useful as they help them save money, others are aware and afraid of potential dangers. The feedback from the respondents suggests, however, that Couchsurfing belongs to the most popular platforms.

The respondents also listed travel-related social network sites and other similar platforms they use most frequently. They could name more than one site. As Tab. 1 shows, the most frequently used platform is, rather unsurprisingly, Facebook. It is followed by TripAdvisor, Instagram, Couchsurfing, Booking.com, and Airbnb. Other ones mentioned by more than one student include Twitter, Google Maps, YouTube, Foursquare, Pinterest, and hostelworld. Even though some of the above-mentioned platforms may not necessarily be considered proper travel-related social network sites, they all provide some kind of travel information and are therefore relevant.

**Table 1.** Popularity of travel-related social network sites among the respondents.

<b>The respondents' favourite travel-related sites (N=40)</b>		<b>%</b>
Facebook	15	37.5
TripAdvisor	9	22.5
Instagram	7	17.5
Couchsurfing	6	15
Booking.com	5	12.5
Airbnb	4	10

It is interesting to compare these results with the figures for the world as well as the Czech Republic. According to Vincosblog (2018), as of January 2018, the most popular platform in the Americas, Africa, Europe, and India was Facebook, whereas in Russia it was VKontakte and the Chinese preferred QZone. The map of runner-ups is more varied. It features Instagram (parts of South America, India, parts of Europe), Odnoklassniki (Russia), Twitter (the U.S., France, Spain, Argentina, South Africa), or Reddit (Canada, Australia).

The figures for the Czech Republic as of April 2017 were published by Lorenc (2017). He maintains that the most widely used social network is Facebook, followed by YouTube, which is expected to surpass Facebook sooner or later. Then comes Instagram, the most progressive platform, which introduced new functions, including Insta Stories, and have gained most new users recently. The fourth place is occupied by LinkedIn and Twitter and Snapchat share the fifth place.

### *3.2. Future travel experts' utilization of travel-related platforms*

The second part of research was meant to determine actual practices that future travel and tourism experts employ before, during, and after their trips. It also looked into the type of content that is of interest to them, as well as most frequently used and visited websites with travel-related content.

Tab. 2 shows that the respondents tend to browse the Internet for travel-related purposes particularly when booking their holidays – e.g. flight tickets and accommodation, then when looking for travel tips, searching for travel information and maps of places they plan to visit.

**Table 2.** How do you personally use the Internet in connection with traveling?

Way of using the Internet (N=62)		%
Bookings (flight tickets/accommodation)	40	64.5
Travel tips/search for destination	25	40.3
Search for information	21	33.8
Maps	12	19.4
Advice/tips/reviews	9	14.5
Prices	9	14.5
Timetables	8	12.9

Tab. 3 indicates that future travel and tourism experts really appreciate authentic travel information provided by other travellers in travel blogs and reviews of various places and facilities.

**Table 3.** What kind of travel-related content do you personally consider the most valuable and why?

Useful travel-related content (N=62)		%
Travel blogs and reviews	21	33.8
Maps	6	9.7
Bookings	6	9.7
Destination information	5	8
YouTube videos	3	4.8

As seen in Tab. 4, a lot of respondents search the Internet before they set out for a trip. Most of them look for and book suitable accommodation and transport tickets and search for travel information or plan the trip. Only a small fragment of respondents does not utilize the Internet before they start their journey.

**Table 4.** Do you use the Internet before the trip? If so, in what way(s)?

Internet utilization before the trip (N=62)		%
Search for accommodation	32	51.6
Research/destination information	26	41.9
Flight/other transport tickets	20	32.2
Planning the trip	17	27.4
Timetables	9	14.5
NO	2	3.2

Tab. 5 demonstrates that during the trip the respondents want to know their way around the destination. Therefore, both maps and GPS information are often searched for. Next comes information needed in order to plan one's travel activities in more detail, in particular, on where to eat or drink, what to visit and see, how to get there by public transport, and what weather to expect.

**Table 5.** Do you use the Internet during the trip? If so, in what way(s)?

Internet utilization during the trip (N=62)		%
Maps/GPS	35	56.4
Search for restaurants/cafés	13	21
Travel tips/advice	13	21
Public transport timetables	11	17.7
Weather forecast	10	16.1
Connect with family/friends	4	6.5
Dictionary	4	6.5
NO	1	1.6

Tab. 6 illustrates whether and in what way(s) the Internet is used on coming back home. Most respondents admit they write reviews and recommendations and share their experience and pictures on the Internet, which justifies their responses to question two (see Tab. 2), where they acknowledge the importance of authentic travel information. Nevertheless, a considerable number of them do not use the Internet after the trip (in connection with it) at all.

**Table 6.** Do you use the Internet after the trip? If so, in what way(s)?

<b>Internet utilization after the trip (N=62)</b>		<b>%</b>
Post reviews/recommendations/share experience	28	45.1
Post/share pictures	17	27.4
NO	17	27.4

From Tab. 7 we can see that the most widely used social network sites among this group of respondents are Instagram, TripAdvisor and Facebook, which correlates with the results generated from the first part of research, where the top three social network sites are the same, only in the reverse order.

**Table 7.** What social network sites do you find most helpful and why?

<b>Useful social network sites (N=62)</b>		<b>%</b>
Instagram	20	32.3
TripAdvisor	19	30.6
Facebook	17	27.4
Google chrome/Google maps	11	17.7
Airbnb.com	6	9.7
YouTube	6	9.7
Booking.com	5	8.1

#### 4. Discussion

Prior studies on the utilization of social network sites in the tourism industry have shown the increasing importance of social media, e.g. Fotis et al. (2012) and well as their success in the tourism industry, e.g. Sahin and Sengün (2015). Nevertheless, these studies have not asked about the user-friendliness of social media. Moreover, the present study looks into the way tourism experts-to-be who study Management of Travel and Tourism at the Faculty of Informatics and Management utilise travel-related social network sites. Although the results were in concord with our expectations, it should be born in mind that this study is limited to certain extent by the fact that the research sample was not very large, forty and sixty-two respondents, respectively.

#### 5. Conclusions

The respondents use social media on everyday basis, most frequently Facebook, TripAdvisor and Instagram but they are also aware of advantages offered by platforms like Booking.com and appreciate other sites, like Foursquare or Wikitravel. The most divisive kind of platforms include Couchsurfing and Airbnb as there are those who like to use them as frequently as possible whereas other ones are too scared to get involved at all. Social media and network sites are currently offering in particular reviews, advice, accommodation, tickets and respondents like to use them to make bookings, look for travel tips, read travel blogs and reviews, search for accommodation and other travel-related information, including the use of maps and GPS services. This knowledge opens space for further improvements as well as finding other ways of social media and social network sites utilization for travel-related purposes. The present study thus shows the utilization of travel-related social network sites among young people from the Czech Republic who at the same time study Management of Travel and Tourism and are expected to pursue a career in the tourism industry. It seems that young Czech students are fully aware of the potential hidden in social media utilization in travel-related business

and other activities, in particular for booking and planning as well as getting up-to-date information. This can be seen as a sign of further development of social media in the field of travel and tourism. Moreover, there can be seen a potentially wide range of opportunities for Management of Travel and Tourism students at the faculty focusing on ICT (Information and Communication Technologies) education, including developing ways for social media utilization in their future tourism-oriented career.

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# Structure of Clients in Residential Social Services for the Elderly: A Regional Analysis

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**Abstract:** The Czech population is aging and, therefore, the demand for long-term care services for the elderly is increasing. This paper deals with the regional structure of clients of residential social services for the elderly concerning their degree of dependence. The study focuses on clients in retirement homes and special regime homes and analyses data obtained from the Ministry of Labour and Social Affairs. Specifically, it compares the regional structure of clients in 2013 and 2017 using descriptive statistics. The structure of clients has changed. In particular, the proportion of clients with the two highest levels (severe and complete) of dependence has increased. Moreover, the number of unsatisfied applicants for special regime homes has also grown. The current system of social care services seems to be unsustainable in the long term. The paper thus seeks to contribute to the discussion of the necessary capacities of care facilities and draws attention to differences in the regions.

**Keywords:** social services, retirement homes, special regime homes, seniors, dependence level

**JEL Classification:** H55; J14; R58

## 1. Introduction

Czech demographic curve shows a significant increase in the share of the population in the age group of 65 years and over (65+) as well as a decrease in the working population (Křesťanová 2018). The ratio of seniors 65+ to a hundred persons of working age 20–64 (so-called dependency ratio) is constantly increasing. This value was 23.5 in 2010, and the prediction for 2050 is 55.2. The indicators in Table 1, including the dependency ratio, very strongly demonstrate the aging of the Czech population and the topicality of the issue of health and social care support for people aged 65+.

**Table 1.** Selected indicators of age composition of the Czech Republic

Indicator	2010	2015	2020	2025	2030	2035	2040	2045	2050
Average age	40.6	41.7	42.5	43.4	44.4	45.2	45.7	46.0	46.2
Percentage of 65+	15.2	17.8	20.0	21.3	22.3	23.2	25.1	27.6	28.6
Dependency ratio	23.5	28.5	33.6	36.9	38.8	40.5	45.0	51.6	55.2

Source: own calculation based on Czech Statistical Office (2011, 2016a) and Czech Statistical Office (2018a) projection, medium variant

As the population ages, the demand for long-term care will increase. Earlier and better diagnosis and medical care increase the odds of survival and extending life expectancy with chronic illness or disability (Colombo et al. 2011). This also results in an increasing need for long-term care. The aging population will thus reduce the availability of potential informal and formal caregivers (Wija 2012). Moreover, the Czech Republic is one of the countries of the European Union with a lower share of employed in the health and social services sector as a percentage of all employed persons (Schulz 2013).

The Czech Republic is already characterized by a lower level of availability and supply of formal care services provided at home and low involvement of the business sector in the provision of social services (Lux and Pfeiferová 2012, Marková and Komárková 2017). The choices of care for the elderly in the Czech Republic are limited (Nešporová et al. 2008). Therefore, the family is placed in a dilemma



between using care with very limited public services or institutional care (Svobodová 2006). Demand for formal care far exceeds supply (Bernášková and Ďurďa 2016; Langhamrová et al. 2018). Moreover, Kraftová (2013) concludes that the capacity distribution of social care services in the Czech Republic is not uniform among regions, even after considering the size of these regions. Therefore, it is necessary to focus on the interconnection and functionality of the long-term care system.

## 2. Czech Support System for Long-Term Elderly Care

The system of support for long-term home care in the Czech Republic consists of three basic pillars: 1/ family care, 2/ outpatient and field social services, and 3/ residential facilities. The residential social care services on long-term care for the elderly with reduced self-sufficiency include: respite care, weekly care centres, retirement homes, special regime homes, social services provided in health care institutions according to Social Services Act No. 108/2006 Coll. Care allowance is provided to clients who are dependent on the help of another person. This allowance is provided from the state budget regardless of the citizen's income and his/her property. Tomeš (2010) points out that the Czech Republic is the only European country that provides these care allowances only in monetary form.

There are four categories of addiction according to the degree of health damage and social constraints, namely *I. mild*, *II. moderate*, *III. severe* and *IV. complete dependence*. People with the level of dependence III or IV usually need full day care in residential social care facilities. The average monthly number of these care allowances in 2017 is shown in Table 2. There were about 353 thousand care allowance recipients in the Czech Republic. The largest number of the recipients is in the Moravskoslezský (MSK) Region, while the smallest one is in the Karlovarský (KVK) Region. Total expenditures on care allowances amounted to CZK 25.1 billion in 2017 (Czech Statistical Office 2018c).

Based on the level of dependency and age of the applicant (two age categories: up to 18 years and over 18 years), the financial range of the contribution varies between CZK 880 and CZK 19,200 per month. The amount of these contributions was last modified on 1 July 2019. This contribution is a significant source of financial income for clients and is intended to cover the costs associated with the residential service. Moreover, Průša (2018ab) predicts that the number of care allowances can be expected between 469 and 489 thousand in 2030 and between 632 and 734 thousand in 2050.

**Table 2.** Average monthly number of care allowances in thousands in 2017, also relatively for the level of dependence in individual regions

NUTS 3 region	Abbreviation	Total	I	II	III	IV
Praha	PHA	30.1	9.8 (32.5%)	10.7 (35.4%)	6.5 (21.7%)	3.1 (10.4%)
Středočeský	STC	37.3	11.6 (31.1%)	12.3 (33.1%)	8.4 (22.7%)	4.9 (13.1%)
Královéhradecký	HKK	19.5	6.1 (31.2%)	6.4 (32.7%)	4.5 (22.9%)	2.6 (13.2%)
Pardubický	PAK	19.5	5.4 (27.8%)	6.5 (33.2%)	4.9 (25.2%)	2.7 (13.9%)
Vysočina	VYS	18.6	5.2 (28.1%)	5.8 (31.4%)	4.6 (24.8%)	2.9 (15.7%)
Jihočeský	JHC	21.8	6.4 (29.4%)	6.9 (31.9%)	5.3 (24.5%)	3.1 (14.1%)
Plzeňský	PLK	19.5	5.2 (26.8%)	6.6 (33.7%)	4.8 (24.7%)	2.9 (14.9%)
Karlovarský	KVK	9.2	2.8 (30.9%)	2.9 (31.5%)	2.2 (24.1%)	1.2 (13.6%)
Ústecký	ULK	30.4	9.4 (31.0%)	10.6 (35.0%)	6.8 (22.3%)	3.6 (11.8%)
Liberecký	LBK	15.3	4.7 (30.9%)	5.0 (32.7%)	3.7 (24.1%)	1.9 (12.3%)
Jihomoravský	JHM	42.7	12.1 (28.4%)	13.9 (32.5%)	10.5 (24.5%)	6.2 (14.5%)
Olomoucký	OLK	23.1	7.4 (32.1%)	7.1 (30.9%)	5.2 (22.7%)	3.3 (14.3%)
Zlínský	ZLK	22.8	6.4 (28.2%)	7.0 (30.7%)	5.5 (24.3%)	3.9 (17.0%)
Moravskoslezský	MSK	43.2	12.4 (28.7%)	13.8 (31.9%)	10.1 (23.5%)	6.8 (15.7%)
<b>Czech Republic</b>	<b>CZE</b>	<b>352.9</b>	<b>105.1 (29.8%)</b>	<b>115.5 (32.7%)</b>	<b>83.2 (23.6%)</b>	<b>49.1 (13.9%)</b>

Source: own processing based on the Czech Statistical Office (2018c) data

Interesting data monitored by the Ministry of Labour and Social Affairs and presented by the Czech Statistical Office in its annual overviews are the percentages of clients in residential social service facilities with a severe mobility restriction, see Table 3.

**Table 3.** Percentages of clients in residential social service facilities with serious mobility restrictions during 2015 - 2018

Social service	Permanently bedridden				Mobile with help			
	2015	2016	2017	2018	2015	2016	2017	2018
Retirement homes	25.3	25.9	25.6	26.1	52.4	52.5	53.6	52.3
Special regime homes	24.0	24.5	24.9	24.0	42.6	42.5	42.2	42.8
Weekly care centres	2.7	2.3	1.9	2.5	20.3	15.8	17.8	29.3

Source: Czech Statistical Office (2016b, 2017, 2018c, 2019)

Percentages in Table 3 show a relatively significant share by clients who are permanently bedridden (immobile) in the case of retirement homes. The proportion of these clients increased slightly from 25.3% in 2015 to 26.1% in 2018. Moreover, there was over 50% of clients who were mobile only with the help of another person or with using some technical aids. We can see a similar situation for special regime homes in the case of immobile clients. The percentage ranged from 24.0% to 24.9% during 2015–2018. The proportion of clients requiring the help of others or aids in special regime homes was about 42% in the considered four years.

Given the above-mentioned expected trends, the issue of support for people in need of social care is very topical. Czech government considers the current system to be complicated and discusses a fundamental change to the Social Services Act. In the context of this current situation, we ask the following research questions:

*RQ1: What is the regional structure of clients according to the level of dependence in residential services for the elderly?*

*RQ2: How has this structure of clients in residential services changed over time?*

Using a deeper analysis of the structure of clients according to the degree of their dependence, it is then possible to discuss the capacities of care facilities, differences in regions, and possible solutions.

### 3. Methodology

Data on clients of social services being obtained directly from the Ministry of Labour and Social Affairs (hereinafter MoLSA data) were used. We focused on two typical residential social care services for the elderly, namely retirement homes and special regime homes. In particular, clients of special regime homes also include seniors with Alzheimer's disease, or dementia, respectively. Our analysis is based on data from two years, 2013 and 2017. The newer data set was used to answer the research question RQ1, the older one for comparing (RQ2).

Table 4 shows the numbers of residential services (facilities) for the elderly in the Czech Republic for both considered years. The number of facilities was determined based on the number of different service IDs in a given region. The region was determined by where the service provider was registered. Concerning this fact, the data for Prague are overestimated. Despite this, the largest share (about one eighth) of retirement homes was in the Moravskoslezský (MSK) and Středočeský (STC) region for both years. More than 10% of the total number of special regime home services is in five regions (PHA, STC, UST, JHM, and MSK) in 2017.

Concerning the research questions, the number of clients was recalculated with respect to their length of stay in the facility. In particular, recalculated numbers of clients were determined based on client-days, when the client was weighted by one if he/she spent 365 days in the facility. All calculations were performed in R software (R Core Team, 2019). As our analysis is explorative, we used descriptive statistical analysis.

**Table 4.** Numbers (proportions) of retirement homes and special regime homes by region

Region	Retirement		Special regime	
	2013	2017	2013	2017
PHA	52 (10.5%)	62 (11.7%)	20 (8.4%)	46 (14.1%)
STC	68 (13.7%)	75 (14.2%)	31 (13.0%)	49 (15.0%)
HKK	33 (6.6%)	36 (6.8%)	9 (3.8%)	12 (3.7%)
PAK	19 (3.8%)	24 (4.5%)	8 (3.3%)	13 (4.0%)
VYS	24 (4.8%)	23 (4.3%)	15 (6.3%)	18 (5.5%)
JHC	36 (7.2%)	36 (6.8%)	12 (5.0%)	11 (3.4%)
PLK	23 (4.6%)	23 (4.3%)	9 (3.8%)	11 (3.4%)
KVK	15 (3.0%)	18 (3.4%)	7 (2.9%)	8 (2.5%)
ULK	41 (8.2%)	40 (7.6%)	30 (12.6%)	35 (10.7%)
LBK	16 (3.2%)	17 (3.2%)	12 (5.0%)	13 (4.0%)
JHM	41 (8.2%)	42 (7.9%)	32 (13.4%)	37 (11.3%)
OLK	34 (6.8%)	35 (6.6%)	11 (4.6%)	16 (4.9%)
ZLK	31 (6.2%)	31 (5.9%)	15 (6.3%)	19 (5.8%)
MSK	64 (12.9%)	67 (12.7%)	28 (11.7%)	38 (11.7%)
<b>CZE</b>	<b>497 (100%)</b>	<b>529 (100%)</b>	<b>239 (100%)</b>	<b>326 (100%)</b>

Source: own calculation based on the MoLSA data

#### 4. Results

In retirement homes, there were 36,477 “full-year” clients in 2013, and 35,165 “full-year” clients in 2017, see Table 5. The percentages of clients according to the level of their dependence was related to the regional (recalculated) numbers of clients.

In 2017, the largest group of clients (30.1%) in retirement homes had a dependency degree at level III. However, this was not entirely true for individual regions. For example, in the MSK region, there was level IV, and the ULK region, level II was slightly more prevalent. There were eight regions (HKK, PAK, VYS, JHC, KVK, LBK, JHM, ZLK) above the national percentage for level III in 2017. Moreover, three regions, namely HKK, ZLK, and MSK, had more than 30% of level IV clients in retirement homes.

**Table 5.** Recalculated numbers of clients in retirement homes by the region and their percentage by the degree of their dependence within the region for years 2013 and 2017

Region	Total number		I		II		III		IV		Non-spezif.	
	2013	2017	2013	2017	2013	2017	2013	2017	2013	2017	2013	2017
PHA	3,334.8	3,416.2	19.9	18.0	26.1	25.9	22.7	27.6	17.4	17.7	13.9	10.9
STC	4,778.3	4,792.1	21.5	16.6	25.3	24.5	21.6	27.0	16.2	21.9	15.4	10.0
HKK	2,146.4	2,039.8	14.8	8.7	23.7	20.0	29.5	35.0	27.5	32.9	4.5	3.5
PAK	1,983.6	1,952.2	19.0	13.1	25.9	24.2	26.9	32.2	21.1	25.8	7.1	4.7
VYS	2,052.9	1,958.9	18.3	12.5	22.5	22.4	26.1	31.4	24.9	28.6	8.3	5.1
JHC	2,794.6	2,777.7	14.8	12.1	24.6	22.4	28.6	32.5	24.8	29.4	7.1	3.5
PLK	1,756.2	1,639.3	14.0	12.1	24.8	23.1	26.8	30.1	19.2	27.5	15.3	7.2
KVK	758.0	777.4	11.7	10.7	22.5	20.0	30.4	31.5	19.6	24.2	15.8	13.6
ULK	3,549.5	3,203.8	19.8	20.4	24.1	23.8	19.6	23.5	13.4	15.5	23.2	16.8
LBK	978.0	873.7	15.3	7.3	25.0	23.3	31.5	39.5	24.6	27.1	3.6	2.8
JHM	2,784.1	2,521.7	18.5	12.2	27.1	27.1	26.0	35.4	16.8	19.9	11.7	5.4
OLK	2,464.7	2,519.2	19.9	15.6	24.3	22.0	24.6	29.5	22.3	25.4	9.0	7.4
ZLK	2,583.3	2,235.1	17.2	12.0	23.2	20.5	24.2	32.1	25.1	30.1	10.3	5.3
MSK	4,513.0	4,458.0	13.6	11.8	20.5	20.0	25.4	29.4	30.4	32.6	10.1	6.2
<b>CZE</b>	<b>36,477.4</b>	<b>35,165.1</b>	<b>17.6</b>	<b>14.0</b>	<b>24.2</b>	<b>23.0</b>	<b>24.9</b>	<b>30.1</b>	<b>21.4</b>	<b>25.2</b>	<b>11.9</b>	<b>7.7</b>

Source: own calculation based on the MoLSA data

Comparing percentages for 2013 and 2017, we can see that the structure of clients had changed. The proportion of two higher levels (III, IV) of dependence increased from 46.3% to 55.3% for four years. The highest increase occurred in the ZLK and JHM regions, namely by 12.9 percentage points (pp), or 12.5 pp, respectively. On the other hand, the smallest increase of 5.2 pp occurred in the capital city of Prague.

In special regime homes, there were 17,160 clients in 2017, see Table 6. However, there was the largest group of clients with a dependence degree at level IV (41.8%). In the case of the Vysočina Region, it was even slightly above 50%. The proportion of higher levels (III, IV) of dependence increased from 63.1% in 2013 to 70.8% in 2017.

**Table 6.** Recalculated numbers of clients in special regime homes by the region and their percentage by the degree of their dependence within the region for years 2013 and 2017

Region	Total number		I		II		III		IV		Non-spezif.	
	2013	2017	2013	2017	2013	2017	2013	2017	2013	2017	2013	2017
PHA	861.1	1950.7	10.0	6.7	21.0	17.3	27.6	27.9	27.1	36.0	14.2	12.2
STC	1,196.7	2726.5	6.1	7.9	19.8	18.0	30.9	31.6	38.0	38.4	5.3	4.0
HKK	412.8	536.0	9.3	5.3	20.0	16.4	27.2	31.8	36.9	43.4	6.6	3.0
PAK	487.4	756.5	11.4	6.9	15.7	14.4	25.5	28.9	40.5	45.8	6.9	4.0
VYS	498.0	662.2	9.0	6.1	23.0	15.0	28.7	26.9	37.4	50.9	1.9	1.0
JHC	409.3	412.8	9.4	10.0	27.5	24.3	26.1	23.6	34.5	41.4	2.5	0.6
PLK	695.9	908.9	10.9	7.1	20.8	21.6	28.7	29.9	34.5	39.1	5.0	2.3
KVK	315.5	355.8	4.7	5.1	18.3	16.6	36.6	35.3	37.3	42.3	3.1	0.6
ULK	1,474.9	1,966.0	12.4	11.2	28.2	24.7	27.8	26.9	26.0	33.1	5.6	4.2
LBK	351.3	646.6	5.6	3.7	21.9	12.8	33.4	35.2	36.3	46.3	2.9	2.1
JHM	2,189.3	3,048.9	10.5	6.2	20.4	14.8	30.3	31.2	33.2	46.2	5.7	1.6
OLK	444.7	743.2	10.5	6.1	20.4	17.7	25.7	27.7	41.9	47.5	1.5	1.1
ZLK	585.5	867.6	18.4	11.4	16.9	18.0	22.0	23.2	36.2	45.4	6.5	2.0
MSK	1,243.5	1,578.4	8.3	7.0	18.8	16.5	23.7	24.6	44.2	46.0	5.0	6.0
<b>CZE</b>	<b>11,166.1</b>	<b>17,160.3</b>	<b>10.0</b>	<b>7.5</b>	<b>21.2</b>	<b>17.7</b>	<b>28.1</b>	<b>29.0</b>	<b>35.0</b>	<b>41.8</b>	<b>5.7</b>	<b>4.0</b>

Source: own calculation based on the MoLSA data

**Table 7.** Recalculated numbers of clients – seniors in the age of 65 and more (65+) in special regime homes by the region and their percentage by the degree of their dependence within the region for years 2013 and 2017

Region	Total number		I		II		III		IV		Non-spezif.	
	2013	2017	2013	2017	2013	2017	2013	2017	2013	2017	2013	2017
PHA	814.3	1,808.5	9.5	6.1	9.5	16.8	28.2	28.3	27.2	36.7	14.5	12.1
STC	1,094.4	2,465.8	5.3	6.8	5.3	16.6	31.6	32.2	40.1	40.3	5.4	4.0
HKK	359.1	472.2	6.4	3.6	6.4	13.2	28.9	32.8	40.5	47.8	6.9	2.6
PAK	422.8	673.5	6.6	4.2	6.6	13.4	28.3	29.9	44.2	49.7	5.2	2.8
VYS	408.1	537.4	6.9	3.5	6.9	10.0	30.2	26.7	42.7	58.8	2.1	1.0
JHC	332.7	315.1	7.8	5.4	7.8	19.4	26.6	24.4	40.2	50.2	2.5	0.6
PLK	590.5	770.9	7.7	5.0	7.7	17.9	29.4	31.4	38.8	43.6	4.2	2.2
KVK	307.6	335.9	4.8	5.0	4.8	16.6	36.5	35.6	37.1	42.2	3.2	0.7
ULK	1,144.4	1,522.2	9.3	7.8	9.3	20.8	30.3	28.3	31.1	39.0	5.3	4.1
LBK	326.3	586.1	4.3	3.6	4.3	11.8	33.8	34.2	38.3	48.5	2.4	1.9
JHM	2,034.2	2,802.4	9.8	5.2	9.8	13.6	31.1	31.7	34.2	47.8	5.6	1.6
OLK	362.2	609.1	7.2	3.9	7.2	15.6	24.8	27.4	49.0	52.2	1.5	1.0
ZLK	471.3	705.7	15.1	6.5	15.1	14.5	24.0	25.5	42.7	51.5	3.8	1.9
MSK	1,057.5	1,315.8	6.4	4.7	6.4	14.5	24.1	24.7	49.4	51.0	4.3	5.1
<b>CZE</b>	<b>9,725.5</b>	<b>14,920.6</b>	<b>8.1</b>	<b>5.6</b>	<b>8.1</b>	<b>15.6</b>	<b>29.2</b>	<b>29.7</b>	<b>38.2</b>	<b>45.2</b>	<b>5.4</b>	<b>3.9</b>

Source: own calculation based on the MoLSA data

Homes with a special regime do not have only seniors among clients; therefore, the summary statistics were conducted separately for clients aged 65+ (Table 7). In 2017, 14,921 (86.9%) clients were at least 65 years old. 45.2% of 65+ clients had a dependence degree at level IV. Moreover, there were five NUTS 3 regions (VYS, JHC, OLK, ZLK, MSK) with more than 50% of such clients. According to these relative figures, the most challenging situation was in the Vysočina region, where almost 59% of clients with age 65+ have the highest level of dependency. The proportion of higher levels (III, IV) of dependence was 74.9% in 2017, in contrast to 67.4% in 2013.

## 5. Discussion

The structure of clients is changing; the proportion of clients with degree III and IV has increased over the last four years. This result is in accordance with the results presented by Průša (2018ab) who focused on the development and structure of recipients of care allowances in the Czech Republic but without regional distinction. The observed change in structure is related to the aging of the population in the Czech Republic when the share of 65+ inhabitants increased by 1.8 pp from 2013 to 2017 (Table 8). However, there are regions with different old population, and this should be taken into account when planning the capacities of the necessary social and health care. For example, in both considered years 2013 and 2017, the Královéhradecký Region belonged to the oldest regions. The share of the population aged 65+ exceeded 20% in 2017. On the other hand, the Středočeský Region was one of the youngest regions in the Czech Republic.

**Table 8.** Average age and percentage of inhabitants with the age of 65+ by region to the end of 2013 and 2017; the percentage of clients (seniors) with the dependence levels III and IV

Region	Czech population characteristics				Percentage of clients with levels III and IV			
	Average age		Percentage of age 65+		Retirement homes		Special regime homes	
	2013	2017	2013	2017	2013	2017	2013	2017
PHA	42.0	41.9	18.1	18.8	40.1	45.3	55.4	65.0
STC	40.6	41.1	16.3	17.9	37.8	48.9	71.7	72.5
HKK	42.0	42.9	18.4	20.7	57.0	67.9	69.4	80.6
PAK	41.5	42.3	17.5	19.5	48.0	58.0	72.5	79.6
VYS	41.6	42.6	17.7	19.7	51.0	60.0	72.9	85.5
JHC	41.6	42.5	17.5	19.6	53.4	61.9	66.8	74.6
PLK	41.9	42.6	17.9	19.6	46.0	57.6	68.2	75.0
KVK	41.5	42.7	16.8	19.4	50.0	55.7	73.6	77.8
ULK	40.9	41.8	16.4	18.8	33.0	39.0	61.4	67.3
LBK	41.1	41.9	17.0	19.5	56.1	66.6	72.1	82.7
JHM	41.7	42.3	17.8	19.4	42.8	55.3	65.3	79.5
OLK	41.7	42.6	17.7	19.8	46.9	54.9	73.8	79.6
ZLK	42.0	42.9	17.8	19.9	49.3	62.2	66.7	77.0
MSK	41.5	42.5	17.0	19.2	55.8	62.0	73.5	75.7
<b>CZE</b>	<b>41.5</b>	<b>42.2</b>	<b>17.4</b>	<b>19.2</b>	<b>46.3</b>	<b>55.3</b>	<b>67.4</b>	<b>74.9</b>

Source: own processing based on the Czech Statistical Office (2014, 2018b) data and the results in Table 5 and 7

Moreover, there is already now an excess of demand over supply of residential social care services in the Czech Republic as various studies (e.g., Bernášková and Ďurďa 2016; Langhamrová et al. 2018) point out. Therefore, Table 9 shows the development of the number of unsatisfied applicants for retirement or special regime home services over the last four years available. Although there is a satisfactory trend for retirement homes in total, the unmet demand for special regime home services has grown. Increasing demand for special regime homes may be related to dementia – another big problem connected with the aging population. The quality of care for this type of residential clients is discussed by Hradcová et al. (2014).

According to Bernášková and Ďurďa (2016), the highest ratio of unsatisfied requests in the total capacity of the facility is for the Prague and the Plzeňský region for both types of facilities, and further for the Jihomoravský Region in the case of retirement homes and the Zlínský Region in the case of

special regime homes. Only subsidies from the state or the founder (municipality, region) amounted to CZK 5.1 billion in 2015 and CZK 8.8 billion in 2018 for the retirement and special regime homes (Czech Statistical Office 2016b, 2019).

Although expenditures on residential social services grow, Horecký and Průša (2019) point out that the current system of financing does not allow for continuous and flexible responses to clients' demand for social services. To meet the demand for placement in retirement homes, Langhamrová et al. (2018) estimated, using input-output analysis based on data from 2013, that this would require an investment of CZK 202.3 billion. However, the resulting impacts of investments vary by region. The greatest impact on the regional economy can be expected in absolute figures in the Jihomoravský region, while in relative terms in the Zlínský Region.

**Table 9.** Number of unsatisfied applications for residential social services during 2015 – 2018

Region	Retirement homes				Special regime homes			
	2015	2016	2017	2018	2015	2016	2017	2018
PHA	6,397	7,267	7,955	7,183	1,419	1,484	1,882	2,345
STC	8,685	8,620	8,748	9,533	1,734	2,243	2,162	2,320
HKK	2,583	2,957	2,821	3,052	505	768	566	710
PAK	1,695	1,677	1,657	1,728	297	398	557	689
VYS	3,353	3,800	3,197	3,515	917	1,337	1,274	1,565
JHC	4,191	4,294	4,192	4,673	600	632	743	1,083
PLK	3,481	3,868	4,647	2,208	1,396	1,624	1,928	1,455
KVK	204	251	455	618	149	186	373	616
ULK	4,163	4,081	4,537	4,906	2,070	2,065	2,527	2,393
LBK	1,165	1,002	900	1,237	400	624	625	775
JHM	11,965	12,556	7,228	5,100	4,670	5,219	4,171	4,026
OLK	3,740	3,558	4,349	4,254	960	1,025	1,268	1,226
ZLK	5,996	5,356	4,613	4,364	1,551	1,544	2,168	2,205
MSK	6,440	6,469	5,714	5,626	2,114	2,185	2,104	2,790
<b>CZE</b>	<b>64,058</b>	<b>65,764</b>	<b>61,013</b>	<b>57,997</b>	<b>18,782</b>	<b>21,334</b>	<b>22,348</b>	<b>24,198</b>

Source: Czech Statistical Office (2016b, 2017, 2018c, 2019)

## 6. Conclusions

Based on the data from the Ministry of Labour and Social Affairs and the Czech Statistical Office, this paper demonstrates the change in the structure of clients in residential social services with regard to their degree of dependence. The share of clients with severe and complete dependence is increasing. This phenomenon increases demands on formal caregivers in these facilities. At the same time, there is an excess demand for residential social services, which is increasing for special regime homes.

The current situation is probably not sustainable in the long term. Expenditures on residential social services grow, and public budgets are limited. Regional governments are thus faced with the challenge of effectively and mainly efficiently extending the capacity of not only residential social services, but also outpatient and field services to support home care. Informal caregivers are an important part of care for the elderly, and their importance will grow because of the limited capacity of formal caregivers. Some studies (e.g., Tóthová et al. 2011) also discuss the advantages and disadvantages of community-based care. Furthermore, it would be desirable to adapt the current system of financing social services. Better conditions for private social services providers than the current ones would also allow for the necessary capacity increase.

A conceptual reform in the area of financing and implementation of social services is currently under discussion. The amendment to the Social Services Act is in the comment procedure. It proposes to change the types of social services, both preventive and care services. In particular, retirement homes and special regime homes should be merged. This proposed change in the categorization of individual types of services aims to make their financing and provision more transparent and simpler.

The limitation of this study is that it focuses only on clients of residential social care services. In the future, therefore, we plan to analyse regional numbers of workers in these services, especially those in direct service care. The aim of the next study should be to discuss the optimal number of clients per one formal caregiver. Furthermore, we plan to focus on particular outpatient and field services.

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# Accounting and Analysis of Biological Asset Transformation Results in Agricultural Companies of the Russian Federation

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**Abstract:** According to IAS 41 "Agriculture" an agricultural company should keep accounting of agricultural products represented by fair value net of sale costs unconditionally. Bio assets should be evaluated by fair value net of sale costs until they are transformed into agricultural products. This article is aimed to suggest a new procedure on analyzing financial results of an agricultural company with regard to bio assets. The suggested procedure can be implemented in the companies splitting accounting of costs into variable and fixed ones and in the companies practicing conventional cost accounting procedures. Integrated agricultural production company "Kolos" was the base for the following research. Recommended procedure of control and analysis of presented indexes evaluates the extent of influence of managerial decision about allocation and utilization of bio assets on return on production investments, output of agricultural products obtained from bio assets. The output is assessed by gross product evaluated by fair value net of sale costs, gross margin, gross profit, labor productivity in plant breeding, animal breeding and in general agricultural activity.

**Keywords:** agricultural products; fair value; operational profit margin; gross profit margin; cost

**JEL Classification:** M11; M41; Q12

## 1. Introduction

Agricultural activity is a complex system of continuous reproduction of streamlined processes of plant breeding and animal breeding. This system also comprises management of plants and animals' biotransformation (bio assets) for manufacturing agricultural products and its sale or utilization for manufacturing additional bio assets.

Bio assets should be evaluated by fair value net of sale costs until they are transformed into agricultural products excluding those cases when fair value can't be defined reliably in initial recognition.

Bio assets have the key role in the agricultural companies. Hie et.al. (2019) noted that accounting of biological assets has significant positive effect on cost of debt capital.

An agricultural company should keep accounting of agricultural products represented by fair value net of sale costs unconditionally. Fair value of harvested agricultural products net of sale costs and change of fair value of bio assets is to be taken into account in calculation of actual financial results of plant and animal biotransformation for the specific accounting period (Alborov 2012). Da Rocha et.al. (2016) in the research suggests the procedure of bio asset accounting which uses an accounting information about groups of assets and combined assets.

As a process of bio asset management, agricultural activity is usually subdivided into the following branches of production corn and grain legume, industrial crops, potato farming, vegetable

farming, fruit farming, vine growing, fodder production, cattle breeding, swine keeping, sheep breeding and goat breeding, poultry breeding, horse breeding, beekeeping, fur breeding, fish farming, rabbit breeding, etc.

Accounting objects in agricultural activity of economic entities are the following bio assets and the products, resulting from biotransformation of these assets, corn and grain legume, industrial crops, vegetables and potato, fruits, admitted as bio assets by a company, fodder crops and others, meat and milk cattle including those which are raised and fattened, pigs and breeding pigs of all ages and piggery, sheep, goats, lambs and goatlings, mature poultry stock and growing birds, reproductive herd of all ages and yield of rabbits and fur animals and other bio assets.

Besides accounting objects might be all kinds of agricultural products cropped or obtained from plant breeding (including fruit crops which were not admitted as bio assets by a company) and animal breeding bio assets, costs of some agricultural activities (wages, social security contributions, material costs, bio costs, depreciation costs, other costs in plant and animal breeding), fair value of bio assets net of sale costs (fair value is calculated at the moment of asset declaration), changes of fair value at the regular accounting date, government subsidies related to the certain asset, which is presented in fair value net of sale costs, free of conditions in that period when it was provided, and financial results of agricultural activity (incomes, expenditures, profits and losses).

Modification of physical characteristics of assets or changes in market prices might cause changes in fair value of bio assets net of sale costs. Calculation of deviations and disclosure of the information about changes caused by physical characteristics (quantity/number) of bio assets and price alteration helps evaluating results of activity for the current period and future prospects especially in case of biotransformation exceeding 1 year. Hence, evaluation and analysis should be done for definite kinds and groups of bio assets with regard to value of recognized financial results (incomes and expenses) from variation of fair value net of sale costs caused by changed physical properties and prices. This information might be also used for bio assets control and efficient utilization (Ostaev 2019).

Biotransformation causes such physical changes as growth, degeneration, production and reproduction and each of them can be observed and evaluated. Each of these changes concerns future economic profits directly. Variation of fair value of bio assets inspired by crop harvesting is also change of physical characteristics viz. quantity. (Kontsevoy 2015). The accounting of bio assets is regulated by the International accounting standard 41 "Agriculture", however, there are some specificities which are not taken into account in the standard. The example of such specificity is a problem in accounting recognition in costs of biological assets which allow the plant to be available for using, but occur when the asset is already in production (Marcolini et. al. 2015). Mikuska et.al.(2017) confirmed that the measurement of biological assets, by fair value methodology, significantly changes the book value of equity, directly influencing the profit or loss of the entity.

This article is aimed to suggest new procedure on analyzing financial results of an agricultural company with regard to bio assets.

## **2. Methodology**

Developing accounting policy, an agricultural company may choose one of three recommended ways of accounting (by fair value) and utilization of accounting information about bio assets and their transformation (including agricultural products):

1. To generate a report on financial results of agricultural activity only;
2. To generate a balance sheet report and report on financial results of agricultural activity;
3. To manage bio resources of a company.

Then annual and interim accounting reports are generated with regard to chosen way of accounting policy in so far as accounting of bio assets and results of their transformation estimated by fair value net of sale costs.

Incomes, expenditures, profit and losses of agricultural activity should be fixed in accounting records when establishing accounting of bio assets and agricultural products by fair value net of sale costs.

Incomes and expenditures, initially generated when admitting bio assets by fair value net of sale costs and changing fair value, are recommended to put into accountings with regard to duration of biotransformation as a part of:

1. Expected (potential) incomes and expenditures over the period when they are generated from bio assets with biotransformation duration more than 1 year;
2. Actual incomes and expenditures over the current period obtained from bio assets with limited biotransformation duration (not more than 1 year).

Incomes and expenditures, generated during initial admitting of agricultural final products (obtained after harvesting) by fair value net of sale costs, are included into actual incomes or expenditures over the accounting period during which they are generated.

Incomes and expenditures, generated during initial admitting of agricultural non-market products (fodders, seeds, organic fertilizers, secondary production of fruit farming) by fair value net of sales, may comprise both expected (potential) incomes and expenditures over the period or actual incomes and expenditures over the period during which they are generated. Company's accounting policy contains one of these two ways of admitting incomes and expenditures. If the first way is implemented, expected (potential) incomes and expenditures should be included into actual incomes and expenditures of the current period with charge off of presented non-market products (fodders, seeds, organic fertilizers, secondary production of fruit farming) in costs of plant and animal breeding.

Government subsidies, related to bio assets estimated by fair value net of sale costs free of conditions, should also be admitted and taken into account as expected (potential) incomes or actual incomes over the current period (depending on biotransformation duration of bio assets to which these subsidies are related), if these subsidies are surely be obtained.

Incomes and expenditures of agricultural activity can be taken into account in the following deposits ("Sales", "Other incomes and expenditures", "Expected (potential) incomes and expenditures") in correspondence with deposits on accounting of consequent bio assets and agricultural products estimated by fair value net of sale costs.

An agricultural company utilizes deposits in accordance with its accounting policy where working plan of deposits is approved.

Profits and losses, taking place during initial admitting of bio assets by fair value net of sale costs or changing of fair value, are taken into account as a part of profits and losses over the period during which they are generated. Profits and losses, taking place during initial admitting of agricultural products by fair value net of sale costs, are taken into account as a part of profits and losses over the period during which they are generated (at the deposit "Profits and losses").

In whole total profit and total loss brought by agricultural activity of a company (biotransformation of bio assets) are defined by comparison of total profit and total loss of agricultural activity.

The analysis is based upon accounting records and internal accounting documents of the integrated agricultural production company "Kolos" for 2018. Examples of calculations were made in accordance with the suggested procedure and on the basis of the accounting records of the integrated agricultural production company "Kolos" in order to evaluate profit of the agricultural company.

Agricultural companies are recommended to control and analyze efficiency indexes of bio asset utilization and production indexes of agricultural products obtained from these assets in order to make managerial decision concerning efficiency of bio asset utilization for sustainable development of the agricultural activity. These indexes are gross margin, operational profit and profit margin from asset biotransformation. Recommended equation for calculation of total gross profit of the agricultural company from asset biotransformation (Gross profit bio) is the following:

$$\text{Gross profit bio} = (\text{Fair value} \pm \text{Change}) - \sum \text{Direct bio cost} \quad (1)$$

where Fair value – Fair value of the whole harvested (obtained) agricultural products (plant breeding and animal breeding products) net of sale costs for accounting period, thou. RUB;

Change – alteration (increase or decrease) of fair value of bio assets net of sale costs as of the end of the accounting period, thou. RUB.;

$\Sigma$ Direct bio cost – an amount of direct (main process) costs for agricultural production and growing bio assets of plant breeding and animal breeding in the specific accounting period, thou. RUB.;

At the same time operational profit bio (operational loss bio) of the whole agricultural activity (from asset biotransformation) is recommended to calculate by the following equation:

$$\text{Operational profit bio} = \text{Gross margin bio} - \Sigma \text{Cost} \quad (2)$$

Where  $\Sigma$ Cost – the amount of direct general and administrative expenses assigned to plant breeding and animal breeding as of the ending date of the specific accounting period, thou. RUB.

Profit margin from asset biotransformation (Profit margin bio) for the whole of the company is recommended to calculate by the following equation:

$$\text{Profit margin bio} = \frac{\text{Operational profit bio}}{\Sigma \text{Direct bio cost} + \Sigma \text{Cost}} \times 100 \quad (3)$$

Such indexes as gross margin and operational profit are recommended to calculate and analyze per unit of bio assets, for instance, per 1 ha of plants and per 1 head/beast.

These indexes can be analyzed in dynamics or compared with planned amounts.

If the company is unable to calculate gross margin and operational profit from the production of agricultural products for the reason of non-use (absence) of subdivision of production expanses of plant breeding and animal breeding into direct and fixed ones in the accounting system of the company, instead the company is recommended to control and analyze gross profit and operational profit of plant breeding and animal breeding separately.

So gross profit from the agricultural production can be calculated by the equation

- for plant breeding:

$$\text{Gross profit bio P} = \text{Fair value P} - \text{Material cost P} - \text{Depreciation P} - \text{Other costs P} \quad (4)$$

- for animal breeding:

$$\text{Gross profit bio A} = \text{Fair value A} - \text{Material cost A} - \text{Depreciation A} - \text{Other costs A} \quad (5)$$

where Gross profit bio P and Gross profit bio A – gross profit from plant breeding and animal breeding consequently, thou. RUB.;

Fair value P and Fair value A – gross product of plant breeding and animal breeding consequently, evaluated in fair value net of sale costs;

Material cost P and Material cost A – material costs of plant breeding and animal breeding consequently, thou. RUB.;

Depreciation P, Depreciation A and Other costs P, Other costs A - depreciation and other costs in plant breeding and animal breeding consequently, thou. RUB.

In this case operation profit from agricultural production is calculated by the equation:

- for plant breeding:

$$\text{Operation profit bio P} = \text{Gross profit bio P} - \text{Salary cost P} \quad (6)$$

- for animal breeding:

$$\text{Operation profit bio A} = \text{Gross profit bio A} - \text{Salary cost A} \quad (7)$$

where Operation profit P and Operation profit A – operation profit in plant breeding and animal breeding consequently, thousands. RUB.;

Salary cost P and Salary cost A – salary costs including social payments in plant breeding and animal breeding consequently, thousands. RUB;

Abovementioned indexes for specific agricultural plants (groups of plants) and animals (groups of animals) should be calculated in accordance with the data from specific accounting records of the agricultural companies.

### 3. Results

The company is recommended to refer to the chain substitution method (Table 1) in the explanatory note to the accounting (financial) statements in order to evaluate, analyze and disclose the information about changes of fair value net of sale costs.

**Table 1.** Main indexes of bio asset fair value of the integrated agricultural production company "Kolos" for 2018, thousands RUB.

Types and groups of bio assets	Unit	Quantity		Fair value per unit, thou. RUB		Total fair value, thou. RUB	
		2017	2018	2017	2018	2017	2018
		1	2	3	4	5	6
A herd of milk cows	head	840	860	34.54	39.19	29,012	33,693
Fatteners (Cattle)	head	518	509	16.46	15.33	8,526	7,805
Rearers (heifers)	head	212	163	45.38	50.73	9,621	8,269
<b>TOTAL</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>47,159</b>	<b>49,767</b>

Fair value net of sale costs of bio assets has grown on 2,608 thousand. RUB by the end of the accounting period according to the Table 1 and the Table 2. This amount is obtained by variation of fair value net of sale costs due to growth of this value per 1 unit of assets and decrease of quantity of bio assets in the company.

**Table 2.** Evaluation and analysis of fair value variation of the integrated agricultural production company "Kolos" for 2018, thousands RUB.

Types and groups of bio assets	With regard to fair value per unit in 2017 and the quantity of the assets in 2018, thou. RUB	Fair value variation (+, -), thousands RUB		
		Total	Including deviations of	
			Fair value per unit	Quantity of bio assets
	9 = column 4 × column 5	10 = column 8 – column 7	11 = column 8 – column 9	12 = column 9 – column 7
A herd of milk cows	29,703	+4,681	+3,990	+691
Fatteners (Cattle)	8,378	-721	-573	-148
Rearers (heifers)	7,397	-1,352	+872	-2,224
<b>TOTAL</b>	<b>45,478</b>	<b>+2,608</b>	<b>+4,289</b>	<b>-1,681</b>

The following changes of fair value net of sale costs occurred by types and groups of bio assets separately: a herd of milk cows – increase of fair value on 4,681 thousand RUB including one happened due to both deviation of fair value per one cow and deviation of the number of cows in the herd by the end of the accounting period; fatteners (cattle) – decrease of fair value on 721 thousand RUB including one happened due to both deviation of fair value per 1 head/beast of fatteners and decrease of the number of fatteners; rearers (heifers) - decrease of fair value on 1,352 thousand RUB including increase of fair value per 1 head/beast of rearers (heifers) and decrease of fair value because of reduced number of heifers by the end of the accounting period.

Evaluation and accounting of bio assets and agricultural products by fair value is incomplete without settlement of control and analytical aspects of the agricultural activity control.

The calculation of profitability indexes using formulae 1, 2, 3 based on the information from the integrated agricultural production company "Kolos" for 2018 is presented below. Fair value of total harvested products was 8,320 thousand RUB, change (increase) of fair value for the accounting period was 2,608 thousand RUB,  $\Sigma$ Direct bio cost for agricultural production and growing of bio assets of plant breeding and animal breeding was 6,536 thousand RUB,  $\Sigma$ Cost as of the end of the accounting period was 1,758 thousand RUB. The following indexes are calculated according to the abovementioned values:

- Gross profit from biotransformation of assets:  
 $Gross\ profit\ bio = 8,320 + 2,608 - 6,536 = 4,392$  thousand RUB;
- Operation profit from biotransformation of assets:  
 $Operation\ profit\ bio = 4,392 - 1,758 = 2,634$  thousand RUB;
- Profit margin from biotransformation of assets:  
 $Profit\ margin\ bio = 2,634 : (6,536 + 1,758) \times 100 = 31,75\%$ .

An example of calculation of profitability indexes of plant breeding and animal breeding without subdivision of costs into direct and fixed ones using formula 4, 5, 6, 7 is presented below.

Gross product of plant breeding evaluated by fair value (Fair value P) – 3,523 thousand RUB, Gross product of animal breeding evaluated by fair value (Fair value A) – 4,506 thousand RUB, material costs in plant breeding (Material cost P) – 2,287 thousand RUB, material costs in animal breeding (Material cost A) – 3,049 thousand RUB, depreciation in plant breeding (Depreciation P) – 225 thousand RUB, depreciation in animal breeding (Depreciation A) – 295 thousand RUB, other costs in plant breeding (Other costs P) – 104 thousand RUB, other costs in animal breeding (Other costs A) – 115 thousand RUB, salary costs including social payments in plant breeding (Salary cost P) – 803 thousand RUB, salary costs including social payments in animal breeding (Salary cost A) – 958 thousand RUB. The following indexes are calculated according to the abovementioned values:

- Gross profit for animal breeding and plant breeding:  
 $Gross\ profit\ bio\ P = 3,523 - 2,287 - 225 - 104 = 907$  thousand RUB;  
 $Gross\ profit\ bio\ A = 4,506 - 3,049 - 295 - 115 = 1,047$  thousand RUB;
- Operation profit for animal breeding and plant breeding:  
 $Operation\ profit\ bio\ P = 907 - 803 = 104$  thousand RUB;  
 $Operation\ profit\ bio\ A = 1,047 - 958 = 89$  thousand RUB.

Recommended procedure of control and analysis of presented indexes provides a possibility to evaluate the extent of influence of managerial decision concerning allocation and utilization of bio assets on returns on production costs, obtained results harvested from bio assets of agricultural products, gross product evaluated in fair value, gross margin, operation profit, labor productivity in plant breeding, animal breeding and agricultural activity in general.

Resting upon this control and analysis controllers and managers of companies are able to make managerial decisions concerning regulating and correcting plans, development strategies, structure and content of bio assets, bio asset production costs and optimization of volumes of products harvested from bio assets.

This procedure was developed as an integral part of the guidelines of Ministry of Agriculture of the Russian Federation.

#### 4. Discussion

Presented procedure is quite simple and can be implemented in relatively small agricultural companies. However, evaluation of fair value is a question for discussion. In some cases, fair value can't be defined with appropriate degree of reliability. However, the survey presented in the research of Hinke and Stárová (2014) proved that farmers in the Czech Republic are rather restrained as for the use of value measurement of biological assets and agricultural production.

Further researches will be devoted to study of the accounting records of agricultural companies for some years. These companies implemented new procedure. So future research will be devoted to comparison of the periods when the companies utilized conventional accounting procedure and the periods after implementation of the suggested procedure.

## 5. Conclusion

Estimation by fair value helps take correct managerial decisions. Suggested methodology provides two ways of the analysis of financial results and includes procedure for those companies which carry out traditional accounting of expenditures, and for the companies with direct costing system. Calculation of profitability indexes of bio assets is based upon fair value. Suggested indexes gross profit bio, operational profit bio should be calculated with regard to dynamics per unit of bio assets, per 1 ha etc. Obtained results allow judging the results of influence of managerial decisions on harvested products from bio assets.

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# Trade Flow Estimation Between Russia and European Union Countries per Agricultural Commodity Group

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**Abstract:** All countries in the world are involved into international trade so it is crucially to understand economical patterns of interrelations between countries. This research is aimed to estimate current condition of international agricultural trade between Russia and EU countries for the period of 2000-2017. Import and export trade flows were estimated with the gravity model for specific groups of products. Impact of such variables as gross domestic product (GDP), the distance between countries, common border, language and history on trade flow value was also estimated. Impact of Russian import ban was also studied in the article. Obtained results of 48 regressions were subdivided into 3 groups for import and 4 groups for export by means of the cluster analysis. The classical gravity model works for meat, fruits and cereals, and this fact can be proved by existence of dependency between distance and GDP of trade partners. However, influencing factors for other groups of products are common language and border. The import ban variable influences each group of the agricultural products exported from Europe to Russia and partly extends its influence on the imported products. Hence, impact of import ban is much stronger than it was declared earlier.

**Keywords:** gravity model; Russian import ban; agriculture; trade

**JEL Classification:** Q1; F1; F510

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## 1. Introduction

In the modern condition of the world international trade has quite important role and almost each country is involved into this game. Hence, it is of crucial importance to know every trick in the book of trade mechanisms and estimate impact of such different factors as bans or export specialization in definite kinds of products.

The conventional tool for estimation of trade flows between countries is the gravity model. It was firstly suggested by Timbergen (1962) and further Anderson (1979) put finishing touches on this model. He suggested that the key criteria in choosing a supplier or a service are a distance and a delivery price. An ideal supplier is the one which can deliver the product of required quality at lowest price in time. Anderson suggested specification of the model in the way that each country was specialized in production of one (or some) products. In other words, he confirms that the gravity model can be utilized for some single industry (product).

Traditionally the gravity model (Koo 1994) utilizes a panel data to take into account implicit characteristics and temporal effects. In his work "Meat trade polices" he generated the model for the specific product group.

The other question appearing when implementing such model is the choice of the model type that is the pooled ordinary least square (OLS) or the fixed ordinary least square or random ordinary least square. Recently some scientists utilized pooled OLS (Kankge, 2006) though it does not meet BLUE requirements. Fixed or random effect models help solving problem with missing variables. The main difference between the fixed effect OLS and random effect OLS is that changes between objects are



random and they are not related to the explanatory variables in the model. It was random effect model which was utilized in this research as it omitted all dummy variables.

The research is aimed to estimate current condition of international agricultural trade between Russia and EU countries. Research objective is to generate the regression model using the gravity model approach for the particular group of agricultural products and find some regularities using cluster analysis.

## 2. Methodology

The idea of utilization of gravity in economics is based upon Newton's universal gravitation law stating that the more mass and the less distance between objects the more magnitude of the attraction force between them. Resting upon this approach Tinbergen (1962) created the gravity model in the international trade.

$$\ln X_{ij} = \underbrace{\ln G}_{a_0 \equiv \text{constant}} + \underbrace{a_1 \ln M_i + a_2 \ln M_j}_{\text{economic attractors}} + \underbrace{a_3 \phi_{ij} + a_4 N_{ij}}_{\text{distance}} + \underbrace{a_5 V_{ij}}_{\text{policy}} + \underbrace{\varepsilon_{ij}}_{\text{iid}} \quad (1)$$

where:

$X_{ij}$  – the size of trade flow between two countries

$M_j$  – the amount of exports from the country  $i$  to the country  $j$

Since that time the gravity model was studied and modified lots of times. For instance, Assem (2005) in his research "Agricultural exports in Egypt" offers an additional variable "Regional trade agreement". Keith (2006) suggests a dummy variable "Common border".

In this research the specification of the gravity model is the following:

$$F(\text{agricultural trade flow}) = \text{Imp}_i, \text{Exp}_i, \text{GDP}_i, \text{GDP}_{ru}, D_i, B_i, L_i, H_i, S_i, \text{BN}_i \quad (2)$$

$\text{Imp}_i$  – Import trade flow of agricultural products from some EU country to Russia

$\text{Exp}_i$  – Export trade flow of agricultural products into some EU country from Russia

$\text{GDP}_i$  – GDP (ppp) of EU country, million USD

$\text{GDP}_{ru}$  – GDP (ppp) of Russia, million USD

$D_i$  – the variable designating the distance between capitals of EU countries and Moscow or St. Petersburg

$B_i$  – the dummy variable designating existence of common border between countries

$L_i$  – the dummy variable designating existence of common language for work

$H_i$  – Existence of active relations for the last 100 years

$S_i$  – Existence of a sea port on the territory of each country

$\text{BN}_i$  – Russian import ban

The variables of import/export trade flow and the distance between countries are taken from Tinbergen's model (Eq. 1). Some dummy models impacting import/export of agricultural products are also included into the model. Existence of common border, common language for work and active historical relations in EU country facilitate external trade. Existence of a seaport significantly cheapens price of good delivery between countries. The variable ban decreases trade volume between EU countries and Russia.

These calculations were made with the data about import/export between EU countries and Russia from Un cometrade database. The selection comprises 29 countries – 28 European countries and Russia. Import and export was subdivided into 24 agricultural items. Thus, the analysis included 24 groups of agricultural products for the period of 18 years since 2000 till 2017. To eliminate inflation impact trade flow data was indexed by agricultural producer price index from FAOSTAT. The data of GDP volume for the total period were taken in the constant prices from WTO site. The calculations were performed in STATA 15 software. The Table 1 presents the data of descriptive statistics.

**Table 1.** Descriptive statistics for the gravity models.

Variable	Obs	Mean	Std. Dev.	Min	Max
Import thou. USD	12,096	7,989,822	2.46e+07	0	4.39e+08
Export thou. USD	12,096	1,610,126	1.13e+07	0	6.44e+08
GDP EU mln. USD	12,096	606,072	859,280.8	9,605	3,740,232
GDP RU mln. USD	12,096	3,094,072	550,526.6	2,059,806	3,693,841
Distance km.	12,096	1,856.32	854.5	300	3,907
Boarder	12,096	0.1	0.3	0	1
Language	12,096	0.3	0.4	0	1
History	12,096	0.2	0.4	0	1
Sea port	12,096	0.8	0.3	0	1
Ban	12,096	0.2	0.4	0	1

Source: Un cometrade, own calculation.

The data was tested by BLUE and some specifications for the model were applied. These specifications are the ordinary least square, the panel data model, the generalized least square, the random and fixed effect model. In order to find the most suitable model the series of such tests as the Ramsey test, the Breush-Pagan test, the White test, the Hausmann specification test and the Breush - Pagan LM test for random effects was made. Finally the model with panel data generalized least square model with random effect was considered the most suitable one. The variables import, export and distance were taken logs. Final formula of the gravity model is the following (Equation 3).

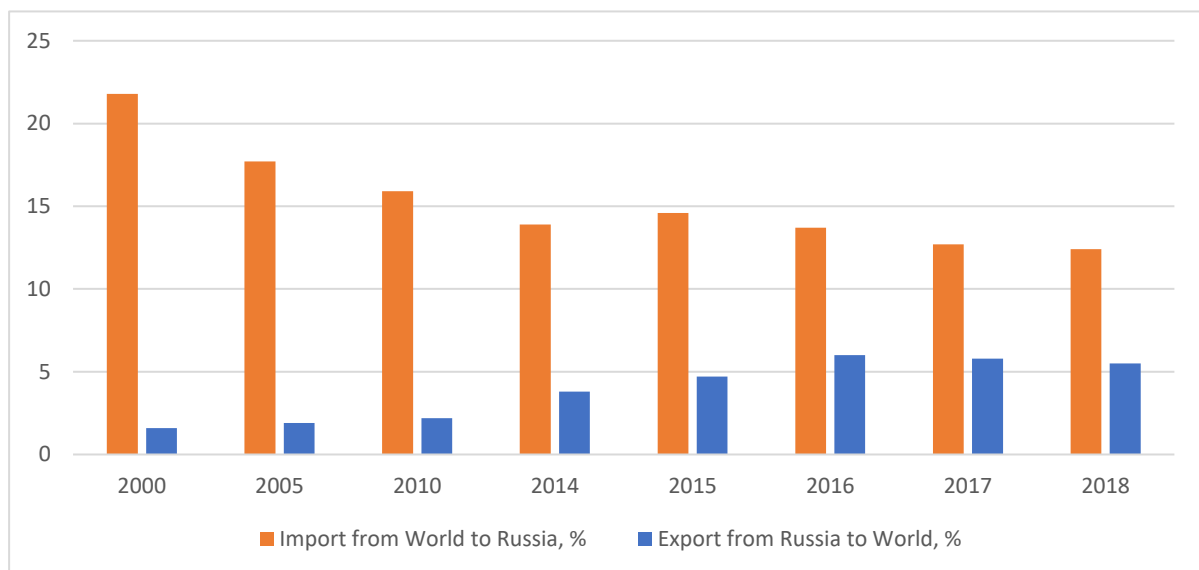
$$F(\text{trade flow per commodity}) = \ln \text{Imp}_i, \ln \text{Exp}_i, \ln \text{GDP}_i, \ln \text{GDP}_{ru}, \ln D_i, B_i, L_i, H_i, S_i, BN_i \quad (3)$$

This model was utilized for each of 24 groups of imported and exported products. A set of specific variables was assigned to each group of products. Further the results of modeling were subjected to the cluster analysis by Ward's method (Ward 1963).

### 3. Results

#### 3.1. Current condition of agricultural trade between Russia and the European Union. Impact of import ban

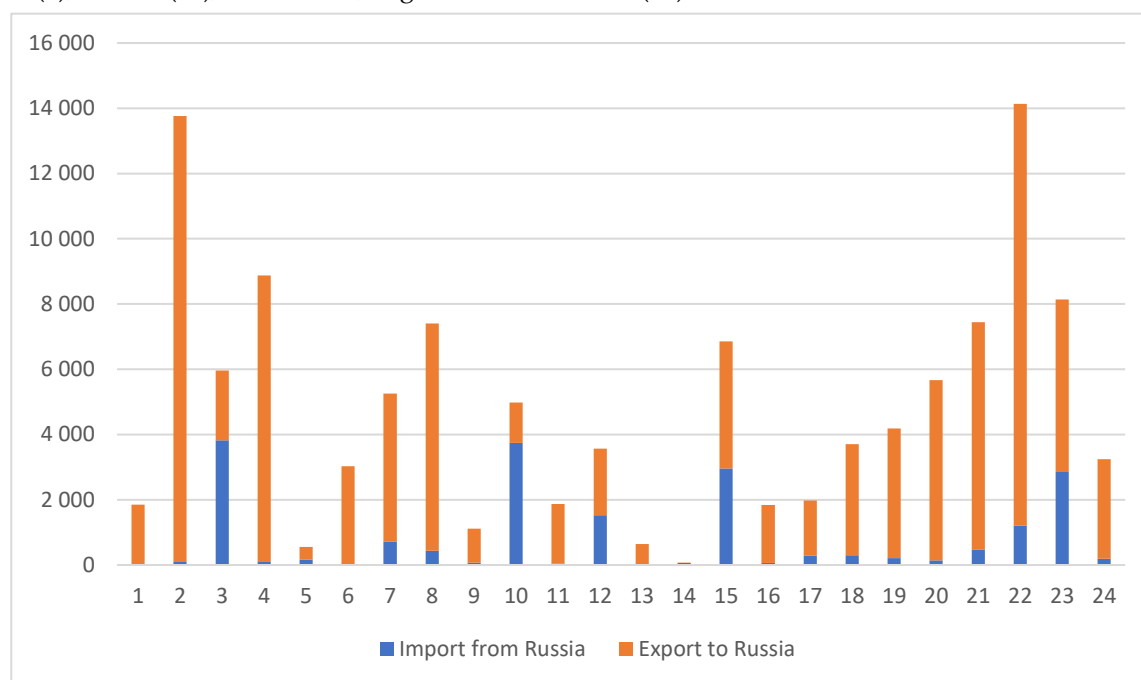
Import of agricultural products exceeds export by several times in modern condition of international trade in Russia. Though, as it is presented on the Fig. 1, there is a trend of reduction of import and increase of export but this gap is still big.



**Figure 1.** Share of agricultural products in International trade in Russia.

The most imported products for 18 years are machinery, equipment and transport in Russia. In 2018 the share of this import was 47.3%. The share of mineral products export was more than 70% as it was expected in Russia. In 2018 this share was 64.8%.

The EU together with China, Belarus and Brazil was the key trade partner of Russia. The share of imported agricultural products in Russia from the EU was 37% from the total import of agricultural products. The most demanded products according to Fig. 1 are meat and beverages. The data was presented in constant prices for 18 years. Imported products from Russia are far less and they include fish (3), cereals (10), and animal, vegetable fats and oils (15).



**Figure 2.** Export and import of agricultural products for the period 2000-2017, constant price, bill. USD.

Where: 1-Live animals; 2-Meat and edible meat offal; 3-Fish, crustaceans, molluscs, aquatic invertebrates etc; 4-Dairy products, eggs, honey, edible animal product etc; 5-Products of animal origin; 6-Live trees, plants, bulbs, roots, cut flowers etc; 7-Edible vegetables and certain roots and tubers; 8-Edible fruit, nuts, peel of citrus fruit, melons; 9-Coffee, tea, mate and spices; 10-Cereals; 11-Milling products, malt, starches, inulin, wheat gluten; 12-Oil seed, oleaginous fruits, grain, seed, fruit, etc; 13-Lac, gums, resins, vegetable saps and extracts; 14-Vegetable plaiting materials, vegetable products; 15-Animal,vegetable fats and oils, cleavage products, etc; 16-Meat, fish and seafood and food preparations; 17-Sugars and sugar confectionery; 18-Cocoa and cocoa preparations; 19-Cereal, flour, starch, milk preparations and products; 20-Vegetable, fruit, nut, other food preparations; 21-Miscellaneous edible preparations; 22-Beverages, spirits and vinegar

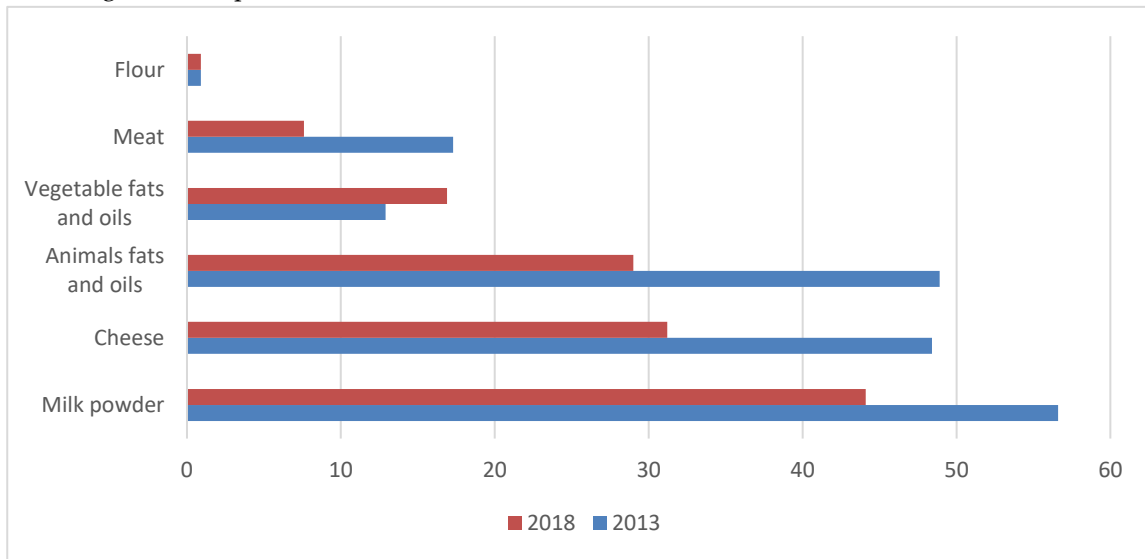
In 2014 Russia imposed food ban (embargo) for certain agricultural products against countries Canada, Australia, the European Union, the United States and Norway. Banned products are presented in the Table 2. Ban covered the most popular exported products in Russia from the EU.

**Table 2.** The structure of the banned imported products in 2013.

Commodity code	Canada		Australia		Norway		USA		EU members		Total	
	mill. USD	%	mill. USD	%	mill. USD	%	mill. USD	%	mill. USD	%	mill. USD	%
Meat (2)	255	68.14	202	69.10	0	0.00	323	40.70	2,138	21.89	2,918	23.65
Fish(3)	106	28.27	0	0.17	1,106	99.55	81	10.24	209	2.14	1,502	12.17
Dairy (4)	6	1.68	75	25.66	4	0.39	17	2.16	1,946	19.93	2,049	16.61

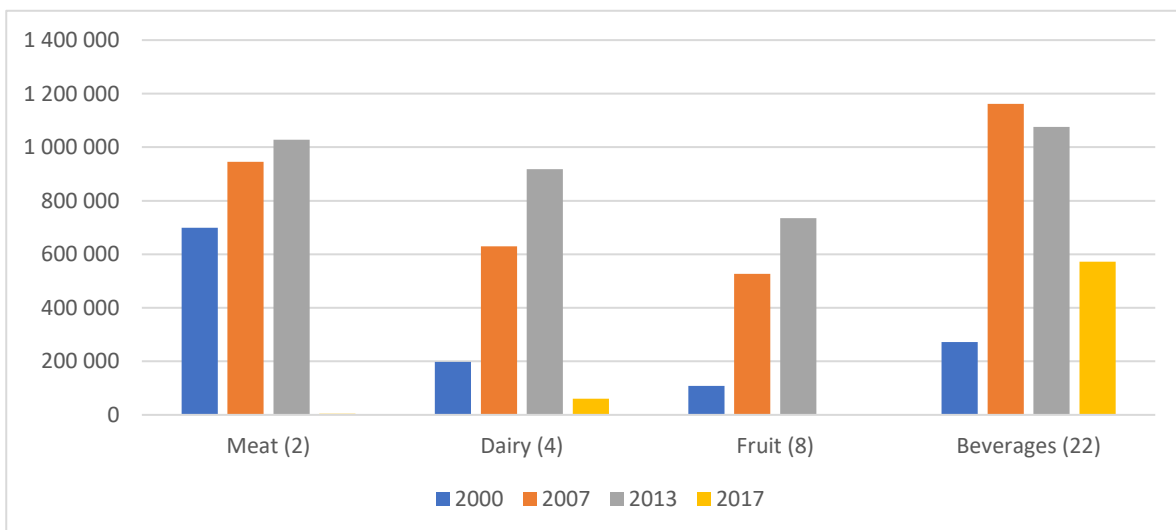
Vegetab. (7)	3	0.74	0	0.02	0	0.01	6	0.80	1,017	10.41	1,026	8.32
Fruits (8)	3	0.69	9	2.96	0	0.00	223	28.02	1,688	17.28	1,922	15.57
Food prep. (16.19.20.21)	2	0.46	6	2.09	1	0.06	144	18.08	2,769	28.36	2,922	23.68
Total	374	100	292	100	1,111	100	795	100	9 766	100	12,338	100

Smutka (2016) in his article suggested that Russian import ban was aimed to support Russian agriculture and remove competitors from the internal Russian market. This hypothesis is proved by the data from the Fig. 3. The share of imported products in Russian food malls was significantly decreased by comparison with the period before ban. Russian agricultural manufacturers successfully produce agricultural products and deliver them on internal market.



**Figure 3.** The share of imported goods in the Russian food stores 2013-2018.

The share of imported cheeses in Russia reduced from 50% in 2013 to 30% in 2018 (Fig.3), though these values do not reveal one important characteristic that is quality of the local products. The example of replacement of foreign cheese was presented in the article of Mirzobobo (2018) who investigated tastes of Russians. Russian customers do not consider Russian cheese dangerous for health but prefer more expensive European kinds of cheese in case of having financial abilities.



**Figure 4.** Main products exported to Russia from EU, 2000-2017, million USD.

The most popular products from the EU in Russia are presented in Fig. 4. Export of all products was obviously decreased after 2013 and in 2017 even the group Beverages suffered from decrease though it was not banned officially. In other words the Fig. 4 presents impact of ban on exported agricultural products totally and not only on specific groups of products. This impact will be also proved by the regression model below.

### 3.2. The regression analysis for particular group of products using gravity model approach

The article includes the regression analysis of the model with panel data generalized least square with random effect for each group of imported and exported products. So evaluation comprises 48 regression models made with formula 3. Evaluation comprises 48 regression models made with the formula 3. Each product type was checked using 5 types of the regression models. The best suitable model for each of 24 product was chosen using comparison test Breush - Pagan. First and second OLS models have serious problem with heteroskedasticity and do not fulfil BLUE assumption, even with the robust method. Example of calculation for dairy products is in the Table 3.

**Table 3.** Five types of regression models for dairy products exported to Russia from the EU.

Variables	1st OLS Robust	2nd OLS In Robust	3th Gravity panel random effects GLS	4th Gravity panel random effects ML	5th Gravity panel fixed effect
Distance	-11,263*** (1,920)	-1.166*** (0.215)	-1.148 (0.809)	-1.169* (0.676)	Omitted
Border	3.638 (4.814)	1.484*** (0.428)	1.555 (1.565)	1.616 (1.310)	Omitted
Language	-1.681*** (2.394)	-0.857** (0.342)	-1.398 (0.996)	-1.218 (0.853)	Omitted
History	3.420*** (3.861)	1.400*** (0.239)	2.071** (0.980)	1.883** (0.834)	Omitted
Sea Port	1.603*** (2.417)	-0.299 (0.262)	0.00415 (0.895)	-0.0894 (0.754)	Omitted
GDP RU	12.48*** (2.620)	3.151 (1.918)	2.544*** (0.430)	2.494*** (0.424)	4.111*** (0.603)
GDP EU	10.64*** (2.373)	0.953*** (0.111)	0.782*** (0.298)	0.875*** (0.262)	-2.392*** (0.922)
Ban	-2.313*** (3.552)	-1.498*** (0.420)	-1.708*** (0.194)	-1.709*** (0.194)	-1.609*** (0.194)
Constant	-1.917** (7.447)	513.6 (1,308)	-24.91*** (8.551)	-25.11*** (7.856)	-15.84** (7.760)
R-squared	0.444	0.482	0.682	-	0.205

Standard errors in parentheses \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

According to the Table 3, dairy products, exported to Russia, are influenced by GDP volume, Russian ban and availability of common history. The last brings positive effect to the trade flow, and ban logically shows negative effect.

Thereby, for analyzing data receiving from 48 regression models (24 for export and 24 for import), it was decided to group results of regression using the cluster analysis. Additional argument for the cluster analysis is that showing all regression results takes many pages. The cluster analysis allows observation of main trends of significant variables for imported and exported agricultural products.

The classical gravity model works for meat, fruits and cereals can be proved by existence of dependency between distance and GDP of trade partners. However, influencing factors for other groups of products are common language for office work and common border.

The results of the cluster analysis are presented in Fig.5. The groups were made by the indexes of the models obtained in the result of the regression analysis for each product.

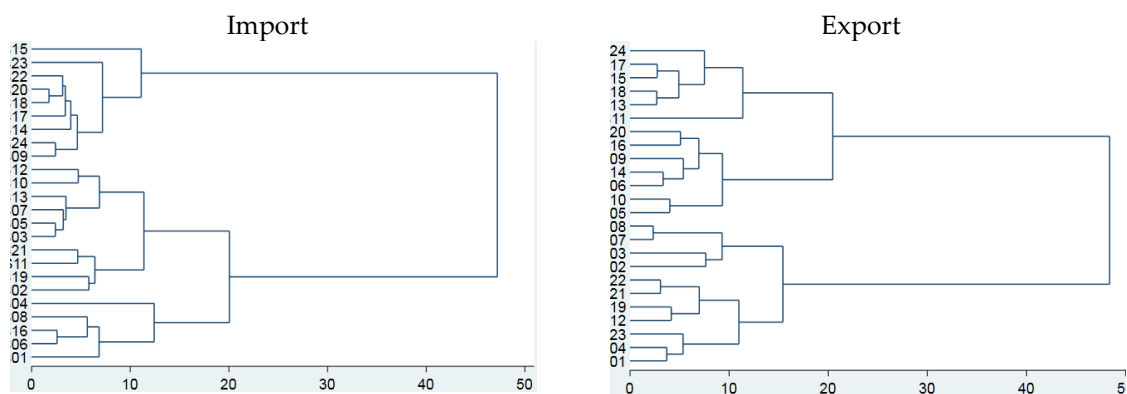


Figure 5. Dendrogramm based on Ward's methods.

The structure Import includes 3 groups of clusters and the structure Export – 4 groups.

The variable "Import ban" is significant for all groups of exported products in Russia and imported from Russia. In other words, import ban influences stronger than it was expected earlier.

To summarize, different significant variables influence different type of agricultural products. Dependence between trade flow, GDP and distance does not suit for each type. Availability of common language and common boarder is more important than distance between countries for some commodities.

#### 4. Discussion

The type and specification of the econometric model is subject of discussion. In this article the gravity model approach was implemented for evaluation of influence of Russian import ban and such indexes as common border, common language, sea port availability and common history. Previously other researches (Dascal 2002; Ferrantino 2006) showed good results of implementation of the gravity model approach. However, Babula (2005) investigated impact of non-tariff measures on wheat in the USA and suggested the vector autoregression model which provided more reliable evaluation. This approach provides more opportunities for future researches and it will be utilized for evaluation of temporal effects of Russian import ban on international trade of agricultural products.

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# The Impact of International Economic Sanctions on Industrial Output of the Russian Federation

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**Abstract:** Since 2014, a number of foreign countries and interstate associations have been imposing financial and economic sanctions on the Russian Federation. The official goal of the sanctions was to force Russia to change its foreign policy. The sanctions were aimed at key economic sectors: energy, defense, mechanical engineering, financial sector. Imposed sanctions were to cause economic slowdown in Russia and worsen several macroeconomic performance indicators, such as inflation, employment, foreign trade balance, net capital inflow, industrial output etc. The article seeks to analyze the impact of sanctions on Russian industry, therefore it contains the definition and classification of sanctions imposed on Russia, characterizes Russian pre-sanctions industrial production, and evaluates the state of industry after the sanctions were introduced. The conclusion on the effectiveness of sanctions will be made based on comparison of indicators of Russian industrial output in pre- and post-sanctions period.

**Keywords:** international financial and economic sanctions; Russian industry; impact of sanctions; mining; manufacturing; industrial production index; import substitution

**JEL Classification:** F51, F42, F23

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## 1. Introduction

The main trend of global economy today is a transition from liberalism, globalization and free trade to neomercantilism и protectionism (Orekhovsky 2018). The USA, where financial and economic sanctions have been actively implied during the last 5 years to solve economic and political problems with Russia, China, Mexico etc. can be a good example.

The problem that sovereign states influence economic and political decision-making by economic coercion is not new in worldwide practice. According to G.C.Hufbauer (Hufbauer 2007), in 1995-2000 there were 47 cases of imposing economic sanctions, mostly initiated by the USA and the UK (Hufbauer 2007). In 2000-2006, G.C.Hufbauer mentions 13 cases (Hufbauer 2007), initiated mainly by the USA and the EU. A.Baldwin, D.Cortright, M.Doxey, R.J.Ellings, K.A.Elliott, J.Dashti-Gibson, L.Davis, D.Lektzian and other authors have also studied effectiveness of international economic sanctions.

In this article sanctions will be defined as economic and financial restrictive measures imposed by one party of international economic relations (state, group of states, international organization) on another party (state, group of states) in order to force the latter to change its political direction or economic policy.

G.C.Hufbauer in his work "Economic Sanctions Reconsidered" has defined sanctions as "deliberate, government-inspired withdrawal, or threat of withdrawal, of customary trade or financial relations" (Hufbauer 2007) for political purposes. This definition reflects interconnectedness of political and economic causes of sanctions as well as correlation between political and economic leverages over the target state.

Application of international economic sanctions against Russia has raised interest in this issue among Russian researchers – Nureev R.M., Busygin E.G., Zagashvili V., Bulatova A.I., Petrakov P.K., Novikov, S.V., Lastochkina, V.V., Solodova, A.D. etc.

The purpose of this study is to evaluate the impact of sanctions on Russian industrial output. In order to achieve the purpose, the following tasks were solved:

- to analyze and classify sanctions imposed on Russia on various grounds;
- to characterize Russian industry before sanctions were imposed;



- to evaluate the change of key industrial indicators as a result of sanctions.

Achieving this goal will allow to judge the effectiveness and expediency of applying those measures. There is no doubt that the cost of such influence is extremely high both for initiating and target countries. The question is whether the goals set by the initiating country are being achieved by imposing sanctions.

## 2. Methodology

In order to achieve the purpose of this study, international economic sanctions have been analyzed and classified by range of criteria, such as countries which imposed sanctions, sectors sanctions were aimed at, territorial coverage, and their influence on Russian economy. Russian industry in pre- and post-sanctions period has been characterized based on statistical data. The data in this study were provided by the Federal Service for State Statistics of the Russian Federation (Rosstat), therefore objectivity of the results directly depends on the objectivity of the data of the Federal Service for State Statistics. The indicators used to characterize Russian industry were industrial production in value terms, industrial production index, balanced financial result, cost per 1 ruble of manufactured products. Evaluation indicators allowed to estimate the change in the industrial production volume in value and physical terms, profit and loss of output in branches of industry, and unit cost for production. Besides the Rosstat data, statistical information provided by the Bank of Russia has been used. The study required the use of statistical method, comparison and index methods, horizontal analysis, and methods of analysis and synthesis.

## 3. Results

Financial and economic sanctions can be classified on various grounds. In particular, Nureev R.M. in his monograph "Economic sanctions against Russia and Russian anti-sanctions: goals and results" divides sanctions based on the aims of initiating country into:

- Sanctions connected with change of political regime and democratization;
- Sanctions connected with disruption of military adventures;
- Sanctions connected with military impairment;
- Sanctions connected with significant political changes (Hufbauer 2007).

International financial and economic sanctions imposed on Russia might fall into the first category. The reason for it was the reunification of Russia and Crimea as well as civil unrest in Ukraine. At the same time, it is necessary to note that economic contradictions between Russia and the USA, competition in fuel and energy sectors in particular, are also the basis for sanctions imposition.

The first anti-Russian sanctions package was enforced in mid-March 2014. Later it has been broadened with new actors, some of which imposed their own sanctions and some have joined the existing ones. In order to provide a precise evaluation of the impact of sanctions on the industrial output in Russia, it is necessary to analyze the economic essence of sanctions and classify them according to different characteristics. The analysis and classification of financial and economic sanctions allow to group them in accordance with the following criteria (Table 1).

**Table 1.** Classification of international financial and economic sanctions

Classification categories	Types of sanctions
	Sanctions imposed by:
Actors imposing sanctions	<ul style="list-style-type: none"> <li>• OECD</li> <li>• The European Parliament</li> <li>• The European Free Trade Association</li> <li>• The European Bank for Reconstruction and Development</li> <li>• The World Bank</li> <li>• countries (USA, UK, Canada, Australia etc.)</li> </ul>
	Sanctions aimed at:
Branch	<ul style="list-style-type: none"> <li>• financial sector</li> <li>• fuel and energy sector (oil and gas extraction, in particular)</li> <li>• defense industry</li> <li>• machinebuilding and shipbuilding</li> <li>• space industry, electronics, IT-business</li> <li>• foreign trade</li> <li>• energy</li> <li>• rail transport</li> </ul>
	Sanctions aimed at:
Geography	<ul style="list-style-type: none"> <li>• Crimea and Sevastopol</li> <li>• Russian Federation in general</li> <li>• The Eurasian Economic Community</li> </ul>
Effect on Russian economy	<ul style="list-style-type: none"> <li>• depriving Russian economic actors of access to foreign credit resources;</li> <li>• ban on high-tech products supply to Russia (including technology and equipment for oil production, space industry, defense enterprises), as well as so called dual-use products;</li> <li>• complication of foreign trade operations, outright ban on the purchase of Russian goods in accordance with the approved list;</li> <li>• ban on investment in infrastructure, transport, telecommunications and energy sectors, oil, gas and minerals extraction</li> </ul>

Thus, the Russian Federation is subject to a range of various sanctions. They are aimed at influencing a variety of sectors of the economy through direct restrictive and prohibitive measures. The ultimate goal of all these diverse sanctions is inability to overcome technical and technological backwardness, banning the arrival of new technologies, weakening Russia's position in international markets, reducing opportunities for credit financing, and as a result – slowing economic growth, stagnation in priority sectors of the Russian economy.

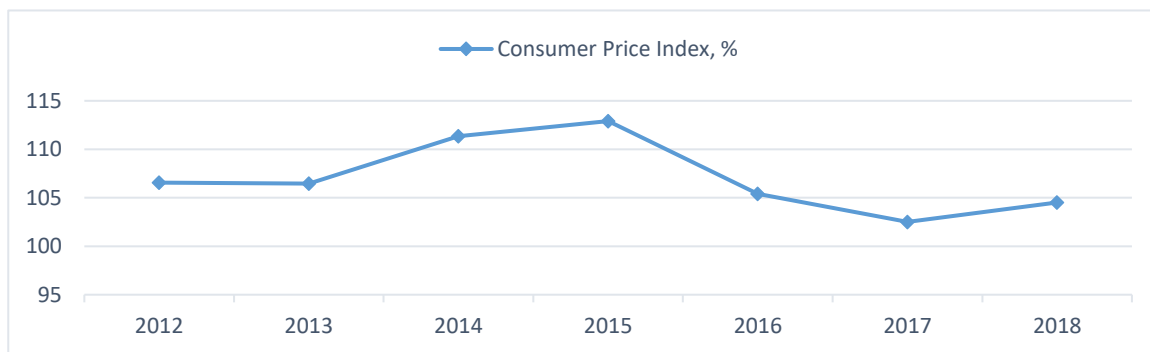
The analysis shows that sanctions can influence Russian industrial production, both directly and indirectly. Direct impact applies to:

- ban on the supply of modern equipment and technology for oil extraction, defense, space industry, dual-use products and technologies to Russia;
- challenging access to foreign markets (cancellation of duty-free import of a number of goods to the US, increase of import customs duties for a number of countries), outright ban on the purchase of more than 250 Russian goods;

- non-involvement in joint investment projects in Russia (projects of the World Bank, the Overseas Private Investment Corporation, the European Investment Bank, investment projects of private companies etc.)

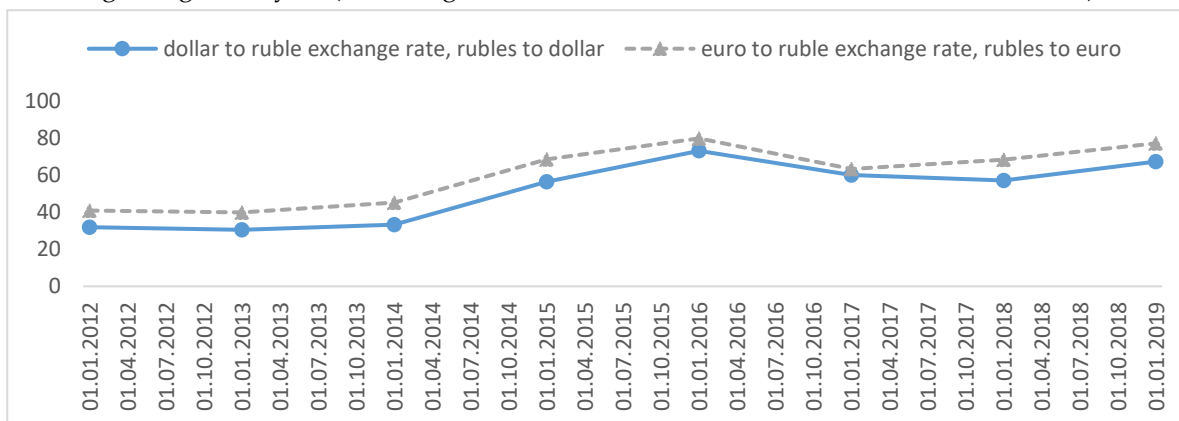
Indirect impact results in banning of Russian business entities from international financial markets, foreign credit resources, debt financing opportunities. The ban on debt financing applies to a wide range of economic entities in various industries: banks (Sberbank, VTB, Rosselkhsobank, Vneshekonombank, Gazprombank etc.), defense enterprises (Uralvagonzavod, Oboronprom, United Aircraft Corporation etc), fuel and energy complex enterprises (Rosneft, Transneft, Gazpromneft, Lukoil etc), industrial enterprises (OOO "Russkiye Mashiny", Rusal, OOO "Nasosy Ampika", United Shipbuilding Corporation, Mytishchi machine-building plant, Izhevsk Mechanical Plant, Izhmash group, Mayak machine-building plant, OOO Foreign Economic Association "Technopromexport", OJSC "Siloviy Mashiny – ZTL, LMZ, Elektrosila, Energomashexport" etc)

A rise in the inflation rate can be considered consequential impact of sanctions on the Russian economy. According to Rosstat data, consumer price index, one of the main inflation indicators, was 6.57% in 2012 and 6.47% in 2013. In 2014 and 2015 it increased to 11.35% and 12.91% respectively, causing twofold increase in inflation. Since 2016 Russian economy has adapted to restrictions, therefore inflation rate fell (Figure 1).



**Figure 1.** Consumer price index in 2012-2018 (according to the Federal Service for State Statistics data).

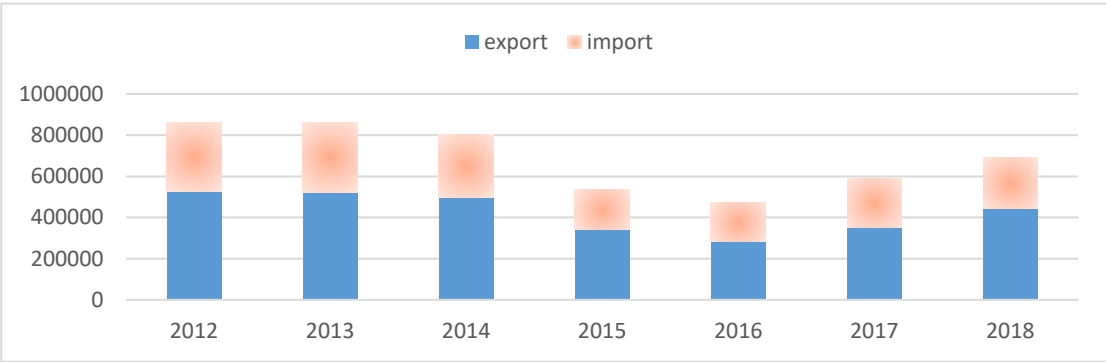
Despite the opinion expressed in chapter 2.4 of "Economic Sanctions against Russia: Expectations and Reality", devaluation of the Russian ruble in 2014-2019 can be considered a positive consequential impact (Nureey and Petrakov 2016). Figure 2 shows the US dollar and Euro against the Russian ruble at the beginning of the year (according to data of the Central Bank of the Russian Federation).



**Figure 2.** The exchange rate of major foreign currencies against the Russian ruble in 2012-2018 (according to data of the Central Bank of the Russian Federation).

The positive impact of devaluation affects export-oriented industries. The volume and dynamics of Russian goods export according to Rosstat are presented in Figure 3. The negative impact of

devaluation results in a sharp cost increase of imported goods, equipment and technology (it compounds an outright ban on machinery and technology supply).



**Figure 3.** Dynamics of Russian foreign trade balance (based on balance of payments method) (according to the Federal Service for State Statistics data).

The data on Figure 3 indicates a decline in export-import operations volume as a result of international financial and economic sanctions. In 2014, Russia's foreign trade turnover decreased by 6.9% compared to 2013. It amounted to \$804.7 billion including \$496.7 billion in export (94.9% of 2013) and \$308 billion in import (90.2% of 2013). Trade balance remained positive amounting to \$188.7 billion (\$181.9 billion in 2013). According to the Central Bank of the Russian Federation, in 2014 trade turnover between Russia and countries further afield amounted to \$428,929/\$271,978 billion (export/import); trade turnover between Russia and CIS amounted to \$68,834/\$36,048 billion (export/import).

By 2019, export volume has almost reached pre-sanctions performance, while import volume is still lower by almost a third. Despite fluctuations in foreign trade operations volume, the balance of payments of the Russian Federation remained positive – export volume has always exceeded import volume. One of the reasons for that was the devaluation of the Russian national currency which made Russian goods more competitive on the global market. Another reason is that the Russian economy as a whole is focused on commodity exports.

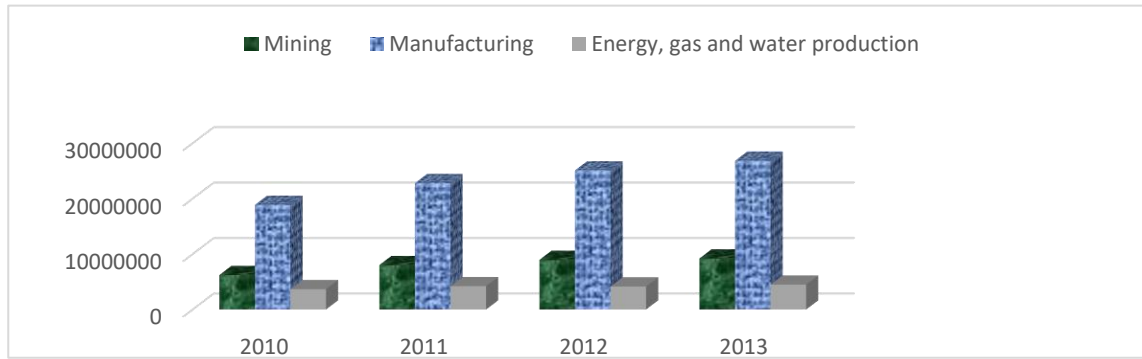
As shown above, international financial and economic sanctions impact the entire Russian economy. In addition, the list of sanctions clearly highlights the so-called "sectoral" sanctions aimed at destabilizing the situation in Russia's priority economic sectors. One can evaluate the way sanctions affected Russian industry by characterizing pre-sanctions industrial output in Russia and compare it with similar indicators during the sanctions.

According to Russian legislation, industrial production refers to "a combination of economic activities defined by the Russian Classification of Economic Activities and related to mining, manufacturing, electricity, gas and steam, air conditioning, water supply, drainage, waste collection and recycling, as well as pollution liquidation" (Law of the Russian Federation «About industrial policy in the Russian Federation»).

The analysis of industry in this study implies it to be defined as a set of extraction and manufacturing industries, as well as power, gas and water production and distribution. Being the core of material production, industrial production will be characterized by the following indicators:

- Industrial production in value terms;
- Industrial production index;
- Balanced financial result;
- Total cost per 1 ruble of product.

State of the industry data is based on the information provided by the Federal Service for State Statistics. Figure 4 shows industrial production dynamics in value terms in 2010 – 2013.

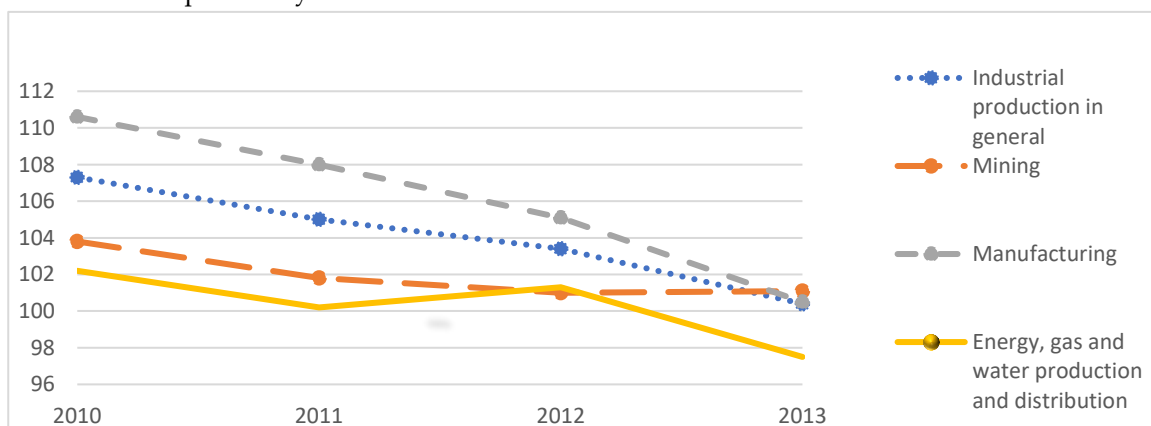


**Figure 4.** Russia's industrial production in 2010 – 2013, million rubles (according to the Federal Service for State Statistics data).

The data show that industrial production grew steadily in 2010-2013 but growth rates were uneven. In 2010-2012 mineral extraction volume growth exceeded inflation rates in value terms (i.e. there was a real increase in output), whereas in 2013 there was nominal growth as the output growth rate did not exceed the inflation rate in the same period. Manufacturing output grew more evenly and strongly. During the period under review there was a real increase in output (gross output growth rate exceeded the inflation rate growth in value terms in the same period).

The growth rate of production and distribution of electricity, gas and water was even more uneven. The output in value terms in 2013 to 2012 increased at about the inflation rate. i.e., in fact, the production volume has not changed in kind. In 2012 the growth rate in output in value terms was 98.6% compared to 2011. Thus, there has been a decline in the production volume in this industry.

A more detailed change in industrial production in kind can be analyzed using the industrial production index. According to Federal Service for State Statistics methodology for statistical indicators compilation, the industrial production index is a relative indicator of change in production in comparable periods. For analytical purposes, a consolidated production index is used which characterizes cumulative changes in all types of products and reflects the change in the value generated in the production process as a result of changes in the volume of products alone. The industrial production index in this study is an aggregated production index for types of activity involving "Mining", "Manufacturing", "Electricity, gas and water generation and distribution" (Figure 5). The index is calculated by dividing the value of the current year to the corresponding value of the indicator for the previous year.



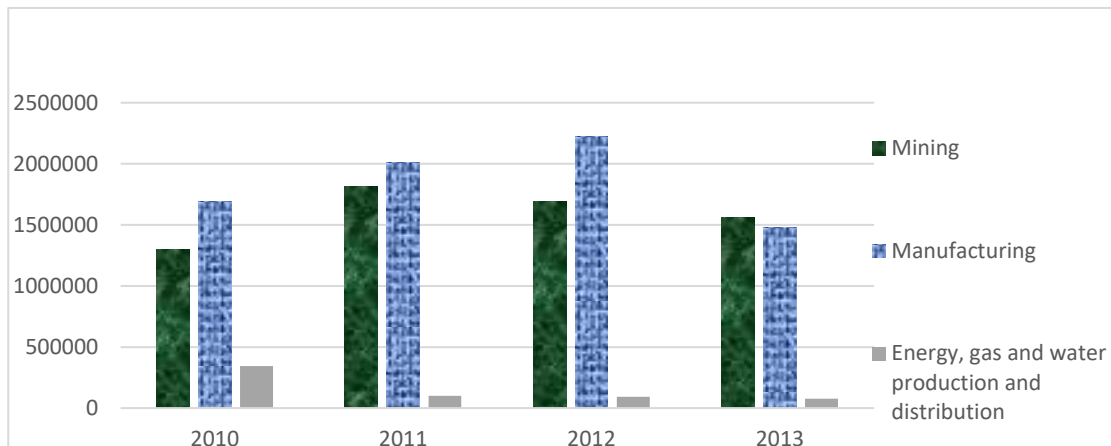
**Figure 5.** Change in the industrial production index in Russia in 2010-2013, % (according to the Federal Service for State Statistics data).

The data shown in the chart illustrate a decrease in industrial production growth rate in Russia during the "pre-sanctions" period. At the time of imposing sanctions there has been a decline in output growth in all areas of industrial production. Furthermore, in some industries (electricity, gas and water

production and distribution) there was a decrease in absolute production in kind. At the same time, it should be noted that industrial production growth rate as a whole remained positive throughout the "pre-sanctions" period.

According to Rosstat methodology, a balanced financial result is a final financial result based on accounting of all business transactions of organizations. It represents profit (loss) from the sale of goods, products, fixed assets, other assets of organizations and income from other transactions reduced by the amount of expenses on these operations.

Data on the balanced financial result of organizations are provided in actual prices, structure and methodology of respective years. Therefore, the analysis should be adjusted for the inflation rate in the same period. Data on the balanced financial result of industrial enterprises over the period analyzed are shown in Figure 6.

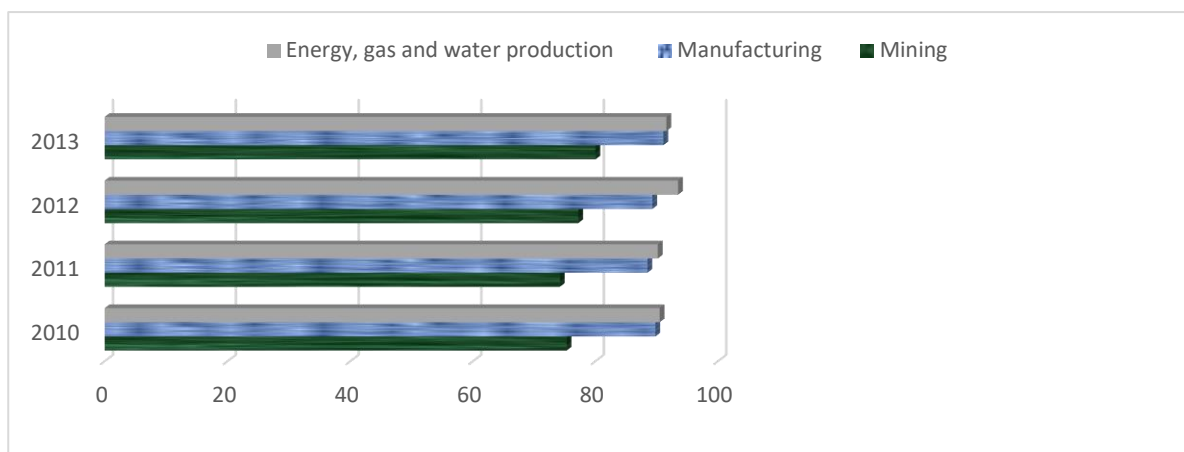


**Figure 6.** Balanced financial result (profit minus loss) of industrial enterprises in Russia in 2010-2013, million rubles (according to the Federal Service for State Statistics data).

The chart data show that balanced financial result dynamic in pre-sanctions period was very heterogeneous. In particular, in 2011 the increase in balanced financial result of extractive industries was 39.55% compared to 2010, and the increase in electricity, gas and water production and distribution was -70.93%. (i.e. there has been a nearly threefold decline in the balanced financial result in 2011 compared to 2010, but the balanced financial result remains positive, hence, in general the overall activity of industrial enterprises remains profitable).

As for the rest of the industry, 2011 was quite financially successful. In 2011, extractive and manufacturing industries showed a strong increase compared to 2010 (39.55% and 19.0% respectively in extractive and manufacturing industries). Then the situation changed, the dynamics of the indicator turned negative. In 2013 compared to 2012, the growth of the balanced financial result in all industry sectors was negative. For the industry as a whole production activities have become less profitable during the period under review.

The conditions in which industrial enterprises operate, as well as the results of their production activities, can be characterized by an indicator called the cost per 1 ruble of manufactured products. This indicator is important for comparing the "pre-sanctions" and "sanctions" period of organizations' activities. After sanctions were imposed on Russia and the national currency was devaluated, most enterprises working on imported raw materials experienced difficulties with its acquisition and, accordingly, with the increase in the production cost. As a result, their competitiveness in the market and the pressure on the inflation rate towards its increase have decreased. Data on the state and dynamics of industrial enterprises relative cost are shown in Figure 7.



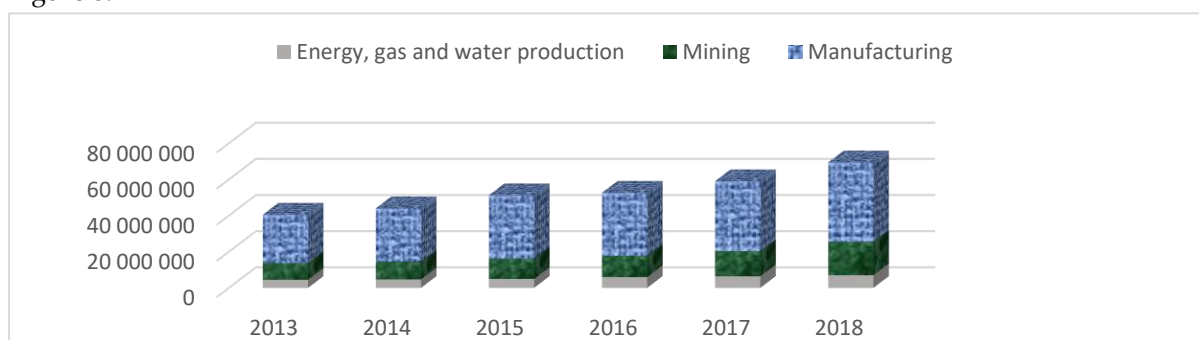
**Figure 7.** Cost per 1 ruble of manufactured products by industry sectors in 2010-2013, kopecks (according to the Federal Service for State Statistics data).

The analysis shows that, in general, there has been an increase in the unit cost in all industry sectors. This conclusion is consistent with the previous figure, which characterizes the change in the balanced financial result. In addition, it could be noted that the unit cost in industrial enterprises that produce and distribute electricity, gas and water is higher than in other industry sectors.

Thus, it could be concluded that Russia had had a number of accumulated problems by the time the international financial and economic sanctions were imposed. The main economic indicators of the industry show its deterioration – industrial production growth has decreased, unit costs have increased, the balanced financial result has decreased. At the same time, despite the slowdown, growth in Russian industries has nevertheless been observed, therefore the change of main indicators under the influence of sanctions should be analyzed.

The analysis of the current state of Russian industry will be conducted on the basis of separate reports of the Federal Service for State Statistics, in some cases the indicators will be calculated. It should be taken into account that methodological changes in economic activities data compilation which have entered into force in 2016 lead to some distortion of analysis results. The current state of the industrial sector of the economy will be characterized using the same indicators that were used to characterize the "pre-sanctions" state of the Russian industry. For the convenience of comparison, the analysis will include year 2013, prior to the imposition of sanctions.

The change in industrial output dynamics in value terms as a result of the sanctions is shown in Figure 8.



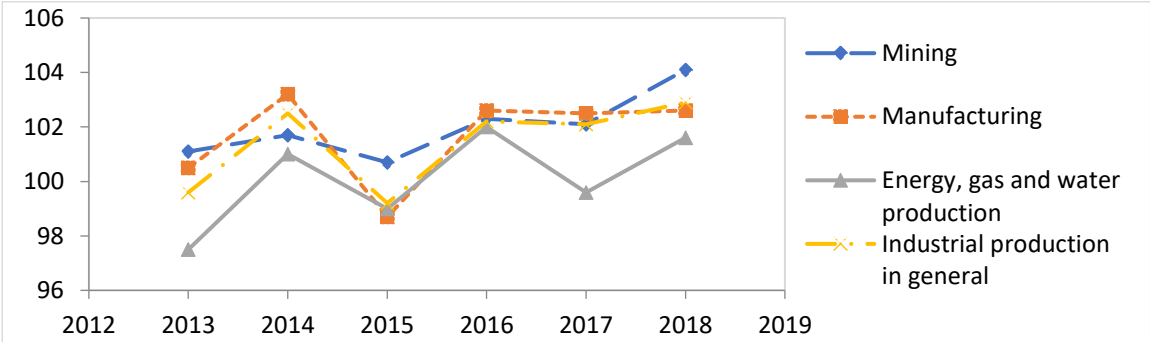
**Figure 8.** Industrial output dynamics in value terms in 2013-2018, million rubles (according to the Federal Service for State Statistics data).

Analysis of the data shows that, in general, industrial output in value terms for all types of economic activity grew in every period (except for manufacturing output in 2016, where it decreased by 0.35% compared to 2015). But this indicator is formed in value terms. Overall, the growth in industrial output in value terms was lower than the consumer price index in 2014 and 2016. In 2018,

all types of economic activity demonstrated strong growth, which resulted in a growth rate of 17.6% compared to 2017. It seems that such a strong growth in difficult economic circumstances during the period under review was largely due to the devaluation of the national currency (increased price competitiveness of Russian products and the growth of foreign exchange earnings from exports also made an impact).

Industry analysis shows that the mining sector increased unevenly, from 104.3% in 2016 to 132.9% in 2018. The manufacturing sector showed stable growth, exceeding the consumer price index (except for the "drop" in 2016). A sharp increase in the production of electricity, gas and water in 2016 is related to the peculiarities of statistics compiling (the Russian Classification of Economic Activities has been modified). In general, this sector shows low growth rates usually not exceeding the consumer price index. But in 2017-2018, the situation changes and the growth volume in this sector exceeds the inflation rate, although lagging behind the industrial average.

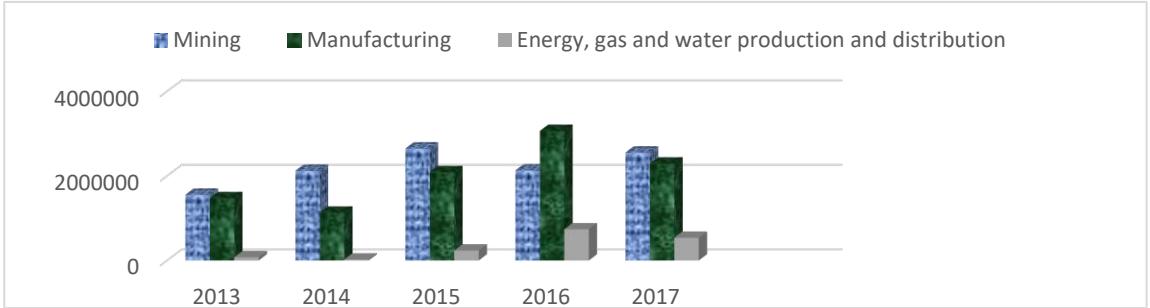
The change in industrial production indices could be analyzed by industry as a whole and for certain types of economic activity (Figure 9).



**Figure 9.** Industrial production indices dynamics in 2013-2018 (according to the Federal Service for State Statistics data).

It appears that the change in the industrial production index is a more objective indicator of the state of industry as it reflects a change in output volume. The Federal Service for State Statistics data show that the industrial production index as a whole remained positive after 2014 (the growth rate was generally at least 2% per year, except in 2015 when the index was 99.2%). At the same time, for an objective assessment it should be taken into account that in 2014 the index was calculated by comparing the output reached in 2014 with the data from 2013 (when the output decreased compared to 2012). Therefore, the 2014 data are not that optimistic, although the industrial production output exceeded that in 2012.

Financial results of industrial enterprises are characterized by an indicator called balanced financial result. The data are presented in Figure 10.



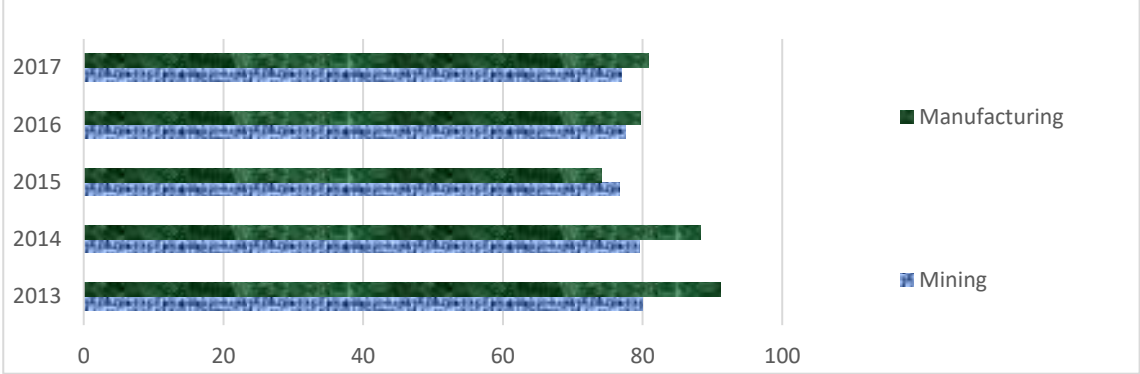
**Figure 10.** Balanced financial result of industrial enterprises (profit minus loss) in 2013-2017, million rubles (according to the Federal Service for State Statistics data).

The analysis shows that the balanced financial result of industrial enterprises remained positive even during difficult "sanctions" periods, i.e. the total profit by industry sectors exceeded the total loss received. But this indicator varied significantly from period to period. In addition, significant



differences could be observed in the range of economic activities. It is important that since the imposition of sanctions the balanced financial result in mining has grown substantially (it can be explained by export revenues growth). In 2016, the indicator for fuel and energy mining companies was almost halved, while other mining enterprises showed a doubling of the balanced financial result.

The data for cost per 1 ruble of manufactured products are illustrated in Figure 11. Due to changes in compilation of indicators for electricity, gas, steam and water enterprises, it is impossible to determine it by calculation, as the results will be biased.



**Figure 11.** Cost per 1 ruble of manufactured products in 2013-2017, kopecks (Figures are calculated based on Federal Service for State Statistics data on production in kind and production costs).

Interestingly, in the period leading up to the imposition of sanctions, the cost per 1 ruble of manufactured products has been increasing in all types of economic activity. After 2014, the unit cost rate as a whole decreases for all types of economic activity. The result is quite unexpected given that imported raw materials have significantly increased in price. It can be assumed that the bulk of industrial enterprises is represented by companies working with domestic raw materials. Lower unit costs could also be led by lower labor costs.

**4. Discussion**

Thus, an analysis of the state of industrial production in Russia in the post-2014 period showed that (according to Federal Service for State Statistics) negative external pressure on the Russian industry did not lead to the collapse of the main indicators. Even under existing restrictions on access to credit resources, there is an increase in industrial production in physical terms (growth in value terms cannot be an objective criterion), balanced financial result remains positive in each reporting period.

Nevertheless, the negative consequences for Russian industry do exist. The author expects the onset of major negative consequences in the medium and long term. They may be led by a ban on Russia's import of machinery and technology in hydrocarbon production. This is mainly the case with offshore and Arctic drilling technologies. The deposits located there are classified as complex, and in order to master them Russia needs the technology developed by the European countries and the United States.

Currently, Russia looks forward to the East in search for affordable technologies. But the technologies that China is able to offer are inferior to the European ones. The author suggests that the lack of adequate technologies could soon lead to an increase in hydrocarbon production cost and a weakening of Russia's competitive position in the international market. Thus, the main objective for sanctions application could be achieved. At the same time, a number of Russian scientists believe that the imposition of sanctions on the fuel and energy sector has a dual effect. On the one hand, they have negative consequences. On the other hand, they create encouraging conditions for industry restructuring. (Ismagilova et al. 2017.)

There is often a positive assessment of the impact of sanctions imposed on Russian industry among Russian economists. Authors who share this position (e.g. a team led by R.M.Nureev, in a monograph "Economic Sanctions Against Russia: Expectation and Reality", 2019), suggest

that sanctions will only lead to a slight decline in oil and gas production, while the countries initiating the sanctions will suffer from an increase in purchase prices of Russia's oil and gas resources. This position seems unfounded, given that (in the author's opinion) the purpose of imposing sanctions is to replace Russia's presence by the United States in the hydrocarbon market in Europe (primarily).

Another reason for a positive assessment of the impact of sanctions is the import substitution policy pursued by the Russian government (Novikov et al. 2019; Cherkesova et al. 2018). Some Russian researchers believe that "In general, we can talk about positive trends and an effective mechanism for the implementation of the import substitution strategy in Russia" (Novikov et al. 2019). According to the data (Novikov et al. 2019), the largest number of state import substitution programs is implemented in the aviation industry, by 2020 there should be 90 of them. In the area of mining it is expected to be 60 programs by 2020.

Thus, it can be concluded that at the moment the economic sanctions imposed on Russia have caused a number of negative consequences against Russian industry. However, it should be admitted that Russian industry as a whole is coping with negative pressure. This is partly facilitated by the import substitution policy pursued by the Russian government. Despite this, the negative effects of the sanctions could have long-term consequences and manifest themselves in the medium and long term.

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# Eco-innovations in Network Relationships of Enterprises for a Low-carbon Economy

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**Abstract:** Nowadays, taking into account economy, we are facing in the European Union transformation to a low-carbon economy. This process needs actions targeted for development of renewable energy sources, increasing energy efficiency, decreasing greenhouse emissions. Simultaneously, it is necessary to involve various entities in order to successfully carry out structural changes for implementation of low carbon economy. The paper presents the issue of networks between producers, which help them to adapt to the ongoing challenges related to a low-carbon economy and the development of innovations that are perceived as one of the most important elements of this process. In the latter case it is a particular type of innovation - eco-innovation. The scientific method is a case-study based analysis of good practices to present the issue of cooperation between enterprises which use eco-innovation to head towards a low-carbon economy. On the one hand, enterprises implement eco-innovations to adapt to the challenges of creating a low-carbon economy and on the other global companies wanting to support activities associated with combating climate change, seeking more and more highly specialized service providers who have innovative products, unique knowledge and skills necessary to perform complex objectives and expectations of the various groups of stakeholders.

**Keywords:** ecological innovations; low-carbon economy; enterprise networks; CSR

**JEL Classification:** D29; L260; M140

## 1. Introduction

Modern private enterprises are characterized by the ability to quickly adapt to changing external environment. It is an effect of the requirements of the free market economy, mechanisms of demand and supply conditioned by the needs and tastes of the customers and by access to production factors, the level of state involvement in the economy, scientific and technical progress, as well as of other challenges, such as ageing society, civilization diseases, or climate changes. All those are the challenges they have to face. In order to stay on the market and/or enter new markets, enterprises modernize and improve their products and services. They seek and implement innovations to increase the efficiency of various types of resources (people, material, finances, and information) at their disposal. In addition, they create new types of relationships between themselves which allow them to acquire knowledge and skills and to cooperate to increase the scale of operations, as well as to meet legal regulations and customers' needs, especially in the context of growing importance of care for the natural environment. Responsible business orientation, preceded by the awareness of today's and future realities of competition, mobilize to look for innovative solutions in business, new ways of operating which can improve the company's image on the market and often reduce the costs of its operations. In turn, these solutions (innovations), publicized and positively verified by the market, become a role model for other organizations.

Currently, particularly in the European Union, within the transformation to a low-carbon economy, activities related to adaptation to a new socio-economic development framework are being undertaken. The term of a low-carbon economy, popularized by the recent crisis of the real economy, is identified with the need for targeted actions:

- development of renewable energy sources,
- increasing energy efficiency,
- decreasing greenhouse emissions.

Implementation of a low-carbon economy needs direct actions, which requires a number of changes in different areas:

- legal regulations,
- fiscal and financial instruments,
- adaptation of sectoral policies of the state (particularly those related to energy, transport and construction),
- changes on the labour market (a new type of workplace, new skills),
- technological changes focused on energy and raw materials efficiency,
- greater use of knowledge and electronic systems for communication, automation and robotisation,
- rational waste management.

Moreover, governments, enterprises and societies need to take an active role. In this paper, the authors consider the issue of enterprises which are making the necessary changes:

- in production processes, aimed at increasing the efficiency of energy and raw materials use, and reducing greenhouse gas emissions,
- in relation to services rendered to make them more environmentally friendly,
- in the product offer (in relation to ecological issues).

The development of a low-carbon economy is related to a transformation process whose one of the key elements are innovations of a special type: those associated with environmentally friendly solutions. In literature we can find a wide selection of terms related to this word “innovation”. The genesis of the main issue of innovation is related to Joseph Schumpeter’s theory of economic growth and a business cycle (Lemanowicz 2015: 63-64). A low-carbon economy is related to eco-innovation, environmental innovation (Szajczyk 2017), green innovation and other related terms. Practice of their creation and implementation needs knowledge, experience, financial expenses and entities willing to take the associated risk. Networks between enterprises are useful in this matter.

The paper presents the issue of networks between producers, which help them to adapt to the ongoing changes related to a low-carbon economy and the development of innovations that are perceived as one of the most important elements of this process. Within the issue of networks, the innovations include:

- cooperation in green-energy investments;
- cooperation in implementation of new green-solutions in production, services or products;
- teamwork in waste management;
- cooperation with local subjects to overcome environmental problems;
- collaboration in development of social innovation related to the environment; co-actions in market education.

We have to take entrepreneurs into consideration due to the fact that, as Z. Ács and W. Naudé have written, *entrepreneurship is considered to be an important mechanism for economic development through employment, innovation, and welfare* (Ács and Naudé 2012:6).

A wide selection of literature presents backgrounds of the theory of networks between enterprises and practices related to this issue. In practice, it is possible to distinguish corporate networks (facilities, branches belonging to a given organization) or cooperative networks. The latter, which are increasingly developing on the market, are the so-called vertical networks (connections of independent entities in a vertical arrangement, e.g. the principal, service contractor) or horizontal (connections of competing companies in the form of at least associations, purchasing groups or franchise networks) (Kowalska 2012).

More and more publications also show the entities' involvement in solutions aimed at creating a low-carbon economy. They cooperate with others for obtaining such a goal. Further parts of this paper will include references to more literature. However, they present to a limited extent good practices in enterprise network systems for the development of eco-innovation and creating a low-carbon economy. This work is an attempt to fill this gap.

## 2. Methodology

The scientific method is a case-study based analysis of good practices in the area of cooperation between enterprises which use innovation to head towards a low-carbon economy. The following problematic questions will be considered:

- why do enterprises cooperate to create a low-carbon economy?
- which of the functional parts of their activity is a basis for cooperation?
- why are innovation one of the elements of cooperation towards a low-carbon economy?
- what kind of innovation is implemented by enterprises in cooperation networks?
- what are the aims of this kind of innovation?
- what is the role of Corporate Social Responsibilities?

## 3. Results

### 3.1. *The issue of connection between innovation and low-carbon economy*

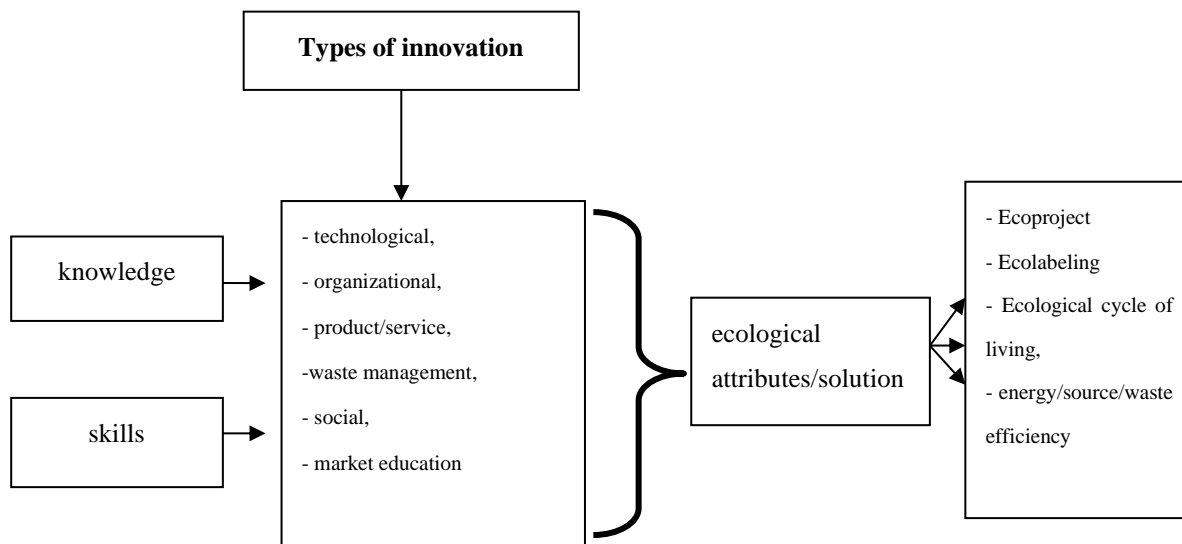
There is no one definition of a low-carbon economy on the level of the European Union. The document entitled "A Roadmap for moving to a competitive low carbon economy in 2050" mentions the transition, which means that *the EU should prepare for reductions in its domestic emissions by 80% by 2050 compared to 1990*. It is therefore necessary to take measures to reduce emissions, particularly of carbon dioxide, in the following sectors of the economy: energy, industry (especially heavy industry), transport, residential and services, and agriculture (EC 2011). In all those, the role of technological innovation is emphasised:

- energy: low-carbon technologies related to i.a. using renewable energy sources for energy generation;
- industry: i.a. *more advanced resource and energy efficient industrial processes and equipment, increased recycling*;
- transport: new engines, materials and design;
- residential and services: e.g. nearly zero energy buildings;
- agriculture: *sustainable efficiency gains, efficient fertiliser use, bio-gasification of organic manure, improved manure management, better fodder, local diversification and commercialisation of production and improved livestock productivity, as well as maximising the benefits of extensive farming*.

Detailed examples of technological innovations for a low-carbon economy are presented in the paper prepared by the experts of the Grantham Institute (Napp undated):

- aviation: biojet, hydrogen aircraft;
- industrial sector: carbon capture and storage, hydrogen in steelmaking, iron ore electrolysis;
- advanced biofuel supply: artificial photosynthesis for biofuels production, algae for bioethanol production;
- built environment: building materials alternative for steel and cement;
- negative emissions technologies: bioenergy with CCS, bio-char, ocean liming (OL), soda/lime process;
- energy storage: Thermal Cycle, Flywheels, Power-to-Gas, Lithium-Ion Battery, Redox Flow Battery, High Temperature, Sodium-based Batteries.

The specific kind of innovations mentioned above does not exhaust their catalogue. We can point out to those related to technology, organization, product/service, waste management, society, or market education. All of them, in terms of the issue of a low-carbon transition, should have ecological attributes (related to their living cycle) and/or introduce environmental friendly solutions (Figure 1.).



**Figure 1.** Innovation in transition to low-carbon economy.

Ecological features of innovation may be categorized by using more specific terminology. Innovations, related to the issue of a low-carbon economy, are characterized by the following terms:

- low-emission innovation,
- clean energy innovation and renewable energy innovation, energy efficiency innovation,
- climate-driven innovation,
- environmental innovation,
- eco-innovation,
- green innovation.

It should be emphasized that using the two last terms as synonyms is a misunderstanding. Eco-innovation is *the most precise and well-developed concept, whereas green innovation remains rather shallow* (Schiederling et al. 2012). Green innovation is more strongly related to environmental benefits than to environmental aim. Such opinion is consistent with the definition by Gerstlberger et al. (2014) taken from Pujari (2006), who defines green innovations as new successful products, processes, or services integrating one or more positive environmental aspects (Murzyn and Szyja 2015). Here we can point out to the term of “environmental innovation” which is used interchangeably with “eco-innovation” (Ozusaglam 2012). As Ozusaglam (referencing to Kemp and Pearson 2007) emphasizes: *most current definitions of eco-innovation are based on environmental performance rather than on environmental aim, since it is not the aim that is of interest, but whether there are positive environmental effects related to the innovation (“Measuring Eco-Innovation”).*

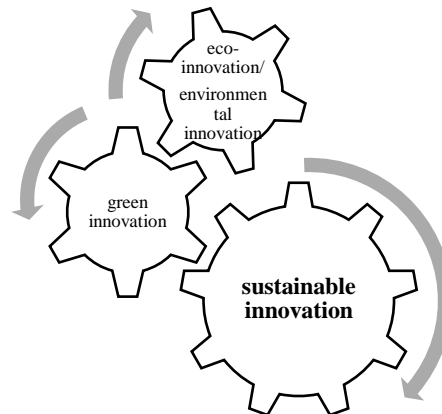
In other cases, the terms are explained as follows:

- low-emissions innovations: those allowing to reduce carbon dependency (OECD 2018);
- clean energy innovations: innovations related to generating energy from renewable energy sources; energy efficiency solutions facilitate i.a. energy storage (Vyas 2019);
- climate-driven innovation: innovation related to technological solutions aimed at reducing greenhouse gas emissions and mitigating the climate change (Nasdaq 2019).

We should also point out to the term of “sustainable innovation”. Lorek points out that *the key issue for making distinction between sustainable innovation and innovation in general is considering social and environmental factors. In order to develop an innovative solution in the sustainable category, it must have a positive impact on major environmental and social issues. Classic examples of sustainable innovations can be, for example, more efficient waste water treatment or the development of new types of dust reduction filters* (Lorek 2018:34).

According to the terms mentioned above, the largest range should be assigned to sustainable innovation. For this paper, eco-innovation is more appropriate since we take into account the features

of these innovations in the context of environmental impact. We should also point out that sustainable innovation is the widest embodied practical reflection of innovation in the context of the concept of sustainable development (Figure 2).



**Figure 2.** Sustainable innovation and its relation to eco-innovation and green innovation.

The role of innovation is strongly related to Europe 2020, the European Union’s strategy, in which the following is highlighted:

*Europe 2020 puts forward three mutually reinforcing priorities:*

- *Smart growth: developing an economy based on knowledge and **innovation**.*
- *Sustainable growth: promoting a more resource efficient, greener and more competitive economy.*
- *Inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.*

According to these goals, one of the flagship initiative of the EU is: “*Innovation Union*” to improve framework conditions and access to finance for research and innovation so as to ensure that innovative ideas can be turned into products and services that create growth and jobs (EU2010) . This sentence states the main aim of creation and implementation of innovation. The link between innovation and a low-carbon economy is mentioned in the second development objective discussed in the document (*smart growth*).

The literature presents the issue of innovation in terms of the issue of a low-carbon economy, taking into consideration i.a.:

- operational aspects of different functional areas of businesses,
- materials used (Xu 2011),
- creation of new sustainable raw materials cycles (Moser and Feiel 2019),
- energy and energy efficiency ( Scheffran and Froese 2016),
- offered products and services (Das and Jharkharia),
- involved stakeholders: government, business, society (Ekins 2011),
- waste management (Mohareb and Hoornweg 2017),
- activities taken by governments, e.g. in China (Lewis 2012),
- good practices of SME (Baranova and Conway 2017).

### 3.2. *Eco-innovation and enterprise networks*

The issue of enterprise networks is presented in the literature, taking into account both theoretical aspects of their formation, operational aspects of functioning, as well as practical ones (Ricciardi 2016).

Enterprise networks are very important for transition into low-carbon economy in view of:

- the need to embark on the development of new products and/or services while addressing societal and environmental issues (Leite and Latifi 2016),
- development of new “green” skills (Conway et al. 2017),
- optimize operational processes related to production and services (f.ex. energy efficiency, water efficiency, waste management),

- development of green public investments, and finally *entrepreneurship is critical in promoting the necessary industrial growth and development* (Hadjikhani et al. 2005).

This kind of networks are presented in literature by:

- innovation in SME's networks (Lindermann et al. 2009),
- product/service innovation,
- development of green supply chain network (Cao and Zhao 2013) - in mentioned strategy EUROPE 2020, is highlighted to strength the *innovation chain, from 'blue sky' research to commercialization* inter alia by public support (EU 2010).

The issue of enterprise networks is related with different types of them. For example Davide Knoke, according to considerations of Harrison White, writes: *producers are embedded within "networks of continuing flows" of goods and services, procuring inputs from upstream suppliers and selling their outputs to downstream purchasers. Every market involves three distinct economic roles (suppliers, producers, buyers) (...), with two separate market interfaces (the upstream supplier-producer and downstream producer-buyer boundaries)* (Konoke 2012: 60). Networks among producers in transition to low-carbon economy is needed because of cost of changes on operational level, investment in knowledge, development and implementation of innovations.

A modern enterprise, in order to maximize profits and develop over a long period of time, in conditions of such competition and still growing social expectations, has to meet the needs of various groups of stakeholders, minimize the broadly understood risk of business operations.

Business risk applies not only to the material but also to the non-material area in business (social capital, trust). Limiting the risk of traditionally understood supply chain (product quality, delivery time, etc.), as well as the growing importance of reputational risk, are two closely related areas, where an integral approach to risk management is the key and also the condition of the company's long-term success on the market.

Many companies (especially international ones) see an importance and real meaning of reputation in business, hence the visible involvement of these entities in corporate social responsibility (CSR). Pioneering companies in this area, striving to create new business models based on CSR, are focused on achieving efficiency based on pro-social and environmental innovations (FOB 2011: 18). The CSR requirement in business becomes, in a way, an impulse for broadly understood innovations (table 1).

**Table 1.** Key differences between traditionally understood business and business based on CSR principles.

<b>Traditional approach</b>	<b>Innovation resulting from the concept of CSR</b>
Focus on the company's economic capital (narrow perspective).	Perception of value of enterprise from a financial and non-financial perspective (the role of intellectual capital and social capital and trust).
Focus on maximizing shareholder value.	Building value for all of the company's stakeholders.
Focus on short-term goals.	Focus on short and long term goals and effects.
Disregarding social and environmental costs or failure to report the impact.	Measuring the company's impact on the environment and systematic reporting.
Communication with the environment - one way, asymmetrical.	Communication with the environment - dialogue, transparency.
Conducting business within the limits set by law.	Acceptance of voluntary, transnational commitments in the form of codes of conduct, taking into account social interests and environmental protection.

Source: FOB 2013: s. 8.



Companies, especially the largest ones, compete in innovative solutions, such as innovative services or products. However, the requirements for innovative projects and products have changed over time, today innovation must simultaneously meet the needs of consumers and take into account and think about the good of society and the environment. Therefore, the assessment of a given project cannot be limited only to cost-effectiveness, but should take into consideration integrated efficiency, where social, economic and environmental effects of cooperation between enterprises in the whole supply chains are indicated.

The above realities and business requirements are part of the extensive cooperation processes of enterprises (their network). In practice, this cooperation may concern supply, sales, cooperation with companies which are known as a competition (Burt 2001: 110). These areas correspond to the terms: backward linkages, forward linkages and horizontal links.

Vertical connections of enterprises (supplier-recipient) are of key importance from the point of competition process and organization of supply. Due to the extensive supply chains and the growing popularity of outsourcing contracts, there is a great reputational risk at this level and the need of minimizing it. For example, the well-known Swedish clothing company H&M cooperating with the network of over 700 independent suppliers in Europe and Asia (CENTRUMCSR.PL Foundation 2013: 23) Such extended supply chains mean that the implementation of reputational risk reduction strategy is complicated and requires the client's consistent orientation to a CSR-based business.

In a vertical cooperation system, it is necessary to supervise the activities within one's own organization, as well as to control the services provided by external companies (Bielewicz and Meronek 2009: 146). Possible misuses of the supplier are often equated in public opinion with the practice of the principals.

A new way of operating of network organizations, based on CSR principles, and thus more efficient use of available resources, can become a source of innovative solutions in business by searching for and implementing innovative products or solutions (FOB 2013).

An example of the above can be the approach used by the American retail chain Wal-Mart Stores Inc., which, for image and cost reasons, has introduced a new, ecological approach to management. To implement this approach, called Sustainability 360, specific pro-ecological assumptions were adopted which resulted, among others significant retailer savings on the US market. For example, in order to increase the fleet efficiency of the above-mentioned network, fuel-saving technologies were installed in trucks (e.g. engine calibration improved), more aerodynamic shapes vehicles were introduced to the fleet, loading efficiency was improved, road routes were verified (FOB 2011: 57). According to available data, these activities allowed delivering 3% more loads to stores in the USA while reducing the number of kilometers by 7% (FOB 2011: 57). The above actions allowed for savings of USD 200 million in 2008 (FOB 2011: 57). Another activity of the corporation was the implementation of cooperation with suppliers to reduce the size of packaging (by 5% to 2013 compared to 2008) of products offered in Wal-Mart stores (FOB 2011: 57). These activities were to bring specific savings in the form of lower fuel consumption during transport and reduction of CO<sub>2</sub> emissions. Savings for Wal-Mart were then estimated at USD 3.4 billion (FOB 2011: 57).

The above example shows that innovation, understood as a new way of operating, more efficient use of resources, is caused by a strong need of creating a pro-social image, and its effect is both benefits for the surroundings of the organization (state of the environment, health of the local community), as well as savings and demand benefits, felt by the organization itself.

A similar ecological solution was used by the global leader in the logistics industry, Raben Group. The scope of corporation's activities includes contract logistics, storage, road transport, distribution and service of online stores (FOB 2016: 123).

As part of an innovative approach aimed at reducing negative environmental impact and reducing operating costs, improving the quality of life of the local community, as well as setting responsible trends in the industry, the company decided to change the way it manages the car fleet, its offices and warehouses, and offered regular educational programs addressed to its stakeholders (FOB 2016: 123).

Raben Group operates, among others in Poland, Lithuania, Latvia, Germany and the Czech Republic. 85% of freight is transported in these countries by trucks, which means that significant amounts of fuel are burned and emissions are emitted (FOB 2016: 124).

Therefore, innovation concerned new solutions in managing key areas of the company's operations. In the scope of the car fleet, an eco-driving culture was introduced (reduction and monitoring of fuel consumption, employee training aimed at achieving ecological goals), and from 2012 the replacement of cars in the fleet with more ecological ones has begun; in the area of warehouses, solutions that have contributed to greater access to light in buildings and less resource consumption have been introduced (greater glazing in strategic locations of warehouses, installation of automatic light switches, energy-saving lighting, water start sensors) (FOB 2016: 124).

Another example of responsible management innovation, this time in the construction industry, is the approach taken by the MGPA group. The company manages, among others development and regeneration projects on the European and Asian market.

The product innovation for this company is office building the so-called the Rondo, the first building in Europe to have the DALI implemented, the system relating to lighting control (FOB 2016: 121). This building operates entirely based on renewable energy (FOB 2016: 121).

The building provides high ecological efficiency through a system that allows individual adjustment and control of each bulb and blinds; the use of energy-saving light bulbs, the latest ventilation and air conditioning systems, the use of devices with low water consumption (FOB 2016: 121). The latter solution reduced water consumption by 30% in 2012 (FOB 2016: 121). On the other hand, cooperation and education of tenants resulted in greater waste segregation and a change in transport (from car to urban) in getting to work (63% of tenants indicated such a change).

In turn, the Tesco chain of stores, representing the FMCG industry (the so-called high-speed industry, e.g. food, household chemicals, cigarettes), has started cooperation with DS. Smith, which resulted in the creation of new streams of selected waste suitable for recycling (FOB 2016). Redirecting a significant portion of waste from landfills to alternative waste treatment technologies means a reduction in operating costs for the company and creates the basis for building its image as a socially responsible organization.

Additionally Tesco declares that it undertakes all activities to ensure building lasting relationships with suppliers, using supplier audits carried out in accordance with recognized SMETA guidelines (FOB 2016).

The British network of Tesco, in cooperation with specialized suppliers, in addition to replacing the refrigerant R-404A with R-448A in commercial facilities, which in practice ensures a 68% reduction in direct carbon dioxide emissions (advanced refrigeration systems), invests in efficiency of energy and renewable energy sources; (Honeywell 2017: 2). Thanks to installed solar panels, the use of windmills and a ground heat exchanger, the company develops fully energy-efficient stores that use natural energy.

Network relationships between corporations and service contractors are an important part of the supply chain. An effective supply management chain is becoming an essential element for increasing the competitiveness and dynamics of development of international enterprises, which is why they are willing to transfer selected functions to their suppliers.

Such cooperation is often followed by the transfer of technology, eg. in the form of proprietary right transfer of know-how (eg. patents or licenses), product design and production processes and to determine their detailed specifications, counseling and assistance in adapting new technology. The literature emphasizes the role and importance of support providers by international corporations, which results in the development of innovation through implementation of various areas of cooperation between the parties discussed cooperation (eg. the introduction of a new product, information sharing).

On the other hand, global companies wanting to support, among others activities associated with combating climate change, seeking more and more highly specialized service providers who have innovative products, unique knowledge and skills necessary to perform complex objectives and expectations of the various groups of stakeholders. This cooperation is the foundation of change and solutions in line with market needs on a global scale.

### 3. Discussion

Nowadays, in the face of a number of challenges, especially those that have a social and environmental dimension, enterprises are looking for and implementing various solutions to meet them. They take an active part in creating a low-carbon economy. They create new business models based on CSR and related with introducing different kinds of eco-innovation. Business cooperation processes are very helpful in this respect. Cooperation of companies concerns among others practices for increasing resource efficiency, operational efficiency, reducing product packaging, and processing waste. It should be also highlighted that companies are seeking highly specialized service providers with innovative environmental friendly products, services or operational solutions to perform complex objectives and expectations of the various groups of stakeholders.

Areas for further research and analysis:

- identification of factors determining the implementation of pro-ecological innovations in the SME sector operating in a network system and outside the network;
- identification of internal and external barriers in the implementation of green innovations in network relations and outside network enterprises;
- improving the business model as a source of value in business relations;
- transfer of pro-ecological technologies from transnational corporations to local enterprises of host countries.

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# Organic Farming in Poland and the Czech Republic - Comparative Analysis

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**Abstract:** The aim of the article was to assess organic farming in Poland and in the Czech Republic and the changes that occurred in these countries after their accession to the European Union. The study used statistical materials published by FIBL, IFOAM and Eurostat, as well as Czech reports on the state of organic farming. The basic time range of the data covers the years 2000–2018. The article uses basic methods of statistical data analysis, i.e. Pearson correlation, trend lines, and dynamics indicators. Analyses showed changes in these countries in the area, in the number of producers, and in processing plans of organic food. Despite the significant increase in the area of organic farming in Poland, the share of these crops in relation to the total area of agricultural crops in the country is small. The country that develops very dynamically in this respect is the Czech Republic. In Poland, a downward trend has been noticed since 2014, both in respect to the cultivated area and the number of organic producers. However, the increase is visible in the number of organic processing plants. In the Czech Republic, the residents' expenses on organic food are also noticeably higher than in Poland.

**Keywords:** organic farming; organic food; development; Poland; the Czech Republic

**JEL Classification:** Q15; Q18; Q56

## 1. Introduction

Organic farming is a broadly understood, but logically complex system of managing the whole production (Barłowska and Wolanciuk 2017). It applies to both plant and animal base. The basic issue that characterizes this type of production is maintaining a number of strictly defined standards (IFOAM, 2005). Such factors (e.g. a high degree of biodiversity, or very good animal husbandry) must necessarily be presented on ecologically certified farms. Importantly, all production should be based only on natural methods. Organic farming does not contain GMOs, pesticides, synthetic fertilizers, growth regulators, or any feed additives. Any mechanization is also limited. Soil fertility is ensured by means of a well-planned crop rotation. The choice of plants (their species and varieties) and animals (their species and races) is one of the basic principles of managing organic farming. All of that contributes to achieving the main goals, i.e. environmental protection as well as high-quality plant and animal products (Rigby and Câceres 2001). In this way, it can be argued that organic farming can be profitable (Kielbasa 2015). Despite the fact that the yields are usually significantly lower and the time of livestock farming much longer, the prices of manufactured products are also much higher than those from conventional farms. Therefore, the fact is that organic farming has been undergoing significant development and growth for several years. It is worth noting that this is especially noticeable in the member states of the European Union.

The development and growth of organic farming would not be possible without properly formulated and enforced legal regulations. In the past, it was a responsibility of an EU working group. Currently, an important role in creating legislative framework is played by The International Federation of Organic Agriculture Movements (IFOAM). It was formally established in February 2000. Two years later, it was registered in Sweden as an international non-profit organization. Since 2003, its headquarters have been located in Brussels (see <http://www.ifoam-eu.org/>). From this moment it has been this institution that sets international rules for organic farming. It defines its goals and

framework of functioning. Constantly, to the present, this is the legislative base and a reference for the formulation of national legal provisions. The creation of the 'Europe 2020' Strategy, described by Kowalska and Kovárník (2019), presenting sustainable development (i.e. supporting a resource-efficient economy, more environmentally friendly and more competitive as one of its three mutually reinforcing priorities) has had a significant impact on the development of organic farming in the European Union, and thus also in the new Member States.

The purpose of the article was to make a comparative analysis of organic farming in Poland and the Czech Republic over the years 2000-2018. These countries were chosen intentionally, as representatives of the Eastern Bloc and important trading partners. These countries are close neighbours and members of the European Union, which they joined at the same time (Kowalska et. al. 2017). However, it should be noted that both the structure and conditions for conducting agricultural activity in both countries differ significantly (Olszańska and Dittrichová 2018).

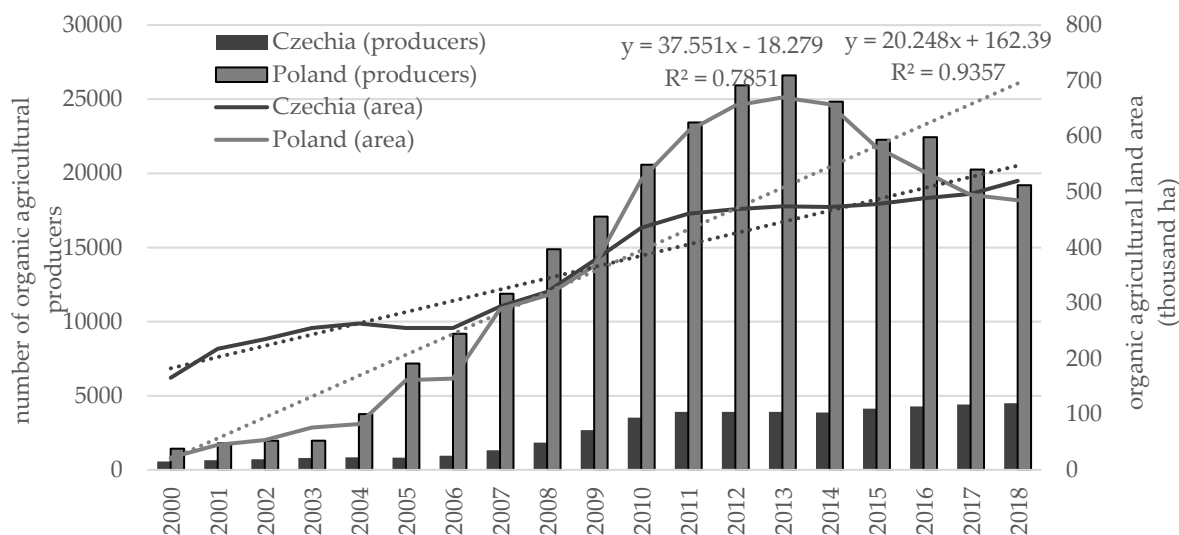
It is intended to pay particular attention to the impact of these countries' accession to the European Union on the analysed issue. The differences and similarities included in the study concern the most important, in the authors' opinion, issues related to organic farming.

## **2. Methodology**

The study used statistical materials published in the form of reports and statistics by FIBL and IFOAM, as well as Eurostat. The data sheets regarding organic farming published by Poland and the Czech Republic were also used. The subject of the analysis were two neighbouring countries that joined the European Union at the same time, i.e. Poland and the Czech Republic. The basic data interval covers the years 2000–2018 (some analyses, due to lack of data, end in 2017). The study used the method of literature discussion, based on both Polish and foreign literature on the subject. The essence of this method is to relate the diagnosed problem to existing knowledge. It shall help significantly address all kinds of issues related to organic farming in the above mentioned neighbouring countries. The article uses basic methods of statistical data analysis, i.e. Pearson's correlation, trend lines, dynamics indicators, and cluster analysis. For the discussed countries, time series of the number of organic farms, their area, and the share of the area of organic farms in the total area of agricultural land were presented. For them, a trend function line and a determination coefficient  $R^2$  were determined. It was assumed that for  $R^2 \geq 0.70$  the fit of functions to empirical data is very strong.

## **3. Results and Discussion**

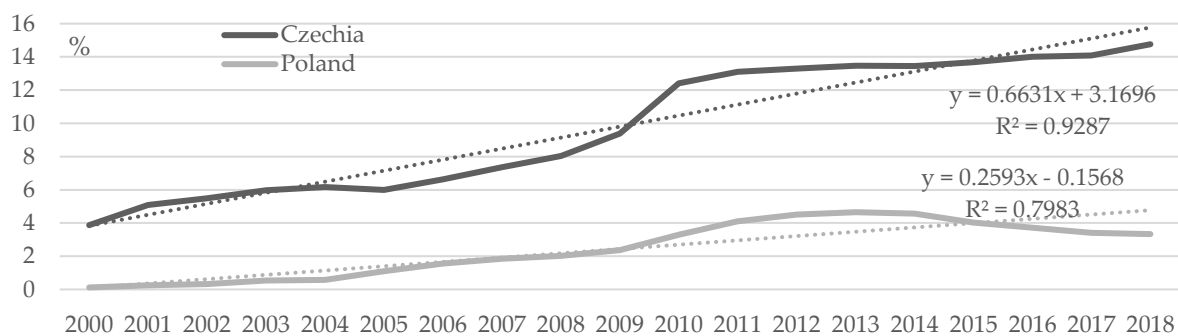
Organic farming in Poland and the Czech Republic, after accession of these countries to the European Union, has begun to develop. This development was more or less intense in each of these countries. The analysis of the area of organic farming indicates that it developed more dynamically in Poland, which was especially visible after 2004 (Fig. 1). In the years 2000–2018, it increased more than 21 times, where the largest increase by almost 710% (from 83,000 ha to almost 670,000 ha) was recorded in the years 2004–2013. After 2013, the area of these crops decreased by over 27.6% (during the last 5 years, i.e. from 670,000 to 485,000 ha). This trend continues. In Poland, the area of organic farming grew annually by over 37.55 thousand ha in the years 2000–2018, with a very good trend line fit ( $R^2 = 0.78$ ). In the Czech Republic, the area of organic farming grew more than three times in the analysed period (from 166,000 ha to over 520,000 ha). In the case of this country, the average annual increase in area during the period under review was over 20.25 thousand ha, with a very good fit ( $R^2 = 0.94$ ).



**Figure 1.** Area and number of producers of organic agricultural land in Poland and the Czech Republic in 2000–2018 (number, thousand ha).

The analysis of farms engaged in the cultivation of organic food in the discussed countries varied. The largest number of organic producers in the entire analysed period was observed in Poland, where it was 19,207 in 2018. The largest number of organic farms in Poland was recorded in 2013 (26,598). After this period, their number has begun gradually decreased. Over 5 years, their number decreased by 28%, i.e. by 7,391 farms. In 10-year period (2003–2013) the number of entities operating organic farms increased 12 times. In turn, throughout the whole considered period it was a 12.5 fold increase; annually by approximately 1,465 producers ( $R^2 = 0.796$ ). The number of organic farms in the Czech Republic was much lower than in Poland. In the Czech Republic, it was 3,929 in 2018, while their number increased almost 7 times in the whole analysed period (i.e. by 3,937 producers), or in other words by 269 farms per year (with a very good fit of the  $R^2$  trendline = 0.912).

The share of the area occupied by organic crops in the total area of arable land was also estimated (Fig. 2). The data obtained indicate that Poland has a much larger total area of the agricultural land than the Czech Republic. In 2018, the area of arable land in Poland amounted to 14.7 million ha, while in the Czech Republic it was 3.5 times smaller (4.2 million ha). However, the share of the area occupied by organic farming in Poland was almost 4.5 times smaller than in the Czech Republic.



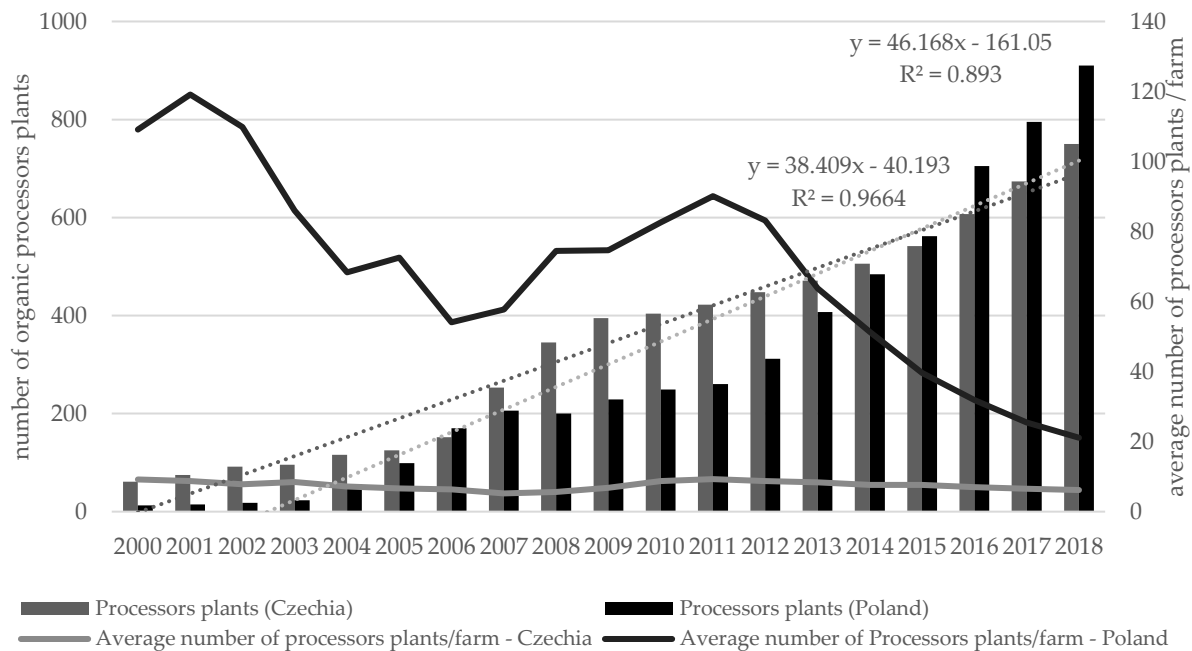
**Figure 2.** Share of organic farming area in Poland and the Czech Republic in 2000–2018 (% of UAA).

In the Czech Republic, organic farming area in 2018 represented almost 15% of the total agricultural area. In 2000–2018, this share increased by almost 11%, and the average annual growth in the area of organic farming was 0.66%. In Poland, the share of organic farming area in the total utilized agricultural area was significantly lower than in the Czech Republic. In this country, the area of organic farming covered only 3.33% of agricultural land in 2018. Over 19 analyzed years this area increased only by 3.21%, and the average annual growth in the area used for organic farming in Poland is 0.26%.



The fit of the trend line for both the Czech Republic and Poland was very good (it was  $R^2 = 0.93$  and  $R^2 = 0.80$  respectively).

The changes in the number of processors of organic products and their average number per one agricultural holding in the discussed countries were also analysed (Fig. 3). In the turn of 2000–2018, the number of ecological processing plants increased significantly both in the Czech Republic and in Poland. In the analysed period, their number grew more than 69 times in Poland, and more than 11 times in the Czech Republic. In Poland, their number has increased every year on average by 46 processing plants ( $R^2 = 0.89$ ), while in the Czech Republic by 38 ( $R^2 = 0.97$ ).

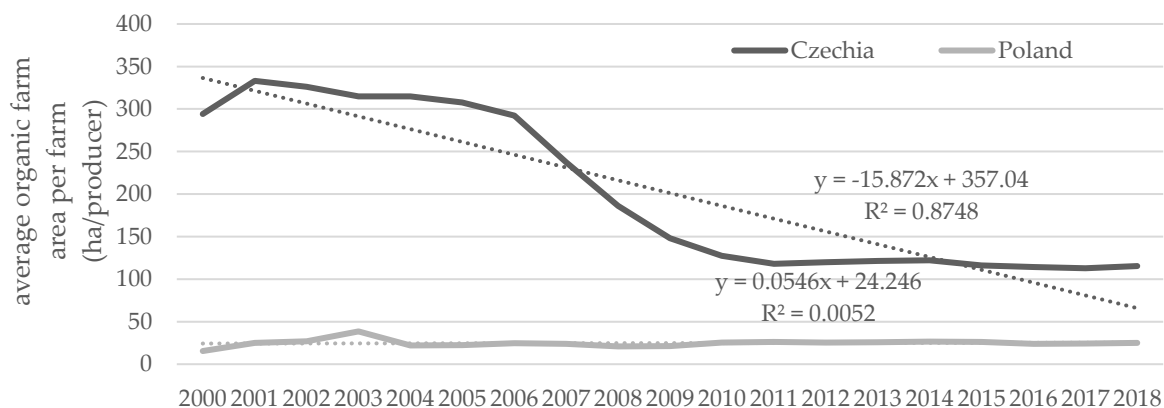


**Figure 3.** Processors plants and average number of processors plants per organic farm in 2000–2018.

Analysis of data on the number of processors showed that their growth was much smaller than that of agricultural producers in the analysed period. A significant problem with the lack of processors was particularly visible in Poland, where there was on average one processor per 119 organic farms in 2001. From 2001 to 2006, a downward trend was visible, indicating that the number of organic processors was increasing at a higher rate than the number of agricultural producers. Another significant increase in the number of producers per one processor was visible in the years 2006–2011. In 2011, there were on average 90 farms per one processor in Poland. Such a small number of processors contributed to the resignation of many farmers on running organic holdings, as the lack of the possibility of processing the perishable raw material, and the low interest of Polish consumers in organic products (caused by their high prices) do not encourage this business activity. This has been visible since 2011, with a downward trend in Poland related to the number of organic farms per one processor. It led to a greater extent by the systematically decreasing number of organic farms than by the creation of new processors in Poland. The situation is completely different in the Czech Republic, where in 2000 there were on average about 9 farms per a processor, while only 5 in 2007. Another increase in the average number of agricultural producers per one processor took place in 2007–2011. Since 2011, the Czech Republic has experienced a systematic decline in the average number of organic producers per one processor, mainly due to the emergence of new companies that are likely to see prospects for development and profits in this business.

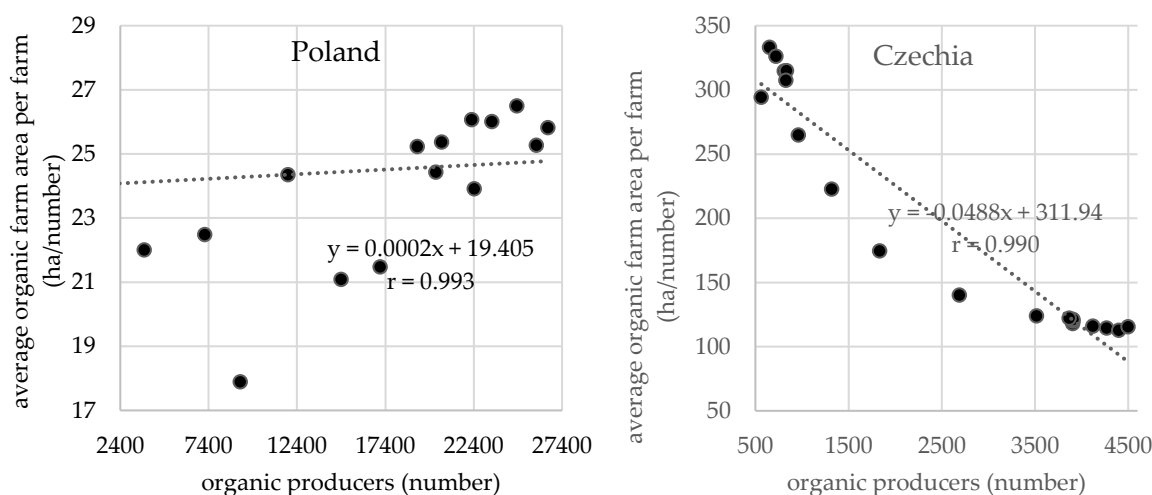
An analysis of the average size of an organic farm in the surveyed countries showed that in 2018 the average size of organic farms in the Czech Republic was 115.5 ha, and it was 4.6 times bigger than in Poland (25.2 ha) (Fig. 4). In the years 2000–2018, the average area of an organic farm in the Czech Republic dropped by almost 61% (by 179 ha), the annual decrease in the studied years was about

15.9 ha / farm ( $R^2 = 0.87$ ). In Poland, unlike the Czech Republic, the average farm area increased in the analysed period (by almost 63%). The average size of an organic agricultural holding in Poland increased over 19 years by 9.7 ha, which gives growth of 0.055 ha annually.



**Figure 4.** Changes in the average land area of an organic farm in Poland and the Czech Republic in 2000–2018 (ha/producer).

Using the Pearson’s correlation coefficient, changes in average organic farm size and number of organic farms were assessed in Poland and the Czech Republic (Fig. 5).



**Figure 5.** Correlation between the number of organic agricultural producers and the average farm area in 2000–2018 (number, ha/producer).

The analysis of the relationship between these variables showed, in the analysed years, a strong positive correlation in the case of Poland ( $r = 0.993$ ) and a strong negative correlation in the case of the Czech Republic ( $r = -0.999$ ). A positive correlation in the case of Poland indicates an increase in both the average area of farms and their number, while in the case of the Czech Republic the number of organic farms grew faster than their average area. Based on these facts can be concluded that in the studied period there were new organic farms established in Poland, which increased their acreage, while the tendency to reduce the area of farms dominated in the Czech Republic.

The analysis of data regarding organic cultivation showed that same crops are cultivated in both countries, which is largely related to the geographical location, similar in the case of both countries. (Table 1).

**Table 1.** Organic land area for selected crops in Poland and the Czech Republic in 2008-2017 (ha, %).

Specification	Berries	Cereals	Pulses and protein crops <sup>1</sup>	Fruit, temperate	Grapes	Nuts	Oilseeds	Root crops	Strawberries	Vegetables
<b>Poland</b>										
2008	13,322.0	62,845.0	3,681.0	6,208.0	no data *	39,300.0	1,397.0	1,951.0	1,020.0	1,544.0
2009	7,930.0	77,473.0	3,993.0	6,709.0	14.0	16,729.0	1,465.0	1,969.0	1,078.0	1,132.0
2010	10,350.0	102,274.0	8,338.0	17,547.0	96.0	33,114.0	2,381.0	2,338.0	1,021.0	1,761.0
2011	11,971.0	109,511.0	9,591.0	36,792.0	22.0	22,028.0	1,315.0	2,617.0	867.0	1,967.0
2012	14,633.0	122,818.0	12,252.0	41,990.0	35.0	1,152.0	1,573.0	2,780.0	904.0	2,825.0
2013	15,052.0	123,229.4	17,670.3	45,553.7	209.1	1,642.2	2,002.1	3,100.9	1,280.7	13,105.0
2014	14,270.0	111,506.1	23,603.6	41,325.7	245.6	1,602.6	1,031.7	3,015.8	1,335.7	9,977.4
2015	13,395.0	101,436.0	44,066.0	30,401.0	278.0	1,432.0	1,820.0	2,393.0	1,255.0	6,901.0
2016	14,391.0	101,148.0	55,968.0	18,616.0	258.0	1,200.0	2,802.0	2,232.0	1,264.0	8,071.0
2017	14,886.8	116,083.1	43,372.7	10,573.9	289.3	1,203.6	4,084.3	1,946.6	1,254.0	10,236.1
Change 2008-2017(%)	11.7	84.7	1,078.3	70.3	1,966.7	-96.9	192.4	-0.2	22.9	563.0
R <sup>2</sup>	0.42	0.38	0.85	0.06	0.84	0.68	0.38	0.02	0.47	0.60
Average annual change (ha)	496.1	3,921.7	5,740.3	1,236.8	36.8	-4,065.3	183.8	21.8	38.5	1,132.2
<b>Czech Republic</b>										
2008	211.9	18,566.7	1,293.0	2,526.2	341.0	17.6	1,147.2	245.9	2.4	315.3
2009	342.0	24,535.0	1,462.0	3,173.0	645.0	57.0	1,191.0	256.0	8.0	501.0
2010	379.0	24,485.0	1,785.0	4,308.0	770.0	136.0	2,303.0	283.0	7.0	1,025.0
2011	484.7	24,381.6	1,845.0	5,683.8	978.3	140.5	2,319.3	288.6	5.6	738.7
2012	585.7	27,444.2	2,368.7	5,917.8	869.9	170.4	1,985.7	270.1	5.8	454.4
2013	475.7	25,883.9	1,944.3	5,998.2	1,004.5	178.4	1,736.6	270.7	3.6	167.5
2014	554.4	24,255.4	1,893.2	4,845.5	881.3	97.6	2,045.8	262.2	4.4	110.4
2015	369.0	27,904.0	2,300.6	4,740.0	1,021.0	146.0	2,056.0	247.0	9.0	225.7
2016	305.0	27,633.0	2,632.7	4,106.0	885.0	171.0	2,000.0	233.0	3.0	185.9
2017	323.1	29,482.9	3,455.1	4,435.0	787.9	188.9	1,322.1	285.7	4.0	248.3
Change 2008-2017(%)	52.5	58.8	167.2	75.6	131.1	976.1	15.2	16.2	63.2	-21.3
R <sup>2</sup>	0.02	0.67	0.77	0.14	0.38	0.55	0.04	0.00	0.02	0.32
Average annual change (ha)	4.8	818.7	181.5	142.0	41.2	13.8	29.9	-0.4	-0.1	-54.4

<sup>1</sup> for the production of grain

\* no data available - analysis since 2009

In Poland, as well as in the Czech Republic, cereals occupy the largest area under organic farming. It was almost 116.1 thousand ha in 2017 in Poland, while less than 29.5 thousand ha in the Czech Republic. Over 10 years, the area under cereal crops increased in Poland by 85%, while in the Czech Republic by almost 59%. In Poland, large crop areas were also occupied by dry legumes and high-protein plants (43.4 thousand ha), berries (14.9 thousand ha), fruit (10.6 thousand ha) and vegetables (10.2 thousand ha) in 2017. In contrast, the highest dynamics of acreage growth during the 10 years studied was recorded in the case of growing grapes (almost 20-fold) and dry legumes and high-protein plants (almost 11-fold). However, the decrease in crop area was recorded in the case of nuts (-96.9%) and root crops (-0.2%). In the Czech Republic, in addition to the already mentioned cereals, the largest were the crops of dry legumes and high-protein plants (3.46 thousand ha) and fruit (4.44 thousand ha) in 2017, while the largest increase in the cultivated area (almost 10-fold) during the analysed period related to nuts. On the other hand, the area of vegetable cultivation was significantly reduced (by 1/5).

The value of food sales on the Polish and Czech market was also assessed (Fig. 6). In 2017, the value of the organic food market in Poland amounted to EUR 235 million, while it was EUR 93.6 million in the Czech Republic.

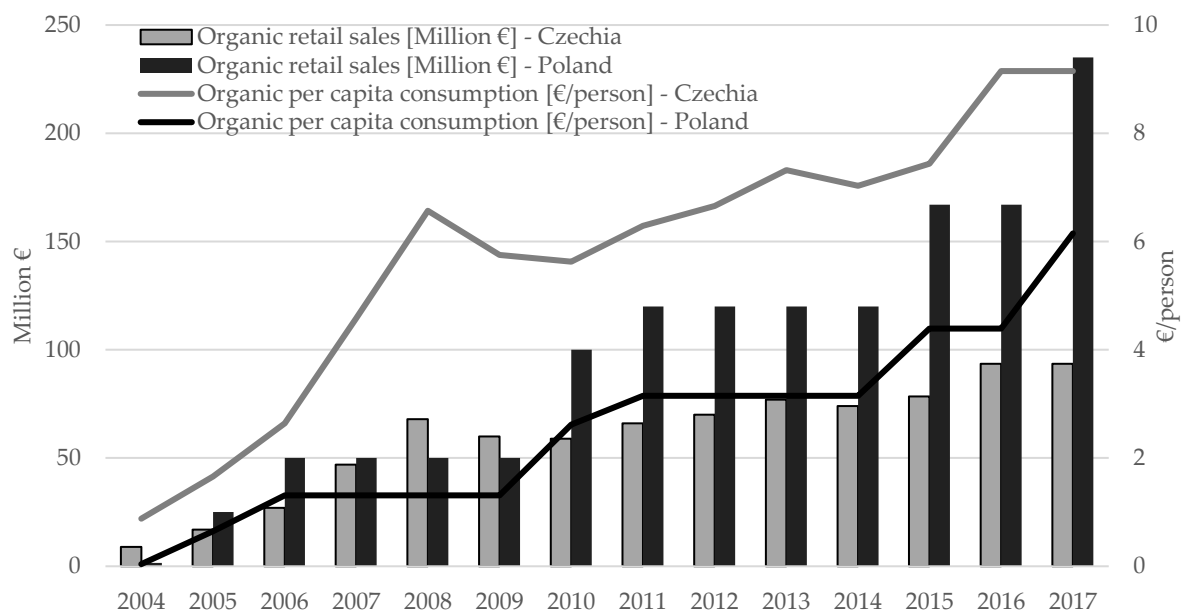


Figure 6. Organic food sales value in Poland and the Czech Republic in 2004–2017 (million €, €/person).

In the years 2004-2017, the value of this market increased almost 148 times in the case of Poland, annually it was an increase by 15 million EUR on average (with a fit at a high level of 0.92). On the other hand, it was a 9-fold growth in the case of the Czech Republic, where the average annual value of this market increased by 5.9 million EUR (a fit of the trend line at a high level of 0.88). Despite the high value of organic food sales in Poland, when calculating this value per capita, we note that an average Czech spent more on organic food than a Pole. In 2017, a Czech resident spent on average 9.15 EUR on organic products, while an average Polish citizen expenses amounted to 6.15 EUR. However, the analysis of growth dynamics in the years 2004-2017 showed that the value of organic food sales per capita grew faster in Poland than in the Czech Republic in the studied period. In Poland, over 14 years it was almost 153-fold increase (from 0.04 to 6.15 euros), while in the Czech Republic 11-fold (from 0.88 to 9.15 euros).

## 5. Conclusions

Poland, despite a larger utilised agricultural area than the Czech Republic, has a significantly smaller share of organic farming. In 2018, the share of organic farming area in Poland was only 3.3% of arable land, while in the Czech Republic it was nearly 15%.

In the Czech Republic, a growing interest of agricultural producers in converting their holdings to organic farming is evident throughout the entire analysed period. In the Czech Republic, both the crop area and the number of producers and processors of organic food increased, while in Poland has been visible a systematic decrease in the area of crops and the number of organic producers since 2014. In Poland, in the whole analysed period, increased only the number of organic food processors, although for many years they were a bottleneck in the national organic food distribution channel. And yet food, not only organic, belongs to perishable and seasonal products, so that to be available on the market throughout the year, it requires appropriate processing.

The resignation of many Polish farmers from conducting organic agricultural holdings was, to a large extent, a consequence of growing uncertainty among them as to the requirements related to running organic farms and subsidies received from the state. There have been changes in regulations regarding procedures and rules for providing assistance to organic food producers in Poland since 2014. Over a 5-year period (2014–2018), they changed seven times. These changes were the reason for delays in issuing subsidies to organic farmers (the so-called ecological payments) and, consequently, also in the payment of funds allocated. Another reason for the resignation of Polish farmers from running organic farms were the growing requirements for the harvested crops. According to the regulations, an organic producer should at least 80% of his production allocate for sale or processing. Some of these regulations contributed to the elimination of farmers who were not engaged in production for the market but only collecting subsidies. However, such excessive commitments meant that many organic farms lacked produce to feed their own animals (which then had to be bought by the farmers). The farmer might also have problems selling organic products on the increasingly competitive organic food market. High prices of organic products also mean that despite the view that Polish and Czech societies are getting richer, only some of the households could afford them (the share of organic food in the food market in Poland was around 0.3%, while in the Czech Republic 0.9% in 2017).

In these countries, there is a visible tendency for farmers to keep medium-sized organic farms, which is certainly dictated by the way organic farming is carried out. Therefore, there is a visible trend to reduce the area of organic farms, visible in the Czech Republic. The reasons for such situation include, among others, problems with recruiting employees as organic farming (to a greater extent than traditional agriculture) requires manual work. On the other hand, due to the small scale of production, organic farms have difficulties in achieving profitability. As Komorowska (2012) notes, the smallest farms (up to 10 ha of UAA) show the highest level of productivity of land and capital resources. With an increase in a farm size, the productivity of land and capital resources deteriorates. In smaller organic farms, the structure of arable land has a larger share of vegetable, fruit and edible potatoes, i.e. products for which farmers obtain relatively higher prices compared to the prices of conventional products, which in turn translates into their production and economic results.

Consumers often have a misconception about organic farming as it seems to them that organic production does not require any activities (no spraying, fertilizers, etc.), everything grows by itself. Therefore, according to them, such products should be cheaper. In fact, in organic farming, specialized and natural fertilizers are used, which means high costs. As emphasized by the expert of the Polish Chamber of Organic Food, an important barrier to the development of organic farming is the fact that the conversion of a farm into organic production is a long process that takes about three years. During this time, additional high costs must be incurred and stringent standards must be met in order to obtain eco-certification. It is only after this period that a certificate is obtained and organic products can be sold. The farmers, all the time, need to work on the soil, to improve the humus content of the soil, apply green manure (after harvesting, it is necessary to sow plants that build humus), add natural fertilizers, which are more expensive. It requires a lot of work with the soil to make it live, adding soil microorganisms, etc. All of this is of great importance if high-quality crops are to be achieved.

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# Investing in Gold: Good or Bad Choice? 20-Year History

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**Abstract:** In times of prosperity and economic growth, many people can save part of their income. At the same time, people are increasingly considering where to put their savings. Perhaps the most important factor in this is appreciation rate - while in bank accounts these interest rates do not exceed the level of inflation, alternative forms of investment may offer higher appreciation rates. The aim of this paper is to assess the benefits of investing in physical gold in the period from 2000 to 2019. It turns out that although investing in gold is referred to as long-term, and hedging rather than investment, the opposite is true. In the last twenty years, there have been only a small number of cases where an investor would not profit by buying in gold. In the vast majority of cases, it would reach an average annual appreciation of around 9% p.a., except for only a few years, when the gold price reached its maximum values. Generally, it can be stated that if an investor does not have enough information and does not want to entrust his / her savings to investing with the bank, purchasing physical gold will not make a mistake with a few exceptions. This exception is mostly easy to recognize - everyone will know that the price of gold reaches new maximum values.

**Keywords:** gold; investment; stock market; investor

**JEL Classification:** E22; E44; G51

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## 1. Introduction

The basic prerequisite in economic theory is maximizing consumer's utility. Expenditures incurred by consumers on consumer goods utility almost immediately as they usually consume these goods immediately. In many cases, however, the consumer does not spend all his income on the purchase of consumer goods but saves some part, which creates just savings - investments.

When investing, however, the assumption of maximizing consumer utility remains. The goal of any rational person is profit or return on investment. However, when deciding where to deposit (invest) available cash, not only profit or appreciation rates, but also liquidity and risk are taken into account. Liquidity can be understood as the ability to convert assets into money quickly and without significant losses, while any asset that is liquid is also easily traded. Risk then expresses the risk of not achieving the expected results (returns), in the investment environment can distinguish the basic types of risks, which are inflationary risk (causing a decrease in purchasing power of investment), interest (causing market), liquidity risk (insufficient market demand for the asset), currency risk (depreciation of the currency in which the investment is held), and market risk (eg changing trading conditions for different types of assets).

Current time is characterized by the possibility of choosing from a large number of different assets that can serve as investments, but this has not been the case in the past. Gold and silver served as money because coins were made of them (Green 2007). Because precious metals initially served as a tool of exchange, their tenure was more similar to today's form of savings. Given that in ancient Greece interest-rate lending, as well as the accumulation of assets, were not considered natural and philosophically correct, the only way to increase the wealth of the people at that time was to purchase other real assets.

A few thousand years later, however, people broke free from gold and silver as money. Precious metals began to be considered too rare to be paid for goods of common consumption, so they began to

be replaced by other metals, later paper money and nowadays deposit (virtual) money. The advantage of this “modern” money is the speed of payment - for example, a payment card transaction is settled immediately, even over long distances (Svobodová and Hedvičáková 2015). On the contrary, their potential disadvantage and at the same time the common feature is that they are not covered by any real assets (such as the aforementioned gold or silver), which leads to an ever-greater decrease in their purchasing power over time (Rejnuš, 2016). In the first half of the 20th century, the US dollar was covered by gold. This meant that anyone at that time could come to the bank and demand a certain amount of gold of a predetermined value for the paper bill. So there was a gold standard, but several times the dollar was artificially changed against gold. The reason was that the dollars were printed much more than the amount of reserve gold available. In 1971, the exchange rate of 1:35 (\$ 35 per 1 oz of gold) became unsustainable for the US, because European countries, led by France, began to demand gold from the US in exchange for "war" dollars. Following a dramatic decline in gold reserves, President Richard Nixon abolished the convertibility of the dollar into gold, leaving a period of open fiat currencies. Since then, gold has become a real investment in modern concepts that is durable, versatile and easily convertible, divisible, and at the same time is a store of value (Worthington and Pahlavani 2007).

## 2. Methodology

This paper aim is to analyze when in the last 20 years and at what investment horizon the investment in gold was profitable for the investor.

The first part describes the development of world gold mining. These are annual data for the period from 1700 to 2018. At the same time, countries with a significant share in the world gold mining are identified and gold reserves compared with the development of the human population. Interestingly, the proportion of gold per person in the world is also calculated. Data from internet portals that specialize in gold mining and gold prices and population data are used in the analysis.

In the second part, there is an analysis of the development of the price of gold from 1800 to 2019. The price is given in dollars per troy ounce and it is average of average closing daily price. This part is then more focused on the history of the last twenty years (ie 2000-2019). For this period, the appreciation rate of gold ( $i$ ) for each year is calculated according to the formula:

$$i = \sqrt[t]{\frac{FV}{PV}} - 1 \quad (1)$$

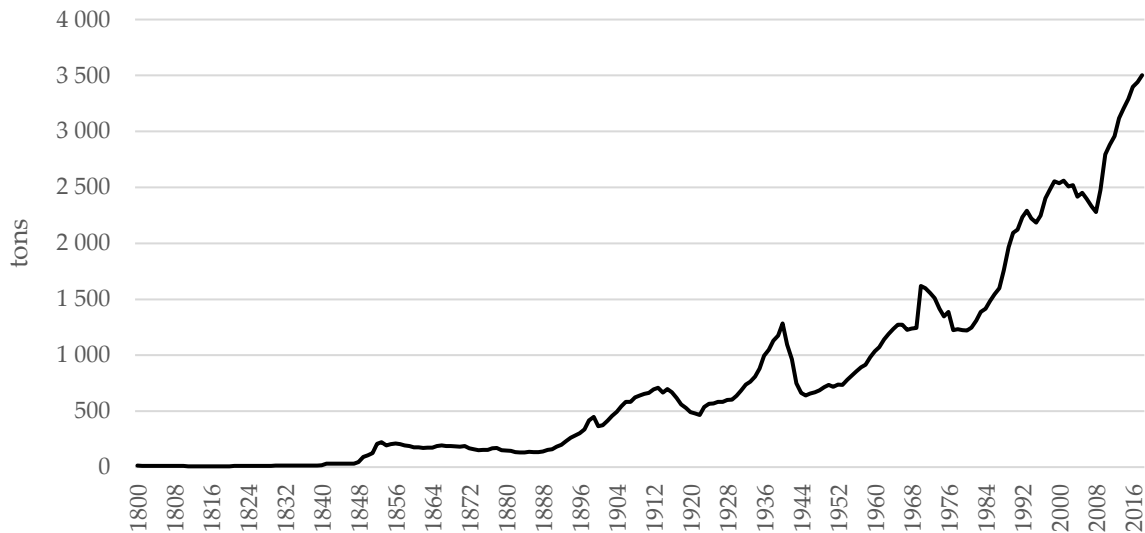
where future value  $FV$  denotes the future price of gold, present value  $PV$  the current price of gold and  $t$  the investment horizon (number of years). This appreciation rate is calculated for all years in the period 2000–2019, and for investment horizons of 1–20 years. The result, therefore, allows comparisons in which of the last 20 years the investment in gold has been the most profitable and for how long it has paid off to buy gold.

## 3. Results

### 3.1. Development of world gold mining

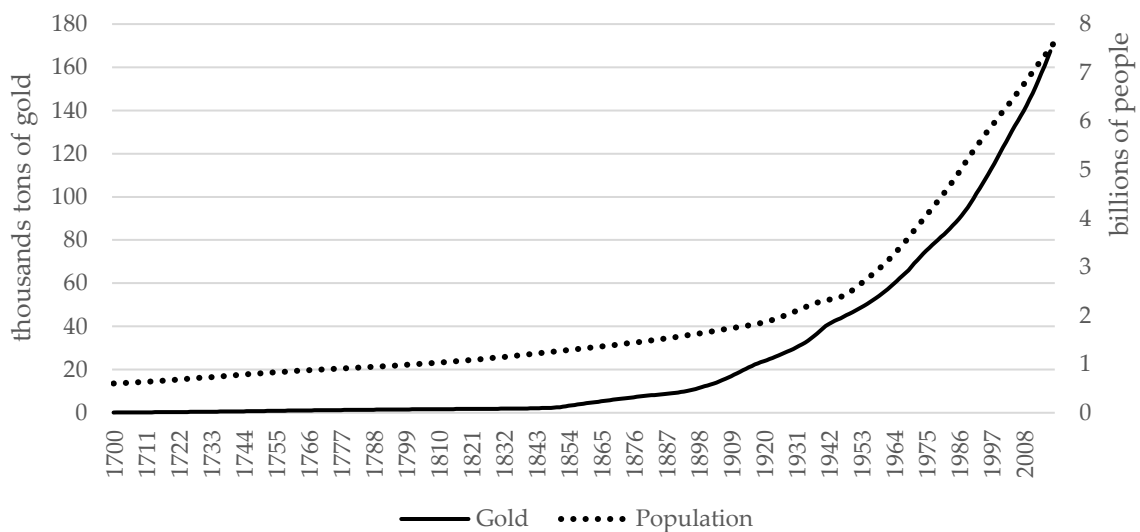
In ancient times, gold mining was carried out manually and it was relatively inefficient. This fact is confirmed by data - until the mid of 19th century, the volume of annual gold mined represented only units, a maximum of tens of tons. With the advent of the Industrial Revolution, the volume of mined gold increased and since 1900 it has been at least 500 tons each year. The significant decline in mining was recorded during World War II. For example, in 1945, the annual volume of mined gold was 640 tonnes, a decrease of more than 50% compared to 1940, where a total of 1283 tonnes was mined (Our World in Data 2019). The development of gold production is shown in Figure 1:





**Figure 1.** Gold production in tons per year, own processing based on (Our World in Data 2019; Gold Hub 2019).

Gold production has increased dramatically in the last ten years. Thus, the supply of gold has increased, which has been and still is counteracting the dramatic rise in its price that could be expected in connection with the stimulation of the economy through quantitative easing. While a total of 2,794 tons of gold was mined in 2010, eight years later in 2018 it was already 3,503 tons of gold (Gold Hub 2019). The total volume of gold production is increasing by an exponential trend, as does the human population, see Figure 2:



**Figure 2.** Gold mined – cumulative (thousands tons) in context with population development since 1681, own processing based on (Our World in Data 2019; Gold Hub 2019; World Bank 2019).

By 2018, South Africa had the largest share of the world's gold production, with almost 53,000 tons of gold being mined, followed by the United States of America with 19,000 tonnes and Australia with 14,388 tonnes (see Table 1). In recent years, it can be stated that the largest countries such as China, Russia, the USA, Canada, and Australia have the largest share in the current world gold production. However, these numbers are treacherous, a very substantial share is also represented by smaller countries, for example in Africa or South America. Because these countries are developing countries where labor costs are relatively low compared to the other countries in the developed world, this is also reflected in the mining costs and hence the final price of gold (see below).

**Table 1.** Gold mined until 2018 in selected countries, own calculation based on (Our World in Data 2019; Gold Hub 2019; World Bank 2019).

Country	Gold mined (tons)	Country	Gold mined (tons)	Country	Gold mined (tons)
South Africa	52,735	China	8,646	Mexico	3,255
United States	19,086	Uzbekistan	4,683	Colombia	2,966
Australia	14,388	Peru	4,030	Indonesia	2,879
Russia	11,522	Brazil	3,680	Papua New Guinea	2,305
Canada	11,424	Ghana	3,472	Zimbabwe	2,059

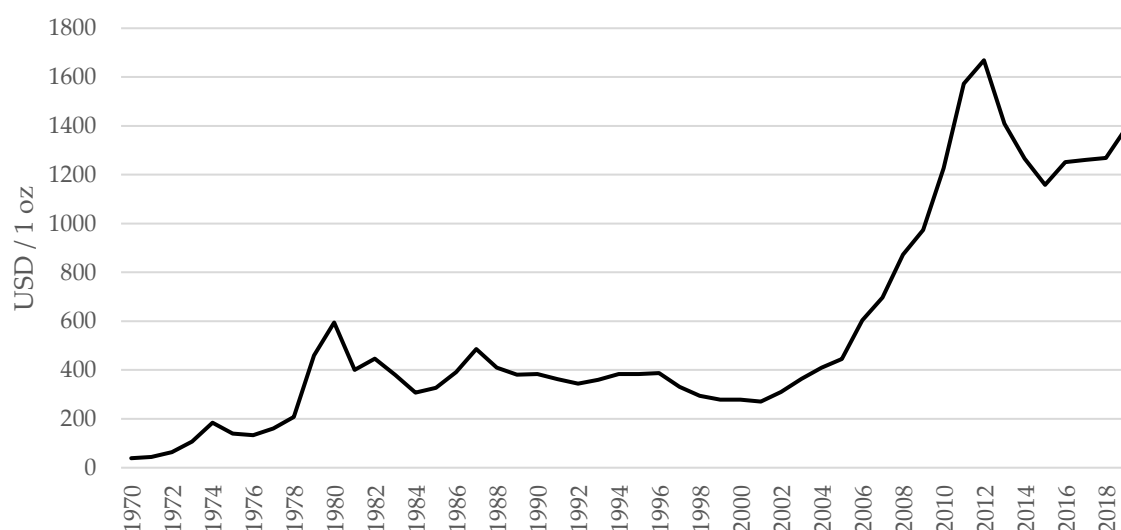
It is clear, however, that the exponential trend in gold mining will not continue indefinitely and is only a matter of time before gold mining begins to slow down. However, due to similarly exponential development of the total human population, the share of gold per capita remains at about the same level and is 0.79 oz (24.57 grams):

**Table 2.** Gold per person (troy ounces), own calculation based on (Our World in Data 2019; Gold Hub 2019; World Bank 2019).

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
0.69	0.70	0.70	0.71	0.71	0.72	0.72	0.73	0.73	0.73
2010	2011	2012	2013	2014	2015	2016	2017	2018	
0.74	0.74	0.75	0.76	0.76	0.77	0.78	0.79	0.79	

### 3.2. Investments in Gold

Given the ever-increasing gold production, one might expect its price to fall. This could be supported by the fact that nowadays the investor can invest his money in many alternative investment instruments or real assets. However, if we look at historical gold prices, we find that in the last 20 years, its average closing price has risen from less than \$ 280 per 1 oz in 2000 to \$ 1,391.8 in 2019. So it was a more than five-fold increase in its price. However, it was not a constant increase, and during these 20 years there was also a significant decrease between 2012 - 2015:



**Figure 3.** Gold price (USD per oz), own processing based on (Macrotrends 2019a).

However, a retail (small) investor does not have, nor can he have perfect information (Soukal and Draessler 2012) based on which he can determine with certainty the future development of the gold price. His investment is, therefore, like any other, exposed to the risk of loss, but this loss can be eliminated if the investment horizon is extended, as in the case of shares, for example. One example is the bear market period between 2012 and 2015 when the price of gold fell from about \$ 1670 per 1 oz to \$ 1158 per 1 oz. This was a decrease of around 30%. However, such an investor would have to wait another 2-3 years and the price of his gold would reach the parallel level as in 2012.

The resulting appreciation of the “gold” investment over the last 20 years is shown in the following Table 3. For each year since 2000, the appreciation according to the above formula (1) is calculated. These values can be compared with the appreciation of other investments or even with the interest rate on savings accounts in banks.

**Table 3.** Appreciation of gold in 1 - 10 years since 2000 (p. a.).

Year	Price	Length of investment (years)									
		1	2	3	4	5	6	7	8	9	10
2000	279.3	-2.9%	5.4%	9.2%	10.0%	9.8%	13.7%	13.9%	15.3%	14.9%	15.9%
2001	271.2	14.3%	15.8%	14.7%	13.2%	17.4%	17.0%	18.2%	17.3%	18.3%	19.2%
2002	310.1	17.3%	14.9%	12.8%	18.2%	17.6%	18.8%	17.8%	18.8%	19.8%	18.3%
2003	363.8	12.6%	10.6%	18.4%	17.6%	19.1%	17.8%	19.0%	20.1%	18.4%	14.5%
2004	409.5	8.7%	21.5%	19.4%	20.8%	18.9%	20.1%	21.2%	19.2%	14.7%	11.9%
2005	445.0	35.8%	25.1%	25.2%	21.6%	22.5%	23.4%	20.8%	15.5%	12.3%	10.0%
2006	604.3	15.2%	20.1%	17.2%	19.4%	21.1%	18.4%	12.9%	9.7%	7.5%	7.6%
2007	696.4	25.3%	18.2%	20.8%	22.6%	19.1%	12.5%	8.9%	6.6%	6.7%	6.1%
2008	872.4	11.6%	18.6%	21.7%	17.6%	10.1%	6.4%	4.1%	4.6%	4.2%	3.8%
2009	973.7	26.0%	27.1%	19.7%	9.7%	5.4%	2.9%	3.7%	3.3%	3.0%	3.6%
2010	1,226.7	28.2%	16.6%	4.7%	0.8%	-1.1%	0.3%	0.4%	0.4%	1.4%	1.3%
2011	1,573.2	6.1%	-5.3%	-7.0%	-7.4%	-4.5%	-3.6%	-3.0%	-1.5%	-1.4%	
2012	1,668.9	-15.5%	-12.9%	-11.4%	-6.9%	-5.5%	-4.5%	-2.6%	-2.2%		
2013	1,409.5	-10.2%	-9.3%	-3.9%	-2.8%	-2.1%	-0.2%	-0.2%			
2014	1,266.1	-8.5%	-0.6%	-0.1%	0.1%	1.9%	1.6%				
2015	1,158.9	8.0%	4.3%	3.1%	4.7%	3.7%					
2016	1,251.9	0.7%	0.7%	3.6%	2.7%						
2017	1,260.4	0.7%	5.1%	3.4%							
2018	1,268.9	9.7%	4.7%								
2019	1,391.8	0.0%									

For a retail investor, investment in gold is generally considered as a long-term investment. Nevertheless, it was possible to achieve any return of investment within only one year, in 16 out of the last 20 years. The same was true for the investment period of 2 or 3 years. In the longer term, there was an increase in the price of gold, offsetting the possible loss (highlighted in gray in Table 3) if the investor was unlucky and bought the gold in the year when its price was at its highest (eg 2010-2013).

The average appreciation of gold with an investment period of only one year has been almost 9.2% p.a. since 2000 (the last 20 years). Even in the case of longer-term investment, the average annual return on this gold investment remained broadly unchanged, and in all cases exceeded 9% p.a.:

**Table 4.** Average appreciation of gold in 1 - 10 years since 2000 (p. a.).

Length of investment (years)									
1	2	3	4	5	6	7	8	9	10
9.16%	9.51%	9.52%	9.52%	9.59%	9.65%	9.64%	9.77%	9.99%	10.22%

In the case of investment in gold over a longer period, the appreciation has always been positive over the last 20 years ranging from an average of 3.3% p.a. per year to 18.0% p.a. if the investor started investing in 2001:

**Table 5.** Appreciation of gold in 11 - 20 years since 2000 (p. a.).

Year	Price	Length of investment (years)									
		11	12	13	14	15	16	17	18	19	20
2000	279.3	17.0%	16.1%	13.3%	11.4%	10.0%	9.8%	9.3%	8.8%	8.8%	8.4%
2001	271.2	18.0%	14.7%	12.6%	10.9%	10.7%	10.1%	9.5%	9.5%	9.0%	
2002	310.1	14.8%	12.4%	10.7%	10.5%	9.8%	9.2%	9.2%	8.7%		
2003	363.8	12.0%	10.1%	10.0%	9.3%	8.7%	8.7%	8.2%			
2004	409.5	9.9%	9.8%	9.0%	8.4%	8.5%	7.9%				
2005	445.0	9.9%	9.1%	8.4%	8.5%	7.9%					
2006	604.3	6.9%	6.4%	6.6%	6.1%						
2007	696.4	5.6%	5.9%	5.5%							
2008	872.4	4.3%	4.0%								
2009	973.7	3.3%									

As in the shorter investment horizon, the average return of the gold investment was always around 9% p.a., the highest was an average of 10.2% p.a. if investing for 11 years:

**Table 6.** Average appreciation of gold in 11 - 20 years since 2000 (p.a.).

Length of investment (years)									
11	12	13	14	15	16	17	18	19	20
10.2%	9.8%	9.5%	9.3%	9.3%	9.2%	9.1%	9.0%	8.9%	8.4%

#### 4. Discussion

Most people use bank products - savings accounts or various funds - to save or invest. While the older generation is conservative and does not make much use of modern banking technology, the young generation takes the bank account and credit card for granted. Nevertheless, this young generation has some reserves in financial literacy (Hedvičáková et al. 2017). It turns out that, instead of actively seeking investment opportunities, young pupils and students only increase consumption spending. They then use pocket money to buy extra goods, and in fact, no one discourages them and prepares them for the "real world", although this can be beneficial for both students and educational institutions (eg universities) in many areas. (Novotná 2019) The style of our time living here and now is more than encouraging.

In addition to merchants, banks also benefit from these purchases. As cash payments are still popular, they charge considerable processing fees and, despite significant cash processing costs (Král 2017; Král and Hájek 2017), they make billions of profits (Finance 2019). Therefore, banking institutions will by no means offer investors alternative investment opportunities, they will always prefer to sell their products - mutual funds, savings accounts, perhaps even buying real estate on credit.

These products are often disadvantageous for investors. For example, in savings accounts, the appreciation rate usually does not exceed the level of inflation. In reality, people lose the value of their savings every year by saving on bank accounts. In the case of investment funds, there may be an appreciation rate that is higher than the inflation rate, but a frequent disadvantage is that investors have to fully trust the bank and often does not even know exactly what it is investing in. The final profit may also be influenced by the exchange rate, which allows further speculation, eg in the period of the end of foreign exchange interventions of Czech National Bank, companies assumed an appreciation of CZK, therefore, the volume of loans denominated in euro compared to loans denominated in CZK etc (Mačí et al. 2017).

In the case of investment in physical gold, this situation cannot occur, moreover, unlike most other investments (stocks, virtual currencies), it is a “net” investment that does not produce any carbon emissions (Baur and Oll 2019). Equally worth mentioning is the comparison of gold and bitcoin, which is said to be virtual gold. So if an investor prefers virtual currency instead of physical gold, he does not invest in virtual gold, as these two “investments” show quite different tendencies. Bitcoin, for example, is much more volatile and, in contrast to gold, responds to financial market events quite the opposite (Klein et al. 2018).

## 5. Conclusions

In many economic and banking books we can read that investment in real assets is a long-term investment. The long-term investment horizon is generally longer than five years and is therefore comparable to the investment horizon for shares or different funds. Investing in a variety of funds, whether equity or bond or otherwise, is generally encouraged, as opposed to investing in precious metals. Political representativeness tells people to save for retirement savings, banks offer their clients various equity, bond, real estate or other funds... However, investments in precious metals are not mostly actively recommended nor by politicians (government representatives) nor banks.

The question remains why this is the case, as the price of gold has risen by about five times over the past 20 years. By comparison, the average closing value of the Dow Jones stock index was about \$ 10,730 in 2000, and about \$ 26,500 in 2019 (Macrotrends 2019b). Compared to gold, therefore, the appreciation of this index was about half. For ordinary people who do not have enough information or rely on social networks marketing information (Hruška and Pásková 2018) and have to rely on the advice of others, this situation is sad.

Of course, it can be argued that no retail investor can buy gold at a middle price, and the price of buying and selling varies considerably, storage costs are not zero, etc., as well as the price of other companies' shares rising much more than average stock indices. This discussion could, therefore, go in many ways, but the point remains indisputable: the average closing price of gold has increased much more than average closing price of stock indices over the past twenty years. So if someone has bought physical gold since 2000, he made a "mistake" only if he bought it when everyone knew the gold price was at historical highs.

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# Active Diversification Tools in the Portfolio of Investment Strategies

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**Abstract:** Investment strategy can be defined as set of rules that identifies BUY or SELL trading signals. There are a lot of investment strategies based on different analysis of capital markets. Investment strategies can be seen for example in mutual fund, hedge funds but also in PAMM systems. Investor invests through these strategies in order to maximize the value of his trading account. Dynamic development of capital markets can cause that single investment strategy can stop working. Main question is how can be investor protected from this situation? Basic way to avoid the situation of one loss strategy is the diversification. In this paper the author tests two tools of active diversification – Moving average and Ideal equity curve. Both of these tools are tested on two different data samples. On the one hand simulated data sample shows that Ideal equity curve is able to protect investment capital. On the other hand, active diversification tools did not prove predict power on real data sample. This situation was caused due to the fact, that real data sample is created only by two loss strategies. Goal of this paper is to test active diversification tools in environment of simulated and real data.

**Keywords:** active diversification; investment strategy; moving average; ideal equity curve

**JEL Classification:** G11; G17; G32

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## 1. Introduction

According to Tomasini and Jaekle (2009) the term investment strategy can be characterized as set of rules that identifies buy or sell signals. These signals are defined exactly so investment strategies can be executed by different algorithms (without human intervention). Graphical representation of changes in the value of trading account (performance of trading account) in time is called Equity Curve.

Today, there is not only the possibility of investing cash in conventional financial instruments (stocks, bonds, ETF, mutual funds etc.), but thanks to advances in the financial industry also in new financial services. These solutions allow investors to invest in complex investment strategies (trading systems). PAMM (percent allocation money management) systems and other similar financial services bring to investors a lot of new financial opportunities. Compared to the hedge funds, PAMM systems are available with lower starting capital. However, the dynamic development of the financial market can cause that any investment strategy can completely stop working. For example, Stonham (1999) analyses hedge fund called Long Term Capital Management (LTCM). This fund ran into trouble in 1998 mainly as a result of the late 1997 financial crisis in Asia spreading in 1998 to Latin American countries and Russia. Fund lost 44 % (2.1 billion USD) of investors' money in august, and more than 52 per cent from the beginning of the year. After this fall LTCM generate net return (after fees) 21% in its first year, 43% in the second year and 41% in the third year.

If we look at fatal failure of the individual investment strategy there is a question how can be investor protected from this situation. Basic method of protection investment capital is diversification. The principle of diversification consists in redistributing the investor's capital into the various financial instruments. The basic capital distribution approach is naive diversification. The principle of this kind of diversification means, that the investor evenly distributes his capital into the financial instruments. This approach is also understood as passive, because naive diversification concept does not require a deeper analysis of assets included in the portfolio. Conversely, the concept of active diversification requires a deeper analysis of assets and selects only potentially better assets into the portfolio. The goal

of an active approach is to overcome the passive approach. The main question is how these active approaches are capable to overcome the passive diversification of capital.

DeMiguel et al. (2009) compared 14 different diversification models with 1 / N approach. All these models were constructed with regular portfolio rebalancing. Author's results point to the fact that none of 14 diversification models was consistently better than naive diversification in terms of Sharpe ratio. This fact was due to author's opinion caused by estimation error in parameters. Their results are confirmed by Allen et al. (2016). By analyzing portfolios created from European indices, these authors did not confirm the higher performance of actively diversified portfolios over the naive diversification performance. Authors Hwang et al. (2013) also tested the performance of naive diversification compared to the optimal portfolio. Like DeMiguel et al. (2009), they demonstrated that the naive diversification overcame by its performance the optimal portfolio. They argue that the portfolio created on the base of naive diversification is characterized by increased exposure in the left tail. It means that such a portfolio tends to have not only a negative coefficient of skewness, but also an increased positive coefficient of kurtosis compared to normal distribution. Statistical data has rather concaved properties, which again confirms the fact, that naive diversification tends to overcome the optimal portfolio. The last factor that results in an increase in performance is associated with the number of assets held in the portfolio. A higher number of assets in the portfolio results in an increase the characteristics in the naive diversification. According to Tu and Zhou (2011) Markowitz's modern theory of portfolio and all its extensions lag behind the principle, what is in line with the results of previous authors. Authors understood the concept of total portfolio diversification as a combination of principle with four other models. Ultimately, the authors achieved better results of the risk-return profile compared to the naive principle.

Blumenthal (2014) states that diversification is effective only with low-correlation assets. But also, correlation can change through time. In time of financial globalization, there can observed higher correlation coefficient not only with same asset classes but also in different. This globalization effect is stronger in turbulent times (Sandoval and Franca 2011). Moldavan (2011) investigated increased correlation at the time of financial crisis. By the regression analyzes, he follows two time periods: the pre-crisis 2003-2006 and the crisis period 2007-2010. His results point to the fact that in the time of financial crisis there is a higher degree of interconnection of the capital markets. Thus, synchronized stock market meltdowns can be problems also for diversified portfolios.

This paper is focused on two diversification tools – Moving averages as a tool of active diversification and Ideal Equity Curve as a tool of active diversification.

## **2. Methodology**

In this session is described methodological concept. The author divides methodology session in to three parts – Data (2.1.), Tools of active diversification and Final portfolio algorithm (2.2.) and Performance indicators of active management in investment strategies portfolio (2.3.)

### *2.1. Data*

In this paper are used two different data samples. First, the author uses simulated data of Equity curves based on the simulator, which generates individual equity curves in 5293 trading days. The generator principle is based on random distribution of monthly deviations calculated from real monthly DJIA 30 data during the whole monitored period. The obtained simulated data will thus not have the character of randomly generated data, which are characterized by a normal distribution of deviations in the form of a Gaussian curve. From these simulations are chosen five Equity Curves with growth trend and five investment strategies with loss trend. This sample is used for the purpose of first test of active management with same number of growth and loss Equity Curves. These data are also useful to reach minimum level of correlation. From these Equity Curves the author randomly choose 30 portfolios construct by five investment strategy. In the first 10 portfolios there will be only one randomly chosen Equity curve with strong loss trend. In next ten simulations there will be two Equity curve with strong loss trend and in the last ten simulations there will be three investment



strategies with strong loss trend. With loss equity curves there is an option to get closer look on active tools ability to protect investor's portfolio.

**Table 1.** Types of strategies (simulated data).

Strategy type	Strategies	Average return correlation
Growth strategy	EC1, EC2, EC3, EC4, EC5	-0.0019
Loss strategy	EC6, EC7, EC8, EC9, EC10	-0.0020

Second, in the article are used real investment strategies form quantopedia.com. This portal concentrates academical papers, which discuss about methods of investment strategies construction. From this database the author chooses 17 available ideas of constructing individual investment strategies. All of 17 ideas were set from starting date 1.1.2005 and to end date 30.11.2019. From this data sample are also created 30 random and different portfolios, which consist of five different investment strategies.

**Table 2.** Types of strategies (real data).

Strategy type	Strategies	Average return correlation
Market timing	EC9, EC11, EC12, EC 14, EC16	0.2128
Stock Picking	EC8, EC10, EC13, EC6	0.0299
Momentum-equity	EC1, EC2, EC3, EC5, EC7, EC12, EC15	0.1592
Forex	EC4	N/A
Arbitrage	EC17	N/A

## 2.2. Tools of active diversification and final portfolio algorithm

### *Moving averages*

First, the author uses the Moving average system as a tool for selecting investment strategies into the portfolio. In this article are used three different moving average periods ( $X=50$ ,  $X=100$  and  $X=200$ ). The algorithm for selecting investment strategies into the final portfolio is based on the cutting principle. If the closing value of the investment strategy is higher than its moving average, investment strategy is selected into the final portfolio. Table 1 summarizes entry and exit condition for investment strategies.

**Table 3.** Buy and sell conditions for Moving average.

	Condition for ENTRY	Condition for EXIT
Moving average	Close price > MA (X)	Close price < MA (X)

Moving average concept in investment strategies portfolio was tested by authors Kisela et. al. (2015). Authors managed investment strategies portfolio by technical analysis indicators. Their study point to the fact, that the worst results achieved moving average.

### *Ideal equity curve (IEC)*

The idea of Ideal Equity Curve (IEC) was presented by Virdzek et al. (2018). Authors defined IEC as a hypothetical curve (hypothetical benchmark) with growing trend without negative volatility. This curve represents at least wanted equity curve performance in the future. Authors also points to a problem of setting the slope for IEC. They state that the basic slope for IEC is 0. In this situation the investor protects his capital from loss situation. Due to authors higher slope for IEC pushes on individual performance of investment strategies. IEC is used in three different slopes. First IEC=0 (basic slope), second IEC= 0.00026 (as a daily return captured from MSCI world index) and third IEC= 0.00038 (as daily return when investor requires 10% return per year). Entry algorithm is set again on cutting principle. If Equity Curve performance is greater than IEC performance than investor invest

into the investment strategy and vice versa if performance of the investment strategy is lower than performance of IEC investor extracts investment strategy from portfolio.

*Final portfolio algorithm*

From simulated and real data, the author creates thirty different portfolios. Each of this portfolio is made by five different Equity Curves. Individual EC are managed by active portfolio tools (Moving average and Ideal Equity Curve). If any of five EC in time is in BUY mode the investment strategy is included to final portfolio and investor's capital is evenly divided into BUY mode strategies. The author compares these final portfolios with benchmark that is always set as naive diversification from five selected strategies.

2.3. *Performance indicators of active management in investment strategies portfolio*

The author evaluates performance of Final portfolio by Total return, Maximum drawdown and Recovery factor.

*Total return*

In the article is used a Total return indicator as a representant of yield part of investments. Fernandez and Fernandez (2018) state that if a rational investor invests in the long-term, he cares about the state of his investment (Total return) at the end of the investment horizon (e.g. retirement). Due to author, rational investor diversifies his portfolio to minimalize risk. The author says that investors are not even interested in maximizing Sharp's ratio or minimizing the volatility of their portfolios. The only thing the investor is interested in is the total return when the investment horizon is met

In this paper are used discrete returns  $r_{t_0}^t$  defined as:

$$r_{t_0}^t = \frac{P_t}{P_{t_0}} - 1 \tag{1}$$

where  $T > t_0$ ,  $P_T$  is close price of investment strategy at time  $t$ ,  $P_{t_0}$  is close price of investment strategy at time  $t_0$ .

Then total return is set as percentage rate of return (loss) observed from whole period under review.

*Maximum drawdown*

As a representant of risk measure is chosen Maximum drawdown indicator. Pospisil and Vecer (2008) defined as the largest drop of the asset price within a certain time period. Due to authors Maximum drawdown can be viewed as a contingent claim that can be priced and hedged using the standard risk-neutral valuation techniques. If  $P_t$  is close price of investment strategy at time  $t$ , then maximum price in time  $t$  is defined as:

$$M_t = \max_{u \in [0, t]} P_u \tag{2}$$

Then Maximum drawdown ( $MDD_t$ ) at close price of investment strategy is defined as:

$$MDD_t = \max_{u \in [0, t]} (M_u - P_u) \tag{3}$$

*Recovery factor*

Recovery factor indicator is used as a representant of overall final portfolios performance. It compares both sides of investment: risk part and yield part. Recovery factor is defined as:

$$RF = \frac{\text{Total return of investment strategy}}{|MDD|} \tag{4}$$

### 3. Results

#### 3.1. Individual performance of investment strategies

Table 4 represents individual performance indicators for both data samples. Simulated data are characterized by stronger performance indicator compared to real data sample. Due to this fact, there is an ability to test both active management tools in the environment of high gains and losses. In the real database, there is only two investment strategy with negative value of Total return (EC6 and EC15). These strategies are based on momentum principle. The best constructed strategy (from the point of view of the highest value of Recovery factor) is strategy EC12 which is based on market timing. Market timing trading strategy is based on rotation between two risky assets.

**Table 4.** Individual performance of simulated and real data samples.

EC	Real data			EC	Simulated data		
	Total return	Max. DD	Recovery Factor		Total Return	Max. DD	Recovery factor
EC1	103.54%	-29.49%	3.511	EC1	880.25%	-56.5%	15.57
EC2	278.78%	-70.34%	3.963	EC2	1329.68%	-60.3%	22.04
EC3	312.94%	-53.84%	5.812	EC3	890.05%	-61.4%	14.49
EC4	70.38%	-25.66%	2.743	EC4	903.74%	-49.2%	18.36
EC5	268.42%	-54.64%	4.912	EC5	906.91%	-50.6%	17.94
EC6	-64.51%	-67.93%	-0.950	EC6	-97.27%	-99.0%	-0.98
EC7	56.80%	-29.00%	1.959	EC7	-97.07%	-97.2%	-1.00
EC8	2.05%	-70.56%	0.029	EC8	-97.09%	-97.3%	-1.00
EC9	158.66%	-36.70%	4.324	EC9	-97.10%	-98.4%	-0.99
EC10	182.25%	-44.67%	4.080	EC10	-97.13%	-97.4%	-1.00
EC11	13.79%	-24.76%	0.557				
EC12	268.69%	-18.69%	14.375				
EC13	110.62%	-25.58%	4.325				
EC14	15.63%	-10.51%	1.488				
EC15	-44.72%	-50.70%	-0.882				
EC16	22.00%	-47.52%	0.463				
EC17	678.93%	-62.71%	10.826				

#### 3.2. Results from simulated data

This part is focused on results from simulated data. Table 5 is divided into three parts (first 10, second 10 and third 10 simulations). Each of these groups represents different number of loss strategies (see 2.1. Data). The motivation is to test Moving average and Ideal equity curve tools in different investment strategy environment. The main goal of active diversification tool is to protect investor's capital against fatal fall in investment capital. Second goal is to test the ability of active tools to gain better performance indicators than benchmark (naive diversification).

There are tested combinations that can be observed from results. If final portfolio reaches better value in each performance indicators (Total return, Maximum drawdown and Recovery factor), this state is coded by 111. There are two possible combination that can not be reached -110 and 001. In the Table 5 there is also presented number of simulations, when Total return of Final portfolio (FP) is greater than 0.

**Table 5.** Results from simulated data

<b>First 10 simulations</b>						
<b>Combination</b>	<b>MA50</b>	<b>MA100</b>	<b>MA200</b>	<b>IEC=0</b>	<b>IEC=0.00026</b>	<b>IEC=0.00038</b>
000	1	0	0	0	0	0
010	0	0	0	0	0	0
011	0	0	0	0	0	0
100	5	2	1	0	0	0
101	4	8	9	5	6	6
111	0	0	0	5	4	4
Total return of FP>0	10	10	10	10	10	10
<b>Second 10 simulations</b>						
	<b>MA50</b>	<b>MA100</b>	<b>MA200</b>	<b>IEC=0</b>	<b>IEC=0.00026</b>	<b>IEC=0.00038</b>
000	4	0	0	0	0	0
010	0	0	0	0	0	0
011	0	0	0	0	0	0
100	0	1	1	0	0	0
101	6	9	9	5	6	6
111	0	0	0	5	4	4
Total return of FP>0	10	10	10	10	10	10
<b>Third 10 simulations</b>						
	<b>MA50</b>	<b>MA100</b>	<b>MA200</b>	<b>IEC=0</b>	<b>IEC=0.00026</b>	<b>IEC=0.00038</b>
000	0	0	0	0	0	0
010	0	0	0	0	0	0
011	0	0	0	0	0	0
100	0	0	0	0	0	0
101	8	7	4	1	2	2
111	2	3	6	9	8	8
Total return of FP>0	2	8	8	10	10	10

In terms of the success of active portfolio tools, the best situation is represented by combination 111. In the first 10 simulations which are characterized by four randomly chosen growth Equity curves and by one randomly chosen loss strategy there was only one simulation, that reach worse value in all performance indicators (MA50). Moving average tool is characterized mainly by two combinations-100 and 101. From the point of view of investor, the combination 100 is not acceptable, due to the fact that Moving average tool is not capable to reach higher value of Recovery factor indicator. On the other hand, the Ideal equity curve is mainly characterized by combinations 101 and 111. The author understands both of these combinations as acceptable for the investor. For the combination 101 the investor takes higher risk, but he gains higher Recovery factor. It means that he gets higher return per unit of the risk measured by Maximum drawdown.

Second 10 simulations are characterized by higher number of combination where MA50 can not outperformed benchmark. This state is due to the fact that there are at least two Equity curves with loss trend in the portfolio. Other MA tools occur mainly in the combination 101. Compared to the first 10 simulations, Ideal equity curve tool is still able to outperformed benchmark at least in two performance indicators.

Last 10 simulations set the hardest conditions for active tools. Compared to the previews results there is no 000 combination for MA50, but using MA50 there are only two portfolios where Total return

was greater than zero. Other MA tools are represented by 101 and 111 combinations, but there are also simulations where Total return of Final portfolio is less than zero. On the other hand, Ideal equity curve tool was able to protect investor's capital in all simulations. In terms of all combinations MA tool is higher sensitive to change in length parameter. With higher number of loss equity curve Moving average tools loses the power to protect portfolio from negative loss.

From the simulated data both of the testing active tools were able to outperformed benchmark. In the discussion part are tested both of these active tools in environment of real investment strategy data.

#### 4. Discussion

In this session the author is testing active diversification tools in the portfolios of real investment strategy data. Again, the author is focusing on different possible combination of performance indicators.

**Table 6.** Results from real data

Combination	MA50	MA100	MA200
000	20	9	14
010	5	6	2
011	0	1	1
100	2	1	3
101	1	3	1
111	2	10	9
Combination	IEC=0	IEC=0.00026	IEC=0.00038
000	5	10	28
010	0	1	0
011	0	0	0
100	13	12	1
101	12	4	1
111	0	3	0

Compared to the Moving average tool, Ideal equity curve prove as a capable tool to protect invested capital in simulated data sample. Main difference against simulated data sample, real data sample is characterized by the fact that from all seventeen Equity curves there are only two which have negative value of total return, so individual equity curves are not tested in strong loss environment.

MA50 tool was not able to outperformed benchmark strategy at least at one performance indicator in 20 simulations. On the other hand, Ideal equity curve with the highest slope (IEC= 0.00038) was not able to outperform benchmark in 28 simulations. This situation was caused due to the high slope. In this simulations, performance of Ideal equity curve was too high compared to the performance of individual equity curves. Final portfolio algorithm did not include these strategies to the final portfolio, so investor can not benefit from a fast growth of Equity curve performance until the performance of individual Equity curve is not higher than actual performance of Ideal equity curve.

Ideal equity curve in the basic state (IEC=0) could outperformed benchmark strategy 25 times in a term of Total return indicator. From these simulations there are only twelve where final portfolio outperformed benchmark strategy at least in two performance indicators. But there is negative result that there was no situation where Ideal equity curve in basic mode was able to outperform benchmark strategy in combination 111.

## 5. Conclusion

Goal of this paper was to test active diversification tools in environment of simulated and real data. In this paper was used two active diversification tools – Moving averages tool and Ideal equity curve tool. The author focused mainly on protection of investor's capital against fatal fall in equity curve. Moving average tool was characterized mainly by two combinations (100 and 101) in the environment of simulated data sample. This situation was not acceptable for investor. On the other hand Ideal equity curve prove its ability to protect investor's capital in the environment of simulated data sample.

Compared to the simulated data sample, active tools of diversification did not prove predictable power using the real data sample. On the one hand, Ideal equity curve tool show as strong tool in term of fatal loss in Equity curve performance. On the other hand, in environment of real data sample, this tool was not able to outperform benchmark in terms of all three performance indicators.

Both of tested active tools seems to be sensitive on individual parameters. Main finding from analysis is that Ideal equity curve can be used as risk tool to prevent investor from fatal failure in individual equity curve.

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# Does the Financial Literacy Increase During the Secondary School Study?

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**Abstract:** (1) Background: The development of new technologies, changes in the functioning of the economy in national and international space, growth in the financial sector place increasing pressure on the man's ability referred to as "a financial literacy". Our study aims to find out if and how does the level of financial literacy of young people change during their study of the secondary grammar school. (2) Methods: The research methodology is based on the questionnaire survey, in which the solution of the four model situations was asked. We focused on three age groups of students: the first included the students of the second year of study. The second group included the students of the fifth year of study, and the third group included the students of the eight years of study. (3) Results: The results did not confirm an increasing level of financial literacy depending on the length of study. (4) Conclusion: The level of financial literacy does not change during the secondary school study. Limitation of the results lies in the number of respondents and only one type of secondary school and also in the model situation, which tests the students' ability to make financial decision.

**Keywords:** financial literacy; finance; financial decision

**JEL Classification:** A22; I25; D14

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## 1. Introduction

The changes in the functioning of the economy in national and international space, the development of new technologies which are closely linked with the growth in the financial sector place increasing pressure on the man's ability to make correct financial judgments and decisions. This ability is generally referred to as "financial literacy". Although the content of this term still has not been defined precisely, many studies have analyzed this phenomenon in various conditions and from multiple points of views. In the economies transforming from the centrally planned economy to the economy functioning on the market principles, this ability is an integral part of the overall transformation of the society and acquire a specific feature. "Individuals are taking responsibility for a growing number of financial decisions, the two most important arguably being the purchase and financing of a home and preparing for retirement." (Hung et al., 2009) All these processes increase the pressure on everyone's ability to make qualified financial judgments and decisions making in conditions when increasing the difficulty and complexity of solved issues.

On the other side, this ability is considered as an essential tool of the performance and stability of the economic system as a whole: "The Endogenizing financial knowledge has important implications for welfare as well as policies intended to enhance levels of financial knowledge in the larger population." (Lusardi, Mitchell, 2014). The importance of financial knowledge was underlined in the first decade of the century and is seen in connection of the personal financial stability as a base of financial stability of the whole economy. "Current economic conditions have raised serious concerns about Americans' financial security, especially for those who lack the skills and resources to withstand financial market downswings and take advantage of upswings."



In consideration of the financial crisis in the year of 2007-2011, many specific international projects were prepared to increase the level of education in the economic area on both on European and worldwide level. It was aimed mainly to raise the global awareness of the significance and importance of financial literacy. Based on it, the EU member states were recommended to develop national strategies for financial education. In 2010 Ministry of Finance CR prepared material called National strategy for the Financial Education. This strategy aimed to reinforce financial literacy of the population, above all as a part of complex measures in the area of consumer protection. In the implementation of this strategy, activities aimed at increasing financial education is gradually expanding. However, a systematic approach to addressing this issue is still missing. Some concrete measures were taken, for example, in the area of secondary education: the schools have to incorporate selected/proper financial knowledge into the content of social science subjects. But the realization of this goal is left to the schools themselves, within the framework of school educational programs. Specific courses and exams were introduced in the area of investment advisors as an obliged condition to conduct their profession. In the past two years, in the field of financial literacy of young people and children, the activity of financial institutions has increased (e.g. Czech Central Bank, Czech Savings Bank). But all these activities are not coordinated, solving only partial problems. They are not based on real knowledge of the actual situation in the financial education as well as on the definition of target state.

Research in this area focuses on various aspects of financial literacy. In the mainstream, the ability to make qualified financial decision is closely linked with the retirement planning. The choice of how much to save for retirement is a complex one, as it requires collecting and processing a broad set of information concerning Social Security and pensions, inflation, and interest rates. Policymakers seek to learn whether households are effectively protected for many years in retirement, whether they know how to plan for retirement and whether they can execute these plans effectively." (Lusardi, Mitchell, 2008).

Other researchers derive the requirement of financial literacy from the rapid development of financial markets. The financial market is expanding in the various form to the retail marketplace: in the form of the student loans, mortgages, credit cards, pension accounts, and annuities. As the findings of the research show, young people's readiness to deal with these situations and their qualified solutions is deficient (Brown et al., 2013).

Another direction of research aims to analyze financial literacy from various aspects, e. g. the level and extent of financial literacy or illiteracy in the different layers of population, the factors influencing the level of the financial literacy, what is the content of financial literacy as a category, what range of knowledge, abilities and skills it covers.

This ability acquire unique character and form in conditions of the transition economies in Central and Eastern Europe. Increasing financial literacy of each member of society is an integral part of the overall transformation of the economic system towards the economy functioning on market principles. Acquiring and increasing knowledge and skills commonly referred to as financial literacy of the all population, but especially young people is a part of overall change in economic behaviour in the process of transformation to a market mechanism.

The research of financial literacy in the Czech Republic is at the beginning. Research studies in this field is associated with names of J. Belász (Belász et al. 2018), J. Svárovská (Svárovská, 2015), B. Chmelíková (Chmelíková, 2015, Chmelíková and Svoboda, 2015), D. Kubíčková (Kubíčková et al. 2019). However, more systematic research attention to this problem is not given.

Our research aims to find out if and how does the level of financial literacy of young people as the ability to decide elementary financial situation change during their study on the secondary school, more precisely at the eight-years of grammar school.

## **2. Methodology**

To reach the aim of our research, we used the questioning method. The respondents were the students of the eight-year grammar school, namely students of the second, fifth and eighth years of study. The questionnaire survey was carried out under the conditions of the normal education

process in October and November 2019. We supposed that the level of financial literacy is increasing during the study, i. e. that the financial literacy is higher in the last year of study compared to the second year and the fifth year of study. It can be supposed that the factor influencing this ability is both the study courses and – may be in the vast extension - the experiences gained in the daily life. To identify the impact of the two factors can be the aim of the next stage of investigation, in our research, we concentrated on the changes in the level of financial literacy during the study.

The level of financial literacy we measure by the four model situations. The situation we try to construct different levels of difficulty so that the ability level can be differentiated to some extent. The construction of the questioning arise from the hypotheses:

H1: The level of financial literacy measured by the selected model situations is higher in the higher classes,

H2: the ability to solve the complicated tasks increased during the study and is the highest at the end of the study.

In the first part, the questionnaire collected the descriptive data on respondents, including their age and the achieved level of their parents' education. The second part included four model situations, the construction of which was based on prior literature (Balász et al., 2016; Kubičková et al., 2019). These model situation aims to identify the level of financial literacy of the students in different degree of their study and find out if and how this ability change in the various stages of their study. The parallel objective of this research is to extend the knowledge of the current situation in the Czech environment.

The solution of model situations lies in choosing one of the suggested solutions which is according to respondents' view the best solution of it. These model situations represent basic, frequent situations where some financial knowledge is necessary. We want to investigate the way of solving these situations by the respondents.

The first one consisted in deciding on a loan with different conditions and tested the ability to take into account all the essential information and to choose a better offer in the credit area. The second situation was based on the assessment of two different payment schedule and had to test the ability to use elementary calculation operations. The third situation was aimed to reveal students' access to long-term income management. The fourth model situation sought to find out the ability to use different forms of payment for goods. The gathered data was processed using essential statistical tools (percentage, average value) and elementary test, the F-test, to reveal the significance of differences between the results in all the three groups of students. More details we present in part 3.

The sample of respondents consisted of three groups of students, aged between twelve to eighteen years. The composition of the examined group of respondents, its gender structure we present in Table 1. Based on the prior research, we consider the level of the parents' education as a significant factor that could affect the results. Thus we have added this information in the data set description. In all three groups, parents with university education prevail.

**Table 1.** Data Set Description.

	Second class				fifth class				eighth class			
	Number		Level of parents' education (in %)		Number		Level of parents' education (in %)		Number		Level of parents' education (in %)	
	abs.	in %	Mother	Father	Abs.	in %	Mother	Father	Abs.	in %	Mother	Father
			U/S	U/S			U/S	U/S			U/S	U/S
Male	18	58%	x	x	18	43%	x	x	7	25%	x	x
Female	13	42%	x	x	24	57%	x	x	21	75%	x	x
Total	31	100%	81%/19%	84%/16%	42	100%	81%/19%	79%/21%	28	100%	82%/18%	75%/25%

Note: U/S = university degree / secondary degree of education (technical or social sciences)

### 3. Results

#### 3.1. Model situations

In the first model situation, we investigated the ability to evaluate all information when deciding on a loan correctly. The two solutions offered reflected the right and wrong decisions. This ability represents one of the elementary skills to ensure a higher quality of individual life because the respondent is not exposed to unnecessary losses and effectively expends its resources.

In the second model situation, we again aimed to assess the ability to evaluate the terms of the loan comprehensively, but while involving time in decision making. The difficulty of the solution was thus greater.

The third model situation was focused on the perception of the future when deciding on the use of income. In this situation, three solutions were offered, one of which was the most correct, which respected the expected view of future needs, the second one differed in the reason of the decision, but with respect of the future.

In the fourth model situation, we tested knowledge of the conditions and benefits of various forms of payment. Three solution were offered, aimed to reveal different approaches and experiences with different forms of payment. Only one solution represents the most advanced solution.

#### 3.2. Results of the questioning

The results in all three groups/classes we present in Table 2. The correct answers in every group are highlighted in grey. Total number of the answers right and incorrect is divided according to male and female respondents.

**Table 2.** Results of the questioning in three students' group/classes.

Model situation		Second class			Fifth class			Eighth class		
		total	male	female	total	male	female	total	male	female
	<i>Number</i>	31	18	13	42	18	24	28	7	21
1 a)	abs.	26	17	9	41	17	24	25	7	18
	%	84%	94%	69%	98%	94%	100%	89%	100%	86%
1 b)	abs.	5	1	4	1	1	0	3	0	3
	%	16%	6%	31%	2%	6%	0%	11%	0%	14%
2 a)	abs.	25	14	11	37	16	21	26	7	19
	%	81%	78%	85%	88%	89%	87%	93%	100%	90%
2 b)	abs.	6	4	2	5	2	3	2	0	2
	%	19%	22%	15%	12%	11%	13%	7%	0%	10%
3 a)	abs.	28	16	12	37	17	20	26	6	20
	%	90%	89%	92%	88%	94%	83%	93%	86%	95%
3 b)	abs.	0	0	0	0	0	0	0	0	0
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%
3 c)	abs.	3	2	1	5	1	4	2	1	1
	%	10%	11%	8%	12%	6%	17%	7%	14%	5%
4 a)	abs.	6	1	5	2	2	0	0	0	0
	%	19%	5%	39%	5%	11%	0%	0%	0%	0%
4 b)	abs.	19	13	6	35	16	19	23	4	19
	%	62%	72%	46%	83%	89%	79%	82%	57%	90%

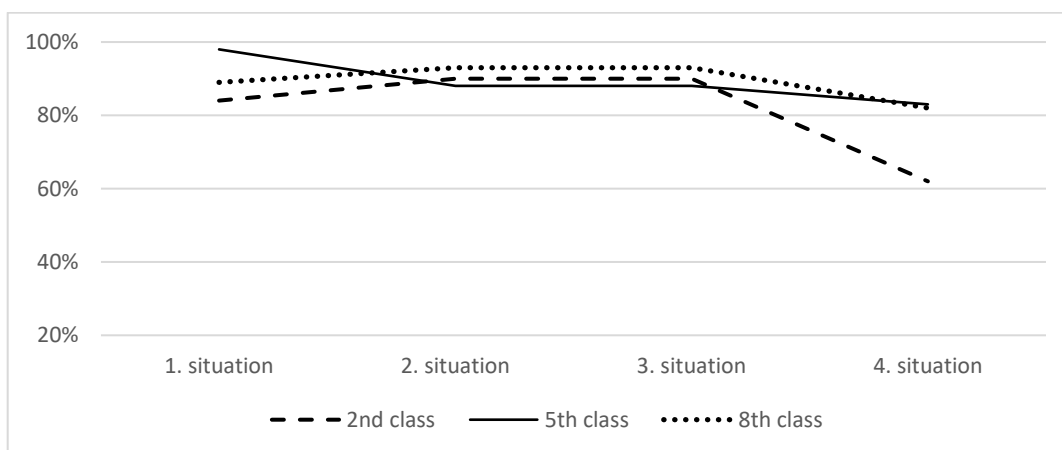
4 c)	abs.	6	4	2	5	0	5	5	3	2
	%	19%	23%	15%	12%	0%	21%	12%	43%	10%
Average rate of correct answers		79.2%	83.2%	73%	80.2%	91.5%	87.2%	89.2%	85.8%	90.2%

The results in all three groups of students/classes are similar. Slightly better can be assessed the results in the eighth class – in the average value of correct solutions - and the second and third model situation. Relatively significant decrease of correct answers' portion is in the fourth model situation in the second class. It can be explained by a vague wording of the task that does not correspond to the experience of the student in this age group.

The average percentage of correct answers in the four model situations in all three students' group are very similar, in the range of 79 to 89 per cent. Using this average success rate as a measure of financial literacy and its development in the age category from 12 to 18 years on the secondary grammar school, we can conclude that financial literacy increases, albeit only very slightly. Interestingly, a relatively high level of financial literacy, similar to the other groups, we found in the second class. The reason of this fact can be in the second year curriculum: based on the recommendation of Ministry of Education and Sport special subject was included, aimed to explain elementary financial situations. The other course with the same purpose is in the curriculum of the eighth class. But it is a part of the optional component of the curriculum.

As the level of education achieved by parents is similar in all classes, the similarity of results in all groups can be associated with the influence of this factor. Differences in the level of financial literacy observed in the previous phase of research in grammar school and business academy students were accompanied by different levels of parent education (Kubíčková et al., 2019). It can thus be concluded that the factor of parents' education plays a role in the level of financial literacy of their children. However, this assertion needs to be verified in further research that focuses on this factor and its role in the financial literacy of young people.

The relation of the correct answers in all three groups of students we present in the following Figure 1.



**Figure 1.** The proportion of correct solutions of model situations in the three students' groups.

### 3.3. Significance of the results differences

To verify the above-formulated conclusion, we tested the results in all three groups using a two-file match test. We used the F-test, which compares the data of two independent selections. If the resulting value of  $F < F_{crit}$  we can reject the null hypothesis, i.e. the variance of both sets is not statistically significantly different (i.e. the samples come from the same basic set with common variation). To test the significance of the differences between the three sets of results, we examine three pairs of data set: results of second and fifth class, the result of eighth and fifth class and the

result in eighth and second class. The three sets of values and the resulting value of the three F-test we present in Table 3.

**Table 3.** The resulting value of the F-test.

Year of study/class		Second	Fifth	Eighth
Model situation:	Solution:			
Situation 1	a)	83,9	97,6	89,3
	b)	16,1	2,4	10,7
Situation 2	a)	80,6	88,1	92,9
	b)	19,4	11,9	7,1
Situation 3	a)	90,3	88,1	92,9
	b)	0,0	0,0	0,0
	c)	9,7	11,9	7,1
Situation 4	a)	19,4	4,8	0,0
	b)	61,2	83,3	82,1
	c)	19,4	11,9	17,9
F-test			0.551598	0.5475088
Critical value (p=0,005)	4.026			0.9950586

All the three values of F-test were identified lower than the critical value. That means the results in all three groups/classes come from the same basic set, and the differences are not significant. Based on that conclusion, we can reject the hypothesis H1 in which the level of financial literacy measured by the selected model situations was supposed higher in the higher classes. The second hypothesis H2 specified in more details the level of financial literacy. In this hypothesis was assumed that the ability to solve complicated tasks, is increasing during the study and is the highest in last year of study. As the more complicated financial situation, we considered the first and the third ones. The correct results in these situations are similar in all the three groups compared to the other two ones: 83.9%, 97.6% and 89.3% in the first model situation and 90.3%, 88.1%, 92.9% in the third model situation. Based on these results we can reject this hypothesis, although a slight increase of correct solutions in the eighth year we should to mention.

#### 4. Discussion

The results of the questioning did not confirm both the first and the second hypothesis. Neither the higher score of correct answers in the last year nor their increasing trend in the three monitored years was confirmed. On the other hand, it is necessary to emphasize an outstanding level of financial literacy demonstrated in all three years of study, which differs significantly from the results in previous research in terms of grammar school and business academy. The proportion of correct solutions in this previous research was in the range of 45-60%. The explanation can be in the fact that the knowledge and problems included in the abilities, skills and approaches referred to as financial literacy is a part of at least two subjects in the curriculum at the grammar school where we conducted the survey.

However, this explanation is not sufficient in the context of the results of previous research achieved at the business academy. In this type of secondary school, there are much more financial oriented subjects in the curriculum. And the proportion of the correct solutions was found to be lower than in the grammar school. Based on these findings and conclusion, we can summarize one crucial conclusion, i. e. to ensure the increase of financial literacy, it is necessary to design a purpose-oriented course included in the curriculum. But this conclusion must be verified in further research.

Broader conclusions based on these results are limited due to the small set of respondents and one type of school and also due to the conditions of only one school. In further research, it will be necessary to focus on the other grammar schools and even different types of school.

Broader conclusions based on this research are also limited, among other things, due to the model situations that we used to measure the financial literacy of respondents. Again, there is an urgent need to define the content and scope of the financial literacy category. It can also be an incentive for further research.

## 5. Conclusions

Our research aimed to find out if the level of financial literacy of young people change during their study on secondary school, namely on the eight-year grammar school. We used the questionnaire survey method. The respondents were the students of three different years of study: the second year, the fifth year and the eighth year. The questioning consisted of solving four model situations, whose solution belongs to the set of abilities known as financial literacy. We suppose that the ability to correctly resolve these situations will increase in proportion to the length of study, i.e. in higher classes will be higher. The results did not confirm both the first and the second hypothesis. The percentage of correct solution was in all three years of study approximately the same. The higher score of correct answers we identified in the eighth year, but the differences were not significant. The test confirmed this conclusion based on which we can conclude the differences are not substantial. The level of financial literacy does not depend on the length of study

The research findings, however, have an essential limitation associated, primarily, with the sample size examined and the structure of the interviewed students. A broader set of respondents-students, as well as other schools, could increase the reliability and explanatory power of the results. A significant limitation arises from the selection and construction of model situations. There is no agreement of the researchers concerning what does the category of financial literacy content. Thus, it is very complicated to select the suitable cases which allow to measure the level of it. Its construction and wording could be improved: the number of situations could be extended, the content could be differentiated according to difficulty, etc. All these questions can be an incentive for the next stage of research.

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# Success Rate of Tax Arrears Recovery: Czech Republic Case Study

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**Abstract:** The study is aimed at the recovery of tax arrears in the Czech Republic. Every tax entity is obliged to pay the tax return. In case of delay the tax administrator is in charge of collection of not paid taxes. This office is entitled to issue execution rulings. The tax law enables the tax administrator to conduct the execution in six different types of execution orders or through court executors. The aim of our article is to assess the success rate of tax arrears recovery by the tax administrator in 2011-2017. Data about the total amount of tax arrears, about tax arrears and about amounts recovered were taken from the document Information about activities of the tax administration office in the Czech Republic in single years of recorded period. The success of the tax arrears recovery is in single years assessed according to the method of recovery. The most spread method is the tax execution: wages abatement, ordering receivables on the account at the provider of payment services, ordering a different receivable, ordering other property rights, sale of movable and immovable property. Furthermore, court execution or recovery of receivables in insolvency proceedings is used. The highest proportion of tax arrears is recovered in insolvency proceedings. In the long-term stable success rate of tax arrears recovery is in the form of tax execution by ordering receivables on the account at the provider of payment services.

**Keywords:** tax; tax arrears; recovery; execution; insolvency proceedings

**JEL Classification:** H20; H21; H30

## 1. Introduction

Tax incomes are a significant part of the state budget of the Czech Republic. In case of delay the tax administrator ensures collection of the unpaid tax through recovery services. Since the tax collection is the income of public budget, this activity is emphasized a lot and becomes an unseparable part of it. An arrear is a part of tax which has not been paid yet, although its payment date has expired. It is a debt on tax that the tax entity has not paid on time. By violating this liability the tax entity becomes a debtor (Baxa et al. 2011).

Tax collection, tax arrears recovery and fight against tax avoidance are parts of tax administration in most countries. In membership countries of the European Union tax arrears mean problems of different sizes for governments and tax offices. According to data provided by the Greek minister of finance the debt of tax payers in Greece at the end of 2014 reached nearly 70 billion euros. While the share of undisputable tax arrears in tax collection was nearly 90.0% in 2010, in countries like e.g. Austria, Germany or Denmark it did not reach over 2.5% (Hybka 2015). According to Espin et al. (2019) in order to increase income, improve liquidity and reduce budget deficit countries can implement as a mechanism for tax collection the performing of tax reliefs for example in the form of cancellation of penalty interests, fines and surcharges. Bunescu (2010) presents impact the tax pressure has on tax arrears of Romanian tax payers and also on budget incomes. He also deals with the impact on the number of cases of tax avoidance or on the dynamics of economic subjects. Kotlinksa (2018) presents a range of statistic data from 2000–2017, which illustrate profits from VAT in comparison with total tax income and total income of the state budget, amounts and structure of tax arrears and tax gap connected with unregistered economic activity. Insufficient tax collection has negative impact on the operation of the whole economy. Popa (2012) states that negative socioeconomic impacts in Romania



are the result of tax evasion and frauds, tax arrears, reduced level of tax collection and incorrect economic policy. Knowledge and practical experience in tax administration confirmed that the growth of tax arrears in some cases reflects conscious avoidance of tax duties.

In the Czech Republic, Grossová (2015) dealt with the tax arrears recovery. She focused on the characteristics of tax execution in connection with the changes stated in the tax law (Act No. 280/2009 Coll.). Holub and Nemethová (2014) show the issues of establishing businesses; limited liability company cannot be started by a subject that has tax arrears or underpayments on taxes.

In some countries tax arrears relate to transfer to trade mechanisms in economy. Hamm et al. (2012) presents that in countries which realized programmes of mass privatisation, it was typical for newly privatized companies to accumulate tax arrears. Lukanson and Adresson (2019) deal in their work with the prediction of a company going bankrupt based on the height of tax arrears and figures of financial indicators. Their results show that information about tax arrears prove higher accuracy in prediction of a breakdown than financial indicators do. As Salayev (2019) presents, the transfer of Azerbajdzhan Republic to trade rules meant a need for essential reforms in the tax system. An effective mechanism for the collection of tax arrears was created and there was a significant decrease in number of tax debtors.

Reduction or eliminatin of tax arrears is an important task of the tax administration. Related to that are set mechanisms for tax collection, system of checking, recovery of tax arrears and the whole efficiency of tax administration. Moskvíčová (2010) refers in her research to basic causes of increase in tax arrears and following tax recovery. The main task is to ensure tax arrears recovery with minimal operation costs and maximalisation of the effect. Semenova et al. (2017) presents that the efficiency of tax administration in Russian federation is based on key indicators. They are the amount of arrears, performing of tax checking and increase in tax benefits as a result of tax checks. As Jain (2016) presents, efficient tax administration requires forming of professional frame of administrators. Thanks to this it is possible to have an efficient tax system and minimalize tax arrears.

Given studies and other studies deal mainly with causes and impacts of the origins of tax arrears, tax evasion and tax gap. Assumed contribution solves possibilites of tax arrears recovery in the Czech Republic and the success rate of single methods of recovery. It is an unseparable part of a complex research of tax evasion and tax gap (mainly focused on VAT and corporate income tax).

## 2. Data and Methodology

Assessment of collection success rate is assembled based on data from Financial Administration of the Czech Republic. Data concerning tax arrears within the researched period 2011-2017 were acquired from the documents Information about activities of the tax administration office in the Czech Republic for relevant year. Data not available in the document above were acquired based on the law number 106/1999 Sb., on free access to information. Data show amount of cumulated tax arrears up to 31 December of relevant year. Tax arrears are recorded by financial administration according to selected types of income from the view of their significance influencing the tax collection (Table 1).

**Table 1.** Amount of cumulative tax arrears by single types of tax income within 2011-2017 in mil. CZK, own processing based on Financial Administration of the Czech Republic (2019).

Type of income	2011	2012	2013	2014	2015	2016	2017
Value added tax	68,725	82,505	96,527	73,951	75,566	37,318	33,202
Excese tax	935	968	904	565	468	19	11
Corporate income tax	19,109	21,872	21,155	14,354	13,344	7,759	8,127
Withholding tax	358	382	438	336	319	192	272
Road tax	1,521	1,614	1,692	1,488	1,324	739	530
Inheritance tax	10	10	9	10	8	6	5
Gift tax	159	148	136	116	60	34	22
Real estate transfer tax	3,209	2,962	2,844	2,204	1,818	1,101	722
Real estate acquisition tax	0	0	0	148	253	310	386

Personal income tax	14,284	13,737	12,298	9,745	8,234	4,548	3,506
Dependent activity income tax	3,974	3,811	3,679	2,795	2,429	1,312	1,026
Real estate tax	954	955	1,030	913	857	616	510
Levy from lottery § 41b (1)	0	12	32	28	26	32	3
Levy from lottery § 41b (2), (3), (4)	0	136	229	87	93	93	19
Hazard tax	0	0	0	0	0	0	1
Other income, levy and fees	3,767	4,649	7,064	3,859	3,058	1,780	1,981
Total of new tax	117,003	133,759	148,037	110,599	107,858	55,860	50,323
Total of old tax	1,819	979	903	6	0	0	0
Total	118,822	134,738	148,941	110,604	107,858	55,860	50,323
Annual growth	12,435	15,916	14,203	-38,336	-2,747	-51,998	-5,537

Data about recovered tax arrears were collected from Information about activities of the tax administration office in the Czech Republic within the researched period 2011-2017 (Financial Administration of the Czech Republic, 2019). The amount of total cumulated tax arrears, tax arrears to be recovered and recovered tax arrears are shown in Table 2.

**Table 2.** Tax arrears to be recovered and recovered tax arrears in billion CZK, own processing based on Financial Administration of the Czech Republic (2019).

	<b>Cumulated arrears up to 31 December of relevant year</b>	<b>Tax arrears to be recovered on 31 December of relevant year</b>	<b>Recovered tax arrears on 31 December of relevant year</b>
2011	118.8	83.4	5.8
2012	134.7	98.8	8.0
2013	148.9	111.4	7.5
2014	110.6	85.3	11.1
2015	107.9	91.4	11.9
2016	55.9	44.1	13.3
2017	50.3	37.3	13.6

Data about tax arrears to be recovered were grouped according to the method of recovery within single tax executions (tax execution through wages abatement, tax execution through ordering receivables on the account at the provider of payment services, tax execution through ordering a different receivable, tax execution through violating other property rights, tax execution through the sale of chattel and tax execution through the sale of immovable property). Also, groups of data about tax arrears recovery processes in the form of court execution and within the insolvency proceedings were created.

Every single form of tax arrears collection shows the amount of the total of arrears to be collected (CVN). With every single method of recovery there is the amount of tax arrears being recovered by that method (tax execution, court execution or as insolvency proceedings) (NV). Also, every method shows the amount of tax arrears that were collected with the method given (MN). Data for single methods is shown in Table 3 – Table 10.

To assess the success rate of single forms of tax arrears collection a separate analysis has been made. (Table 3 – Table 10). The success of tax arrears recovery is assessed individually with every method of recovery (as tax execution, court execution or insolvency proceedings).

The success rate is calculated as the share of arrears that were collected with the given method in arrears which were to be collected with the given method:

$$Recovery\ succes\ rate = \frac{MN}{NV} \times 100\ (in\ \%) \quad (1)$$

The success rate of tax arrears collection is then calculated as a share of arrears that were collected with the given method in the total amount of arrears to be collected. (up to 31 December of the relevant year):

$$\text{Recovery success rate} = \frac{MN}{CVN} \times 100 \text{ (in \%)} \quad (2)$$

### 3. Results

Success rate of the tax arrears recovery differs according to the method of the recovery. The most common recovery is tax execution. Several execution titles are used within the tax execution.

#### 3.1. Recovery of tax arrears through tax execution

Tax execution having impact on the wages of the debtor is widely spread with tax arrears that concern lower amounts. A big group which belongs to incomes violated in this way of execution are also retirement pensions. Regarding the heights of retirement pensions are the execution payments in benefit of the tax administrator low or zero. During the researched period tax arrears recovered through tax execution as wages abatement amounted to 31,443 mil. CZK. The total recovered in the researched period was 1,248 mil. CZK. Success rate of the recovery (share of recovered arrears through wages abatement in arrears being recovered by this method) was on average 3.97 %. The highest success was recorded in 2017 at the rate of 8.85 % (Table 3).

**Table 3.** Overview of the recovery by tax execution through wages abatement in mil. CZK, own processing based on Financial Administration of the Czech Republic (2019).

Year	2011	2012	2013	2014	2015	2016	2017
Tax arrears to be recovered in total (CVN)	83,400	98,800	111,400	85,300	91,400	44,100	37,300
Tax arrears to be recovered through wages abatement (NV)	5,003	5,268	5,105	5,382	5,562	2,964	2,159
Tax arrears recovered through wages abatement (MN)	211	176	147	164	178	181	191
Recovery success rate (MN/NV)	4.22%	3.34%	2.88%	3.05%	3.20%	6.11%	8.85%
Recovery success rate (MN/CVN)	0.25%	0.18%	0.13%	0.19%	0.19%	0.41%	0.51%

Tax execution affecting accounts of tax debtors at providers of payment services (banks) is the fastest and the most efficient of all types of execution procedures. This method of tax execution is influenced by low balance on the accounts of the debtor, where the debtor has their finance saved on a foreign bank account which is not affected by this execution. During the researched period were the tax arrears recovered by tax execution through ordering receivables from the account at the provider of payment services in the amount of 73,086 mil. CZK. In total 17,404 mil. CZK was recovered in the researched period. The success rate of the recovery, meaning the share of the recovered arrears by tax execution through ordering receivables from the account at the provider of payment services in arrears to be recovered in this way, was on average 23.81 %. The highest success rate was found in 2017 and it was 9.10 % (Table 4).

**Table 4.** Overview of the recovery by tax execution through ordering receivables from the account at the provider of payment services in mil. CZK, own processing based on Financial Administration of the Czech Republic (2019).

Year	2011	2012	2013	2014	2015	2016	2017
Tax arrears to be recovered in total (CVN)	83,400	98,800	111,400	85,300	91,400	44,100	37,300
Tax arrears to be recovered through ordering receivables from the account (NV)	7,177	8,934	13,555	8,579	16,886	8,966	8,989
Tax arrears recovered through ordering receivables from the account (MN)	2,637	1,898	1,778	2,299	2,609	2,788	3,395
Recovery success rate (MN/NV)	36.74%	21.24%	13.12%	26.80%	15.45%	31.10%	37.77%
Recovery success rate (MN/CVN)	3.16%	1.92%	1.60%	2.70%	2.85%	6.32%	9.10%

With the efficacy of the tax rulings the tax administrator has been given a possibility to use in tax execution the institute of violating other monetary receivables. Such receivables are not paid and mature or in the future mature obligations towards the tax debtor. The tax execution through ordering other receivables can be used by the tax administrator only in such case when he/she has necessary not paid invoices or agreements, which clearly show the obligation to pay in benefit of the payer. In the researched period were the tax arrears to be recovered through tax execution by ordering other receivables, 19,651 mil. CZK. The success rate of recovery, meaning the share of recovered arrears through tax execution through ordering other receivables, to be recovered in this form, was on average 7.81 %. The highest success rate was found in 2017 which was 0.6% (Table 5).

**Table 5.** Overview of recovery by tax execution through ordering other receivables in mil CZK, own processing based on Financial Administration of the Czech Republic (2019).

Year	2011	2012	2013	2014	2015	2016	2017
Tax arrears to be recovered in total (CVN)	83,400	98,800	111,400	85,300	91,400	44,100	37,300
Tax arrears to be recovered through ordering receivables (NV)	1,409	1,653	2,957	1,970	1,890	1,002	8,77
Tax arrears recovered through ordering receivables (MN)	301	220	202	134	217	237	224
Recovery success rate (MN/NV)	21.36%	13.31%	6.83%	6.80%	11.48%	23.65%	25.54%
Recovery success rate (MN/CVN)	0.36%	0.22%	0.18%	0.16%	0.24%	0.54%	0.60%

Another possible way of tax arrears recovery is tax execution through ordering other property rights. This way is only used in small amount. It is important here to get relevant input from tax entities or from third parties that have such input. The success rate within this type of execution was in single years of the researched period very different (0.44% in 2013 versus 68.75% in 2016). The share of recovered tax arrears in the total of arrears to be recovered is in hundredths or thousandths of per cent (Table 6).

**Table 6.** Overview of tax arrears recovery through ordering other property rights in mil. CZK, own processing based on Financial Administration of the Czech Republic (2019).

Year	2011	2012	2013	2014	2015	2016	2017
Tax arrears to be recovered in total (CVN)	83,400	98,800	111,400	85,300	91,400	44,100	37,300
Tax arrears to be recovered through ordering other property rights (NV)	75	82	229	172	169	16	13
Tax arrears recovered through ordering other property rights (MN)	17	19	1	11	10	11	2
Recovery success rate (MN/NV)	22.67%	23.17%	0.44%	6.40%	5.92%	68.75%	15.38%
Recovery success rate (MN/CVN)	0.02%	0.02%	0.00%	0.01%	0.01%	0.02%	0.01%

Tax execution through the sale of debtor's chattel affects the property of the debtor. Ordered property executions are influenced by the fact that the entity is have-not or that the confiscated chattel cannot be sold. The form of such execution is influenced by the fact that potential objects of execution are obtained in the form of financed leasing or on credit, which is covered by the agreement about transfer of ownership right, possibly by the fact that the tax entity is have-not by the fact that the confiscated chattel cannot be sold. Within the researched period the tax arrears to be recovered through tax execution through sale of debtor's chattel were in the amount of 6,438 mil. CZK. The total recovered in this period was 1,040 mil. CZK. The success rate of the recovery, meaning the share of arrears to be recovered through tax execution through ordering of a different receivable in the arrears to be recovered in this way, was on average 15.59 %. The highest success rate of 33.44% was recorded in 2017 (Table 7).

**Table 7.** Overview of tax arrears recovery through the sale of chattel in mil CZK, own processing based on Financial Administration of the Czech Republic (2019).

Year	2011	2012	2013	2014	2015	2016	2017
Tax arrears to be recovered in total (CVN)	83,400	98,800	111,400	85,300	91,400	44,100	37,300
Tax arrears to be recovered through sale of chattel (NV)	1,095	1,048	1,506	552	717	904	616
Tax arrears recovered through sale of chattel (MN)	140	95	81	135	154	193	206
Recovery success rate (MN/NV)	12.79%	9.06%	5.38%	24.46%	21.48%	21.35%	33.44%
Recovery success rate (MN/CVN)	0.17%	0.10%	0.07%	0.16%	0.17%	0.44%	0.55%

Tax execution through the sale of immovable property affects the property of the debtor and is a firm interference into their property rights. In many cases the arrear was paid immediately after the execution order had been issued. Its consequence is lower proceeds from arrears being recovered in contrast to executions of chattel. Within the researched period were the tax arrears to be recovered through tax execution through immovable property of the debtor in the amount of 10,355 mil. CZK. The total of arrears recovered was 519 mil. CZK. The success rate of the recovery, meaning the share of arrears recovered through tax execution through the sale of immovable property of the debtor in the amount to be recovered in this way, was on average 5.01%. The highest success rate of 0.35 % was recorded in 2017 (Table 8).

**Table 8.** Overview of tax arrears recovery through the sale of immovable property in mil. CZK, own processing based on Financial Administration of the Czech Republic (2019).

Year	2011	2012	2013	2014	2015	2016	2017
Tax arrears to be recovered in total (CVN)	83,400	98,800	111,400	85,300	91,400	44,100	37,300
Tax arrears to be recovered through sale of immovable property (NV)	1,421	1,687	1,908	1,492	1,675	1,142	1,030
Tax arrears recovered through sale of immovable property (MN)	71	41	38	85	68	87	129
Recovery success rate (MN/NV)	5.00%	2.43%	1.99%	5.70%	4.06%	7.62%	12.52%
Recovery success rate (MN/CVN)	0.09%	0.04%	0.03%	0.10%	0.07%	0.20%	0.35%

### 3.2. Tax arrears recovery through court execution

Tax arrears recovery through court executors is used by the tax administrator only in rare cases, regarding the provision § 175 odst. 2 Tax Law, which burdens the principle of proportionality of the costs connected with the execution (Information about the activity of the tax administration of the Czech Republic in 2017). Within the researched period the tax arrears to be recovered by court executors were 151 mil. CZK. The total of arrears recovered was 23 mil. CZK. The success rate of the recovery, meaning the share of the recovered tax arrears through court executors was on average 15.19%. The highest success rate of 0.03 % was recorded in 2017 (Table 9).

**Table 9.** Tax arrears to be recovered by court executors in mil. CZK, own processing based on Financial Administration of the Czech Republic (2019).

	2011	2012	2013	2014	2015	2016	2017
Tax arrears to be recovered in total (CVN)	83,400	98,800	111,400	85,300	91,400	44,100	37,300
Tax arrears to be recovered by court execution (NV)	18	21	25	12	26	25	24
Tax arrears recovered by court execution (MN)	2	5	1	2	1	2	10
Recovery success rate (MN/NV)	10.11%	25.84%	2.42%	15.70%	4.63%	8.70%	40.83%
Recovery success rate (MN/CVN)	0.00%	0.01%	0.00%	0.00%	0.00%	0.00%	0.03%

### 3.3. Recover of receivables in insolvency proceedings

Insolvency proceedings are legal proceedings which solve bankruptcy or imminent bankruptcy. Proceeds from the claimed arrears in insolvency proceedings are in long term very low. The reason for this is not only the time length of the insolvency proceedings, but also the value of debtors' property. The amount of the supply is also influenced by ensuring arrears through the pledge, which stands higher in allocation scheme. Within the researched period the tax arrears to be recovered through insolvency proceedings were of 92,500 mil. CZK. The total amount recovered in this period was 1,732 mil. CZK. The success rate, meaning the share of recovered tax arrears through insolvency proceedings and tax arrears to be recovered in this way, was on average 1.87%. The highest success rate of 0.99% was found in 2017 (Table 10).

**Table 10.** Overview of receivables in insolvency proceedings in mil. CZK, own processing based on Financial Administration of the Czech Republic (2019).

	2011	2012	2013	2014	2015	2016	2017
Tax arrears to be recovered in total (CVN)	83,400	98,800	111,400	85,300	91,400	44,100	37,300
Tax arrears to be recovered in insolvency proceedings (NV)	16,500	19,200	20,900	13,300	11,600	6,000	5,000
Tax arrears recovered in insolvency proceedings (MN)	284.4	124.9	174.2	175.7	252.9	391.1	328.8
Recovery success rate (MN/NV)	1.72%	0.65%	0.83%	1.32%	2.18%	6.52%	6.58%
Recovery success rate (MN/CVN)	0.34%	0.13%	0.16%	0.21%	0.28%	0.89%	0.88%

### 3.4. Depreciation of tax arrears

A big problem when recovering tax arrears is a partial enforceability or uncollectibility of tax arrears. The development of tax arrears recovered is every year influenced by the amount of realized depreciations for uncollectibility. Among the main reasons why arrears cannot be collected belongs mainly the fact that debtors have no property or are indebted too much, the property cannot be found, the debtor died without legal successor, the company entered its liquidation process. Within the researched period were the depreciations of tax arrears for uncollectibility 467,1 mil. CZK. The total of 169,9 mil. CZK was depreciated for preclusion reasons and 36,2 mil. CZK for the rights expiration right. (Table 11).

**Table 11.** Depreciations of tax arrears for uncollectibility, preclusion and expiration in billion CZK, own processing based on Financial Administration of the Czech Republic (2019).

	2011	2012	2013	2014	2015	2016	2017
Depreciations for uncollectibility	8.9	19.6	24.5	71.5	56.9	165.2	120.5
Preclusion	4.0	15.4	20.3	21.1	19.3	56.2	33.6
Expiration	4.7	21.2	6.2	1.9	0.9	0.6	0.7

## 4. Discussion

The success rate of tax arrears recovery is dependent on a range of factors, including the method of recovery. Tax executions through wages abatement are most often ordered with low arrears. Such process of execution is with high arrears long and the output is very low. Leading executions on wages can often be complicated by the fact that the employer pays a part of the wages in the minimal legal amount and another part outside the wages evidence. It also happens that an employer employs a debtor without a labour contract and such work relationship cannot be found. The cause for low output is leading of more executions for receivables of other creditors which makes it impossible to satisfy with execution wages abatement other entitled creditors (Information about activities of the tax administration office in the Czech Republic within the period 2012). Tax execution violating accounts of tax debtors they have with providers of payment services is the fastest and the most efficient of all types of execution processes. However, it is influenced by low balances left on the affected accounts and the fact that the tax entity has wherewithal on a foreign account, which is untouchable by such execution (Information about activities of the tax administration office in the Czech Republic within the period 2013).

Results of analyses show that mainly in 2016 and 2017 there was an increase in success rate with most methods of the tax arrears collection. Changes in some norms and regulations could lead to further increase in the success rate. The issue is mainly the decrease in cumulated tax arrears, being the borderline for issuing of the unreliable payer declaration within value added tax. To change the norms, it is also possible to use experience from other countries solving similar problems. In 2017 in Slovakia a crime called "unfair liquidation" has been implemented. This crime is committed by a person

who transfers its participation on a new agent and the one who accepts it or has mediated the transfer. The legislative administration tries to prevent the transfer of statutory organ participation in a business company on the so called white horses, who have no intention to conduct business any further, but lend their name to the transfer of rights and duties in such way that the original statutory organ is not forced to maintain and pay for company obligations. Orlova et al. (2019) in her study suggests that for the tax administration purposes it would be convenient to use classification of tax debt according to the type of organisation - debtors, including types of economic activity, which would lead to better performance of tax offices when collecting tax debts. She also mentions usage of systems as tax debt prevention, for example: reorganisation, liquidation, fusion and company division.

New software equipment seems to be important for better success in collection. Foreign experience with updating information systems in financial administration could be used here. According to the study published in 2016 "the Irish method" would be suitable. It is assessed in EU as one of the best and for the conditions of the Czech financial administration it was reviewed as relevant (Financial Administration of the Czech Republic 2016). The benefit can be seen mainly in significant cost cut, modern user interface and support of automatization processes of financial administration.

## 5. Conclusions

Development of tax arrears within the researched period recorded in 2011-2013 a rise to 148,941 mil. CZK. Then, there was a decrease in tax arrears which fell to 50,323 mil. CZK and mainly by making real arrears to be recovered in the form of depreciation for incollectibility. Tax arrears to be recovered ranged from 70.20 % up to 84.71 % out of the total arrears in evidence for single years. The rate depending on the speed of transfer to recovery, recognizing debtor's property that can be executed and start of the execution through an execution order.

From the analysis activities pursued within tax arrears recovery it has been found out that out of the total of arrears to be recovered in the total of 551,700 mil. CZK, an amount of 26,472.20 mil. CZK was recovered, which means success rate of 4.80 %. Out of 256,554.60 mil. CZK arrears to be recovered or used in other proceedings the success rate was 10.32 %. The highest share in recovered tax arrears was recorded with tax execution through ordering receivables on the account by the provider of payment services, which violated accounts of tax entities. A total of 17,404 mil. CZK was recovered by this method. The share of recovered arrears in arrears to be recovered by this method of tax execution was 23.81 %. The share of arrears recovered by the given method in the total of arrears to be recovered was 3.15 %. The least output was gained from tax execution through ordering of other property rights. This type of execution was recovering 756 mil. CZK with the return of 71 mil. CZK.

Tax arrears recovery through court executors is an area which is, with the regard to the possibilities of tax administrator's tax arrears recovery, used only in rare cases. The volume of receivables which was used from the side of the tax administrator during the insolvency proceedings amounted to 1,732 mil. CZK in the researched period. Regarding the receivables reported in the amount of 92,500 mil. CZK was the return 1.87 %.

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# Prospects for the Development of the Dairy Industry in the Republic of Belarus and in the Russian Federation

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**Abstract:** In recent years, the Russian Federation and the Republic of Belarus have implemented a set of organizational, managerial and economic-financial instruments, mechanisms and measures, the result of which is to increase production and export potential, strengthen the competitive position of producers in the domestic and foreign markets, as well as ensure national food security. Directly dairy cattle breeding in the countries is one of the most important livestock sectors with an increase in economic efficiency in agriculture. At the same time, a number of problems must be solved, including: modernization of the material and technical base on the basis of the introduction of modern technologies; development of the feed base due to feeds of high energy value and elimination of the deficit of white resources in the feed balance, etc. Based on this, the aim of the study is to substantiate the main trends in the development of the dairy cattle industry in the Russian Federation and the Republic of Belarus related to the new management conditions. Materials and research methods. In the process of work, we used statistical, analytical, and abstract-logical research methods. The information base was compiled by the data of the Federal State Statistics Service of the Russian Federation and the data of the National Statistics Committee of the Republic of Belarus.

**Keywords:** cattle; cows; livestock; milk; export; import

**JEL:** Q13; Q15; Q17

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## 1. Introduction

The relevance of the research topic is due to the fact that for agriculture of the Republic of Belarus and the Russian Federation, milk production is one of the main sources of regular cash flow and, unlike others, occupies the largest percentage in gross agricultural output. According to the official data of the National Statistical Committee of the Republic of Belarus, animal husbandry has a special place in the agricultural economy, since it owns 55% of gross output, 23% of which is meat, and the remaining 32% is milk. Of the total livestock production, 95% is produced in large commodity agricultural organizations. The proportion of the rural population of the Republic of Belarus is about 22%. 775 kg of milk and 129 kg of meat are produced in Belarus per capita, which is 2.3 and 1.7 times higher than the standard values. According to official data from the Federal State Statistics Service of the Russian Federation, livestock breeding owns 46% of gross output. Of the total livestock production, 53% is produced in large agricultural organizations. Only 74% of meat and 50% of milk is produced in agricultural organizations. The proportion of the rural population of the Russian Federation is about 26%. According to our estimates, 212 kg of milk and 99 kg of meat are produced per capita in Russia. For milk, self-sufficiency is 64%, for meat is 32% higher than the standard. The Russian Federation has significant potential for the development of the meat and dairy industries.

The study of best practices is very important for the development of constructive management decisions for the development of the industry. Our long-term analysis of the situation allows us to conclude that the level of development of the dairy industry is higher in large commodity forms of management. That is why, for the development of the dairy industry, the main strategic priorities should include two main blocks of measures: 1) organizational and administrative (administrative) and 2) organizational and economic, aimed primarily at resource conservation. The first block of organizational and administrative (administrative) measures should consist of: 1) regular monitoring

of the main economic indicators of intensification of milk production; 2) analysis of the resource potential and determination of the pace and sequence of intensification of production; 3) the formation and implementation of comparative competitive advantages, taking into account the climatic conditions, the level of competition, the biological potential of animals; 4) the development of technological, transport, financial and market infrastructure; 5) general control over the level of prices purchased by dairy plants and the creation of purchasing centers of milk from the population; 6) increase the level of utilization of production capacities of dairy plants up to 90-95%; 7) development of marketing logistics infrastructure, export of milk and dairy products, and others. The second block of resource-saving measures should include: 1) improvement of the applied equipment and technologies; cost reduction, improving the quality of products (increasing fat content, grading), increasing its competitiveness (environmental friendliness), accelerating the return on investment; 2) targeted budget subsidies for various activities for the development of dairy farming; 3) increasing the availability of credit resources for enterprises of various forms of management; 4) the restoration and operation of long-term cultural pastures; 5) regular zootechnical and veterinary activities; 6) the introduction of modern information technology in the production process; 7) improving the system of motivation of workers in the dairy cattle industry to work, and a number of others.

## 2. Methodology

The subject of the study is the organizational and economic relations that arise during the functioning of agricultural enterprises for the production of milk, and the scientific development of priority areas for development milk production. The work used monographic, statistical, tabular and graphical methods for researching the analysis of the current situation in the dairy industry.

Modern scientists differently describe the state of development of the dairy industry in the countries of the European Union, the Russian Federation and the Republic of Belarus. According to French researchers think, that “increased price volatility, negative environmental effects of intensification, growing competition from neighboring countries (including Germany) put the French dairy sector in conditions of choice and the need for new management decisions” (Chatellier et al. 2013). In recent years, the dairy industry is in a difficult situation (Rozhkova and Olentsova 2020). The authors argue that “the French dairy sector has many assets that will help it recover: a high level of per capita consumption of dairy products per year (due to the exceptional variety of processed products); a wide range of technologies and models of agricultural production with historical adaptation of the economy to natural conditions (climate, agronomic potential); high potential for production development due to low population density in many rural areas, abundance of forage land; improvement of scientific knowledge and technological innovations at enterprises, abolition of milk quotas” (Chatellier et al. 2018). We absolutely agree with the authors that a regular analysis of the current economic situation in the dairy sector (identifying strengths and weaknesses), as well as studying the conditions for the implementation of the contracting system is necessary). The contracting system, in our opinion, is an important protective tool for agricultural producers, allowing them to be confident in the stability of demand for manufactured products.

According to French researcher, “a real threat for European dairy producers is a decrease in demand for dairy products and a rapid increase in milk production in several EU member states after the abolition of milk quotas in 2015”, in his opinion, “New Zealand was far ahead of the USA and EU countries” (Chatellier 2016). Moreover, as noted by other scientist, “markets with a higher dependence on imports under the influence of the embargo and sanctions lose more in welfare than markets with less dependence” (Borodin 2018). External factors such as sanctions certainly weigh on Russia's economy (Russell 2018)

In the work of Russian scientists, the authors state that “the Russian response in the form of an embargo negatively affected the export of food products from the countries of the European Union” (Kastakova et al. 2018). Producers of milk and dairy products began to “look for new markets to enhance territorial diversification, including increasing sales of products to the Republic of Belarus.” This conclusion is confirmed by French scientists. According to some researchers, “Due to increased

imports in several Asian countries, especially China, some European livestock industries have nevertheless succeeded and increased their exports»”(Chatellier et al. 2018).

Within one or two years after the introduction of the food embargo, milk producers in the European Union experienced some financial stress and this contributed to a decrease in the number of dairy cows in the EU in 2015 compared to 2014 by 2.6%. As a result of sanctions in 2014-2015, raw milk prices declined in all European countries. Union in the range of 0.4-29%. The marketability of milk decreased to 68-70%. According to Russian scientists, “for those countries that fell under the Russian response, the export of food products was offset by an increase in supplies to other countries” (Uzun and Loginova 2016).

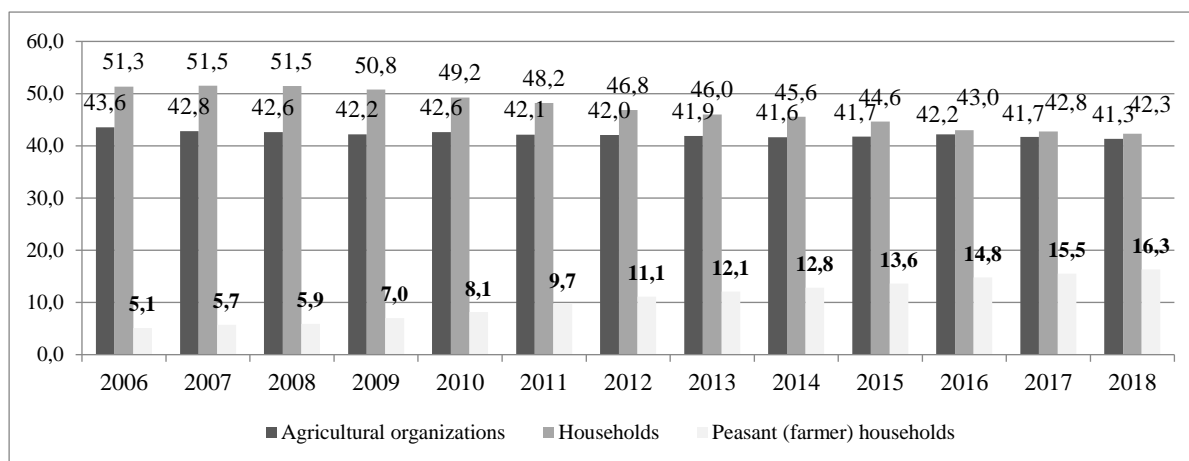
But after entering new markets, the situation improved. According to official Eurostat data, the total number of dairy cows in the European Union (EU) countries increased by 2.2% from 2006 to 2018. More than 80% of the European Union dairy cow population in 2018 is concentrated in ten in the countries of the European Union: in Germany (17.9%), France (15.5%), Poland (9.7%), Italy (8.5%), United Kingdom (8.3%), Netherlands (6.8%), Ireland (6%), Romania (5.1%), Spain (3.6%), Denmark (2.5%), Ten countries account for 85% of the total milk production in the European Union: Germany - 20.6%, France - 15.9%, Great Britain - 9.8%, Netherlands - 9.2%, Poland - 7.5%, Italy - 6, 9%, Ireland - 4.8%, Spain - 4.5%, Denmark - 3.6%, Belgium - 2.6%. Since for most countries of the European Union, livestock farming is also one of the main regular incomes for agricultural producers, therefore, part of the dairy products began to be delivered through the Republic of Belarus. Thus, there are problems of motivating workers to work in agriculture (Kuznetsova et al. 2018), because of which the problems of the formation of skilled labor resources in agricultural production are aggravated (Kuznetsova et al. 2019b) and the general trends in the development of the milk industry are changing (Kuznetsova et al. 2019a), its comparison with development trends in other countries and features is of very important scientific and practical value.

### 3. Analysis of Official Statistics

In the Russian Federation, a state program for the development of agriculture and the regulation of agricultural products, raw materials and food markets for 2013–2020 has been adopted and is being implemented, a national report on the progress and results of the implementation of this program is published annually, practically in all regions where dairy cattle breeding is developed, dairy industry development programs have been developed and are being implemented (National report 2019; Government of the Russian Federation 2012).

The analysis showed that in the Russian Federation in 2006 there were over 21.6 thousand heads of cattle, to 2018 this indicator decreased by 16%. The total number of cows decreased from 9.4 to 7.9 thousand heads (by 15.1%). In agricultural organizations, the number of cattle decreased from 10.6 thousand heads to 8.1 thousand heads, i.e. 23.3%; and the number of cows decreased by 4.1 to 3.3 thousand heads, i.e. by 19.5%. The number of cattle in households decreased from 9.8 to 7.4 thousand heads, i.e. 25%; the number of cows was reduced from 4.8 to 3.4 thousand heads, i.e. by 30.1%. The number of cattle in peasant (farmer) farms increased from 1.1 to 2.6 thousand heads, i.e. 2.3 times; cows from 0.5 to 1.3 thousand heads, i.e. 2.7 times.

Visually, changes in the structure of the number of cows can be seen in Figure 1.



**Figure 1.** The structure of the livestock of cows in various forms of management of the Russian Federation for the period from 2006 to 2018 (in %). Source: (Federal State Statistic Service 2019).

From the data presented in the figure, it is clearly seen that the proportion of the number of cows in the country's agricultural organizations decreased from 43.6% to 41.3%, i.e. 2.3 pp. The proportion of the number of cows in households decreased from 51.3% to 42.3%, i.e. by 9 pp. And the number of cows in peasant (farmer) farms has a steady upward trend from 5.1% to 16.3%, i.e. by 11.2 percentage points. The active development of farming in the Russian Federation is due to the adoption and implementation in recent years of support programs for beginning farmers and family livestock farms. As a rule, households are those in which rural residents traditionally live in rural areas and keep animals in their personal plots and independently grow agricultural products for their own consumption. They do not have state registration of their activities. Practice shows that the level of marketability of agricultural products produced in households does not exceed 20%. Peasant (farm) enterprises are usually state registered. The level of marketability of products in them is 70-80%. The average peasant (farm) economy usually consists of three or more people. Consider the level of cow productivity in the farms of the entire category in the Russian Federation in table 1.

**Table 1.** Cow productivity in various forms of management Russian Federation for the period from 2006 to 2018 (in kilograms).

Indicators	2006 y	2010 y	2015 y	2016 y	2017 y	2018 y	2018 y. in% to 2006 y
Farms of all categories	3356	3776	4134	4218	4368	4492	133.8
Agricultural organizations	3564	4189	5140	5370	5660	5945	166.8
Households	3249	3510	3500	3484	3518	3463	106.6
Peasant (farmer) households	2642	3291	3465	3499	3628	3689	139.6

From the data of table 1 it follows that the productivity of cows in agricultural organizations in Russia for the analyzed period increased at a faster pace - by 66.8%, in peasant (farmer) households - by 39.6%, in households - by 6.6%. On average, in all forms of managing the country, productivity increased from 3356 kg per cow to 4492 kg, i.e. by 33.8%. It is obvious that large-scale form of management is more competitive than small-scale production.

The resources and use of milk and milk products in the Russian Federation will be considered in table 2.

**Table 2.** Resources and use of milk and dairy products in the Russian Federation (thousand tons).

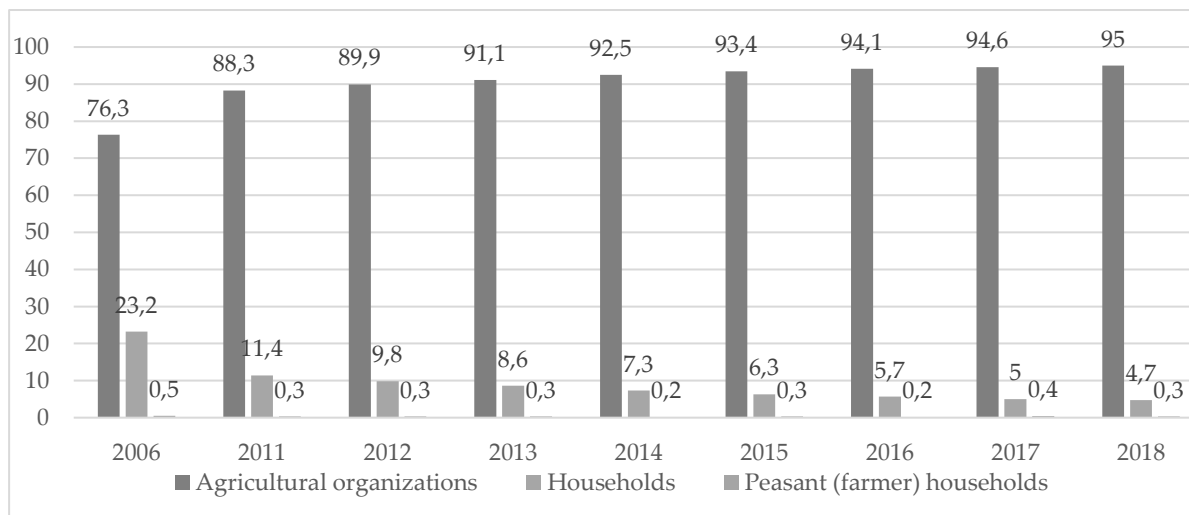
Indicators	2006 y	2010 y	2015 y	2016 y	2017 y	2018 y	2018 y. in% to 2006 y
Resources							
Stocks at the beginning of the year	1777.0	1856.6	2120.4	1947.7	1746.0	1638.9	92.2
Production	31097.0	31507.3	29887.5	29787.3	30185.0	30639.9	98.5
Import	7293.0	8159.4	7951.3	7578.6	6996.9	5687.9	78.0
Total resources	40167.0	41523.3	39959.2	39313.6	38927.9	37966.7	94.5
Using							
Production consumption	4067.0	4219.6	3223.6	3059.6	2915.1	2746.8	67.5
Export	532.0	459.8	606.0	644.8	607.6	574.5	108.0
Personal consumption	33687.0	34949.2	34148.2	33832.9	33736.9	33072.0	98.2
Reserves at the end of the reporting period	1860.0	1865.8	1947.7	1746.0	1638.9	1550.0	83.3

From 2006 to 2018 total milk production decreased by 1.5%, while exports increased by 8%, while imports decreased by 22%. Import volumes in 2006 exceeded the export volume by 13.7 times, in 2018 - by 9.9 times. Stocks of milk at the end of the year decreased by 7.8%, at the beginning of the year - by 16.7%. The volume of industrial consumption decreased by 32.5%, the volume of personal consumption decreased by 1.8%.

Consider the state of development of the dairy industry in the Republic of Belarus. Promising directions for the development of dairy cattle breeding in the Republic of Belarus are defined in the State Program for the Development of Agricultural Business of the Republic of Belarus for 2016–2020 (Council of Ministers Rep. Belarus 2016); the Doctrine of National Food Security of the Republic of Belarus until 2030 (Decree of the Council of Ministers 2017). And Presidential Directive No. 6 «About the development of the village and increasing the efficiency of the agricultural sector» (Belarus today 2019).

For many years, livestock specialization of farms of all categories of the republic has been based on dairy and beef cattle breeding, pig breeding and poultry farming. The proportion of other industries is negligible. So, for the period from 2006 to 2018, the number of cattle in the Republic of Belarus increased from 3,980 to 4,341 thousand heads (8.8%, or 361 thousand heads). At the same time, the number of cows was slightly reduced from 1,506 to 1,498 thousand heads (by 0.5%, or 8.0 thousand heads). Direct changes in the number of cows were also observed (Figure 2).

Over the reporting period, the total milk production in the Republic of Belarus increased by 24.6%: from 5,896 thousand tons in 2006 to 7,345 thousand tons in 2018. In agricultural organizations, milk production increased by 55.5 %: from 4,520 thousand tons in 2006 to 7,029 thousand tons in 2018. If in 2006 the country's agricultural organizations produced 77% of milk, then by 2018 this figure increased to 96%.



**Figure 2.** The structure of the livestock of cows in various forms of management of the Republic of Belarus for the period from 2006 to 2018 (in %).

Our analysis according to Figure 2 shows that the proportion of the number of cows in agricultural organizations increased from 76.3% to 95.4%, in households it decreased from 23.2% to 4.2%, and in peasant (farmer) farms, the decrease was insignificant - from 0.5% to 0.4%. Thus, in Belarus there is a steady reference to large-scale commercial production of milk and dairy products, which ensures the production of dairy products of uniform quality, the possibility of targeted and comprehensive regulation, as well as the timely implementation of the necessary veterinary and zootechnical measures, cost savings for management expenses, etc.

The productivity of cows in various forms of management of the Republic of Belarus for the period from 2006 to 2018 is presented in table 3.

**Table 3.** Cow productivity in various forms of management for the Republic of Belarus for the period from 2006 to 2018 (in kilograms).

Indicators	2006 y	2010 y	2015 y	2016 y	2017 y	2018 y	2018 y. in% to 2006 y
Farms of all categories	3884	4665	4722	4813	4942	4962	127.8
Agricultural organizations	4030	4760	4764	4853	4988	5001	124.1
Households	3468	4118	4229	4456	4782	5125	147.8
Peasant (farmer) households	3110	3845	3916	3942	4022	4046	130.1

From the data presented in table 3 it follows that the level of cow productivity in the Republic of Belarus in 2018 is the highest in households (5 125 kg), then in agricultural organizations (5 001 kg), and the most low - in peasant (farmer) farms - 4,046 kg. The resources and use of milk and milk products in the Republic of Belarus are presented in table 4.

**Table 4.** Resources and use of milk and dairy products in the Republic of Belarus for the period from 2006 to 2018 (thousand tons).

Indicators	2006 y	2010 y	2015 y	2016 y	2017 y	2018 y	2018 y. in% to 2006 y
Resources							
Stocks at the beginning of the year	151.6	225.8	317.4	226.4	226.6	333.2	in 2.2 times
Production	5895.4	6624.6	7046.8	7140.0	7320.8	7345.4	124.6

Import	85.9	49.2	142.7	171.5	66.1	61.4	71.5
Total resources	6132.9	6899.6	7506.9	7537.9	7613.5	7740.0	126.2
Using							
Production consumption	3277.4	3322.3	3066.8	3063.4	3169.2	3124.1	95.3
Export	2471.4	2348.1	2373.5	2342.6	2407.7	2338.5	94.6
Personal consumption	2676.6	3307.5	4213.7	4247.9	4111.1	4385.9	163.9
Reserves at the end of the reporting period	178.9	269.8	226.4	226.6	333.2	230.0	128.6

From the data presented in table 4 it follows that stocks of milk and milk products in the Republic of Belarus for the analyzed period increased 2.2 times, at the end of the year - by 28.6%. Production volumes increased by 24.6%, industrial consumption decreased by 4.7%, personal consumption - by 5.4%. Export volumes increased by 63.9%, import volumes decreased by 28.5%.

It is important to note that in 2006 the Republic of Belarus exported 45.4% of milk and dairy products of the total volume produced in the country, and in 2018 - already 59.7%. Over the past 12 years, the country's export potential has increased by almost 64%, and the share of exports in production has increased by 14.3 pp. The main direction of export deliveries of Belarusian products is the Russian Federation.

Table 5 presents the actual commodity structure of exports of milk and dairy products.

**Table 5.** Export of milk and dairy products from the Republic of Belarus for the period from 2006 to 2018.

Indicators	2006 y.		2010 y.		2015 y.		2018 y.		2018 y. in% to 2006 y.	
Condensed milk and cream	no data	no data	165,4	98,2	324,9	98,6	245,5	95,6	-	-
Condensed and dried milk and cream	153,0	89,6	195,3	81,4	234,3	92,3	215,1	52,8	140,6	-36,8
Buttermilk, yogurt, kefir	N/A	N/A	26,0	96,6	84,2	97,7	116,4	97,7	-	-
Milk serum	N/A	N/A	26,2	99,3	131,1	97,5	102,5	42,7	-	-
Butter	53,6	99,7	62,7	89,2	87,9	97,7	89,4	58,4	166,7	-41,3
Cheeses and cottage cheese	82,6	99,9	127,7	98,9	182,5	98,8	211,2	94,1	255,7	-5,8

From the data presented in table 5, it follows that export volumes for the main types of dairy products in physical terms increased. So, growth is observed for milk and cream condensed and dried amounted to 40.6%, butter - 66.7%, cheese and cottage cheese - 155.7%. The expansion of channels for the sale of milk and dairy products is evidenced by a decrease in the share of products exported to the Russian Federation: for milk and cream, condensed and dried - by 36.8 pp, butter - by 41.3, cheese and cottage cheese - by 5.8 pp

Thus, in the dairy cattle breeding of the Russian Federation and the Republic of Belarus, significant changes are taking place, associated with the new conditions and the development of new economic relations, which together have allowed to increase the volume of agricultural production, increase the competitiveness of the agricultural sector and ensure national food security.



## Conclusions

Sustainable functioning of the dairy cattle breeding industry in the Russian Federation and the Republic of Belarus was achieved thanks to the painstaking and purposeful work of state authorities, the scientific community and labor resources. The efficient functioning of the dairy cattle breeding industry is favored by the possibility of obtaining regular, almost daily income and the availability of stable consumer demand, as well as the availability of labor resources, technological and technical infrastructure, fodder lands, favorable climatic conditions and other factors. Over the analyzed period, in both countries there was an increase in cow productivity, as one of the main factors of intensification and increase of economic efficiency of production. However, we have identified and differentiation in the methods of doing agricultural business.

Firstly, in the Russian Federation, all forms of management in agricultural production are developed approximately identically (especially agricultural enterprises and households), and in the Republic of Belarus such a legal form as a joint-stock company prevails. The positive experience of the latter in the active participation of the state as a subject of the agricultural market shows the importance and specificity of the role of agriculture as the basis of people's livelihoods and the reproduction of labor, production of raw materials for many types of non-productive consumer goods and industrial products.

Secondly, since 2015, the practice of paying price premiums has been resumed in the Republic of Belarus. Decree of the Council of Ministers of the Republic of Belarus dated January 13, 2017 No. 295 provides for the possibility of direct payments from local budgets to a unit of sold agricultural products (Decree of the Council of Ministers 2017). In practice, the largest share is paid for milk. For Russian agricultural producers, this type of state support would be an important effective tool.

Thirdly, in our opinion, it is necessary to develop a system of pedigree cattle breeding, breeding, genetics and increase the longevity of cows, reduce barrels to increase the productivity and economic efficiency of dairy agribusiness. At the same time, questions of maintenance, feeding, milking and care should be carried out on a science-based approach with a focus on reducing the complexity of production and increasing labor productivity. Only an integrated approach in the implementation of strategic measures for the development of the dairy cattle breeding industry is able to give the expected economic effect.

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# Consequences of Forced Migration in the Countries of the European Union

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**Abstract:** The aim of the paper is to study the state and structure of the distribution of refugees in the countries of the European Union, the state of the level of crime in them from 2008 to 2018 and study the state of the labor market in the leading countries for the reception of refugees. During the analyzed period, 6.4 million asylum applications were registered in the countries of the European Union. It was founded that more than 90% of asylum seekers submitted their applications to the governments of 10 countries for the first time: Germany, France, Italy, Sweden, Great Britain, Hungary, Austria, Greece, Belgium, Switzerland. Only five countries have positive refugee decisions, accounting for 90% of all approved decisions: Germany, Great Britain, France, Austria and Sweden. However, among the negative facts that accompany the processes of refugee influx, a high level of crime should be noted. In this regard, the adoption of coherent international policies and constructive measures to regulate and tightly control the deviant behavior of refugees, assistance in adaptation and integration is extremely important for ensuring the socio-economic and psycho-emotional well-being of the population of the host countries of the European Union.

**Keywords:** refugees; European Union; asylum; education; crime; Correlation-regression models

**JEL Classification:** F22; J15

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## 1. Introduction

The rapid increase in the number of refugees in the countries of the European Union is aiming scientists and researchers to find solutions to smooth out the key problems that accompany the processes of forced displacement. Some scientists draw attention to the problems of integrating refugees with host communities due to linguistic and cultural differentiation; others - the lack of qualifications required by refugees for early employment and making a positive contribution to the development of the economy of the host regions and countries, third scientists are trying to identify the psychological problems of migrants, others - their state of health and anthropometric physiological changes, as well as issues of legal insecurity, sexual violence, attacks, human trafficking and other serious problems.

In the work of English scientists, it is noted that “the main causes of migration intentions are socio-economic problems, as well as intangible factors, including the search for sensations” (Williams et al. 2018). The issues of factors and reasons for the successful adaptation of migrants to the European labor market were considered by us in one of our previous works (Kuznetsova et al., 2019). The effects of unemployment and labor market are examined in Hedvičáková (2018), Hedvičáková and Svobodová (2016) and Hedvičáková, Sokolová and Mohelská (2018). Bell, Fasani and Machin (2013) found that differences in labor market opportunities of different migrant groups shape their potential impact on crime. Ousey and Kubrin (2018) indicate that, overall, the immigration-crime association is negative – but very weak.

Since the beginning of the political crisis in the Syrian Republic, a significant part of the refugees went to the Republic of Turkey. Over five million forced refugees arrived in Turkey alone from 2014 to 2019, which amounted to more than 20 % of the previous resident population of Syria (compared to 2013 data), while for Turkey the proportion of the number of refugees who arrived in the country

amounted to over 5% of the resident population of Turkey. Similar cultural and national traditions, customs and linguistic languages contributed to such an active preference / choice of the Syrians of the Republic of Turkey. Sirkeci (2017) noted that "Turkey, which provided generous support to Syrian refugees, was recognized as a «security country» for them" (Sirkeci 2017).

Another part of the forced refugees also went to the countries of the European Union. However, a significant gap in the cultural and educational differentiation between refugees and the local population of the countries of the European Union has led to high social tensions and negative attitudes towards refugees, to integration problems. So, according to the researchers, "refugees are generally more prone to poverty because they are less educated, less economically active and less busy (especially if they are women)" (Tanay et al. 2016). This conclusion is confirmed by other researchers. According to Musset (2015), "among the few young people living in Finland who do not have a good education and highly qualified skills, there is a very high risk of marginalization due to unemployment, which seriously damages their prospects" (Musset 2015).

In 2014, "every fifth refugee between the ages of 15 and 64 had a high level of education; less than half have only secondary education" (Hainmuller et al. 2016a). In our opinion, a good education is the main condition for successful integration into the refugees in the labor market. This improves employment prospects, improves social inclusion. An interesting finding is summarized, according to which each subsequent year of waiting for employment reduces the subsequent level of employment by 4-5 percentage points, which is 16-23% less than the average estimate (Hainmuller et al. 2016b).

We agree with the authors about the fact that in different subgroups of refugees stratified by gender, social origin, age and chosen language region, the situation in reducing the level of employment due to a lack of knowledge of the host language and due to the lack of the required level of educational preparation leads to an increase unemployment. This conclusion is confirmed by other scholars who state: "the income level of migrants directly depends on their knowledge of the language of the host country" (Chiswick & Miller 2013).

Long waiting times weaken the motivation for refugee work because of psychological frustration, and not because of the mechanism of skill atrophy. In the work of Swedish scientists, it is noted that «the main reasons why companies terminate refugee employment are not related to discrimination on the part of staff or clients, but to the optimal work of refugees» (Lundborg & Skedinger 2016). The availability of special knowledge, skills and abilities acquired through vocational training contributes to an increase in labor productivity by 30–50%. Thus, the "length of time during which refugees wait in a «suspended state» for a decision on their asylum application affects their subsequent economic integration" (Hainmueller et al. 2016a). The absence of a language barrier, good knowledge of the language can become the basis for the successful integration of migrants and refugees in labor processes.

However, the main consequences that are accompanied by forced migration are: prolonged lack of work, chronic unemployment, increased crime, increased social tension. That is why there was a defensive reaction from the European Union states in defense of the permanent local population of European countries, manifested in the form of a decrease in the number of positive decisions on the provision of refugees (Harteveld et al. 2018). Europeans are interested in maintaining public and personal security, psychological comfort in their places of permanent residence, no stress, strengthening civilized and cultural interaction between people, maintaining peace and prosperity. Escaping from solving problems, shifting one's own tasks to other people - this is not a way out of the prevailing socio-economic difficulties and solving their own material problems. People must build peace and a comfortable life together, together, mainly in their own territories of their birth and development, without causing discomfort to others. Niedomysl (2011) reveals variation in migration motives, not only over migration distance, but also in relation to migrant socio-economic and demographic characteristics.

If Western European countries want to tackle the root causes of asylum migration, then they need to undertake policy measures that promote economic development, democracy, respect for human rights, and peaceful conflict resolution in countries of origin (Neumayer 2005). It is necessary solve the impact of post-migration factors on the mental health of refugees too (Carswell, Blackburn, Barker, 2011).

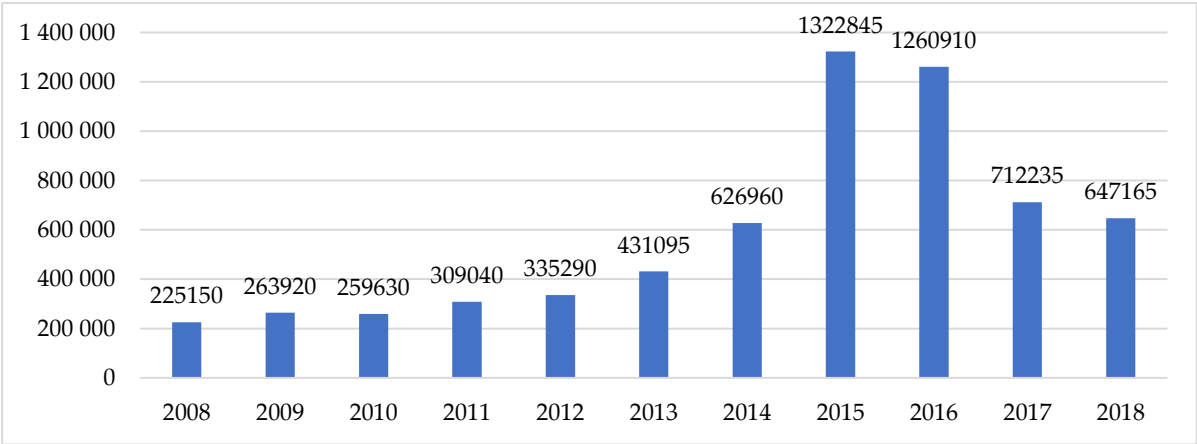
**2. Methodology**

Mainly secondary sources as professional literature, journals, contributions at international conferences, discussions at conferences or seminars, monographs, websites and databases were used during processing of this study. Mainly the official statistics were used as a source for the paper data set, particularly for example European statistics on forced migration during the time period between 2008 to 2018.

The aim of the paper is to analyze the state and structure of the distribution of refugees in the countries of the European Union and second aim is to analyze the criminality of migrants in selected countries and then correlate with the level of education and unemployment in the labor market-from 2008 to 2018. The data consist of some socio-economic features related to 28 European countries. Five countries with more than 90% of positive refugee decisions have been selected for further analysis. To identify the relationship of factors that can provide asylum decision-making, will be conducted several pairwise correlation-regression models for 28 countries of the European Union. Regression analysis is conducted to identify some socio-economic predictors of countries attracting asylum migration (Angeloni, 2016).

**3. Results**

According to official Eurostat data, the number of asylum applications in 28 countries of the European Union for the period from 2008 to 2018 amounted to over 6.4 million (Figure 1).

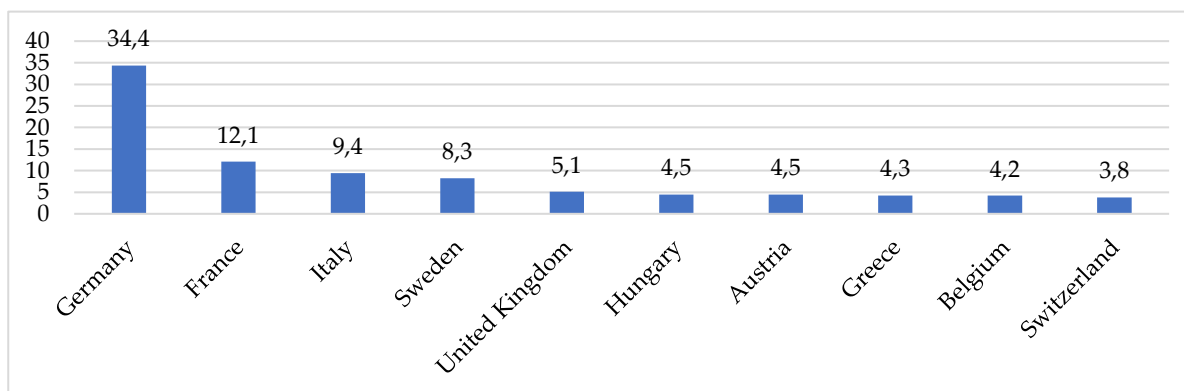


**Figure 1.** Asylum and the first time asylum applicants - annual aggregated data in EU (28 countries) (rounded).

It follows that in the dynamics from 2008 to 2018, the largest peak of people applying to resolve the issue of asylum was firstly noted in 2015 and in 2016, see Figure 1. The increase in the number of asylum applications was 2.1 times in 2015, compared to the 2014 level. The growth in the number of asylum applications amounted to 2.9 times in 2018, compared to the level of 2008.

The structure of the largest share of applications for asylum in the first ten countries is presented in Figure 2.

The largest proportion of people out of 6.4 million, 90% of the first asylum seekers, belongs to 10 countries: Germany (34.4%), France (12.1%) Italy (9.4%), Sweden (8.3%), Great Britain (5.1%), Hungary (4.5%), Austria (4.5%), Greece (4.3%), Belgium (4.2%), Switzerland (3.8%).



**Figure 2.** Asylum and the first time asylum applicants - annual aggregated data (rounded) (in %).

Consider the countries of the European Union that have provided the largest number of positive asylum decisions for migrants in relation to the total number of applications submitted by migrants in table 1.

**Table 1.** European Union countries with the highest number of positive asylum decisions for migrants.

geo\time	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
EU (28 countries)	1414	1413	1365	1379	1351	1484	1599	1811	2366	4959	4172
	5	5	0	0	0	5	0	0	0	0	0
										3059	1998
Germany	1625	1410	1220	1680	2110	2960	4330	5170	8515	0	0
United Kingdom	4170	6215	6010	4010	3920	3770	2700	4030	6170	6170	6195
France	5190	4040	4245	4930	4290	4270	4245	3830	4510	5400	6015
Austria	1705	1400	1060	1325	1240	1180	2050	1740	835	2985	4195
Sweden	210	310	285	455	725	685	750	745	1120	1890	2020
Finland	0	5	5	20	90	50	75	50	185	535	930
Italy	0	45	70	65	45	5	10	0	385	385	825
Belgium	315	165	195	425	295	370	440	395	320	290	475
Netherlands	75	45	90	120	70	450	260	255	340	480	400
Denmark	110	65	130	220	230	265	160	210	205	245	200
Ireland	285	260	130	75	45	55	90	180	205	30	185
Greece	345	30	35	195	185	325	805	1355	770	510	175
Switzerland	170	115	70	35	50	50	45	70	95	115	170
Norway	35	45	165	290	285	345	240	200	130	145	110
Spain	20	25	15	0	10	15	0	5	15	10	45
Iceland	0	0	0	0	0	5	0	15	5	40	30
Poland	5	0	0	5	20	5	5	10	20	0	20
Croatia	:	:	:	:	20	0	0	0	0	20	15
Romania	15	65	85	75	160	390	5	10	5	5	15
Malta	0	0	0	0	10	0	10	30	25	25	10
Czechia	10	0	5	115	0	0	5	0	0	0	5

More than 90% of the positive refugee decisions are in five countries: Germany (19980), Great Britain (6195), France (6015), Austria (4195), Sweden (2020). Consider their specific gravity in Figure 3.

In 2008, only 91% of positive asylum decisions for internally displaced persons of the total number of positive decisions made by the European Union were in France (36.7%), then in the UK (29.5%), then in Austria (12.1%), Germany (11.5%), Sweden (1.5%).

In 2009, only 95% of positive asylum decisions for internally displaced persons of the total number of positive decisions taken by the European Union were in the UK (44%), then France (28.6%), Germany (10%), then Austria (9.9%), Sweden (2.2%).

In 2010, 94% of all positive asylum decisions for internally displaced persons of the total number of positive decisions taken by the European Union were in the UK (44%), then France (31.1%), Germany (8.9%), then to Austria (7.8%), Sweden (2.1%).

In 2017, 95% of all positive asylum decisions for internally displaced persons of the total number of positive decisions taken by the European Union were in Germany (61.7%), the UK (12.4%), then France (10.9%), then to Austria (6%), Sweden (3.8%).

In 2018, 95% of all positive asylum decisions for internally displaced persons of the total number of positive decisions taken by the European Union were in Germany (47.9%), the UK (14.8%), then France (14.4%), then to Austria (10.1%), Sweden (4.8%) (Figure 3).

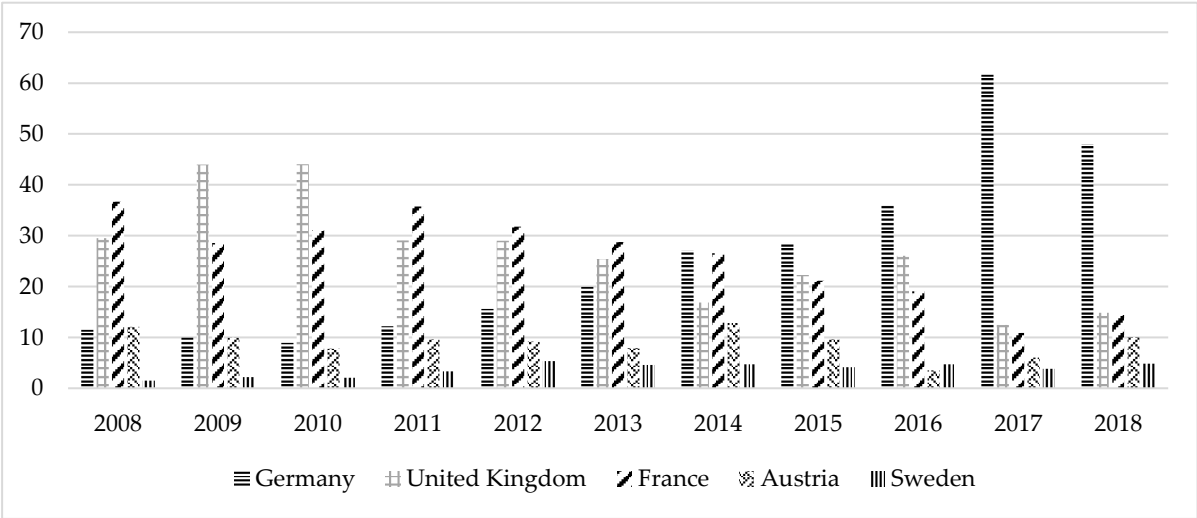


Figure 3. Percentage of positive asylum decisions by the five countries of the European Union.

From the data presented in the figure 4 it follows that the ratio of the number of positive asylum decisions for the period from 2009 to 2018 has increased significantly in Austria (up to 0.05%), Germany (up to 0.02%), Sweden (up to 0.02%). Thousands of shares are hardly noticeable in the figure, however, it is obvious that the percentage of asylum permits has increased in the UK (0.01%), as well as in France (0.01%).

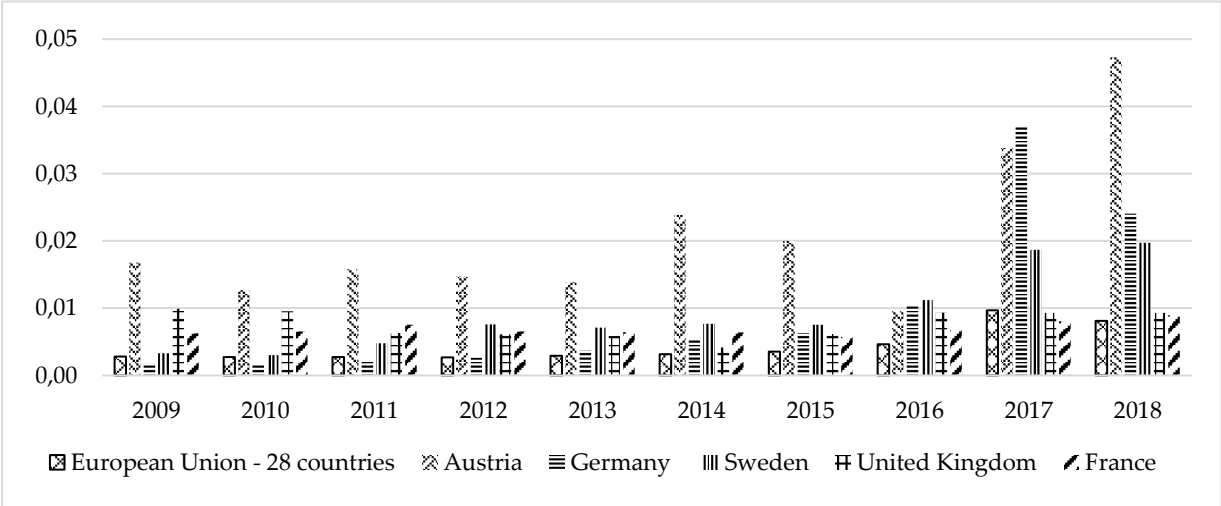


Figure 4. Percentage of asylum in the total population of countries, in %.

As a rule, poorly educated refugees can hold low-skilled jobs in the host countries. The success of quick employment in the host country depends on the level of education and the availability of the required professional competencies of refugees.

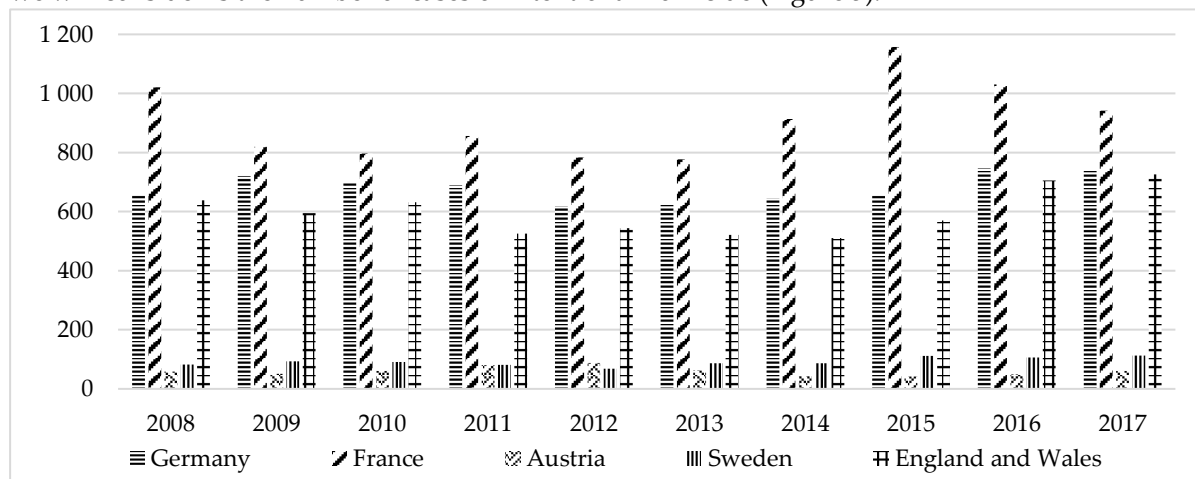
An increase in the number of refugees in host countries is most often associated in recent years with an increase in crime, unrest, and chaos. The local population in every possible way impedes the influx of migrants, especially without education, as this violates the usual way of life and lifestyle, and makes it necessary to take various precautionary measures. Among the data of official statistics of the European Union there is information about the number of crimes, namely - intentional killings, assaults, sexual violence and some others.

Let us consider once again the information on the number of positive decisions on granting refugees to refugees in the leading countries for the reception of refugees for the period from 2008 to 2017 in table 2. From the data in Table 2, it can be seen that for the period from 2008 to 2017, a total of 191 425 positive asylum decisions were issued for the countries of the European Union, including Germany - 59610 (31.2%), Great Britain - 47165 (24.7%) , France - 44950 (23.5%), Austria - 15520 (8.1%), Sweden - 7175 (3.8%). Thus, from 2008 to 2017, over 90% of refugee asylum decisions were issued by these five countries.

**Table 2.** Final decisions on asylum applications - annual data.

GEO\ TIME	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total 2008-2017
EU (28 countries)	14145	14135	13650	13790	13510	14845	15990	18110	23660	49590	191425
Germany	1625	1410	1220	1680	2110	2960	4330	5170	8515	30590	59610
United Kingdom	4170	6215	6010	4010	3920	3770	2700	4030	6170	6170	47165
France	5190	4040	4245	4930	4290	4270	4245	3830	4510	5400	44950
Austria	1705	1400	1060	1325	1240	1180	2050	1740	835	2985	15520
Sweden	210	310	285	455	725	685	750	745	1120	1890	7175

Consider the state of crime in the leading countries for the reception of refugees. The first indicator we will consider is the number of cases of intentional homicide (Figure 5).



**Figure 5.** The number of recorded offences by offence category - Intentional homicide (Number).

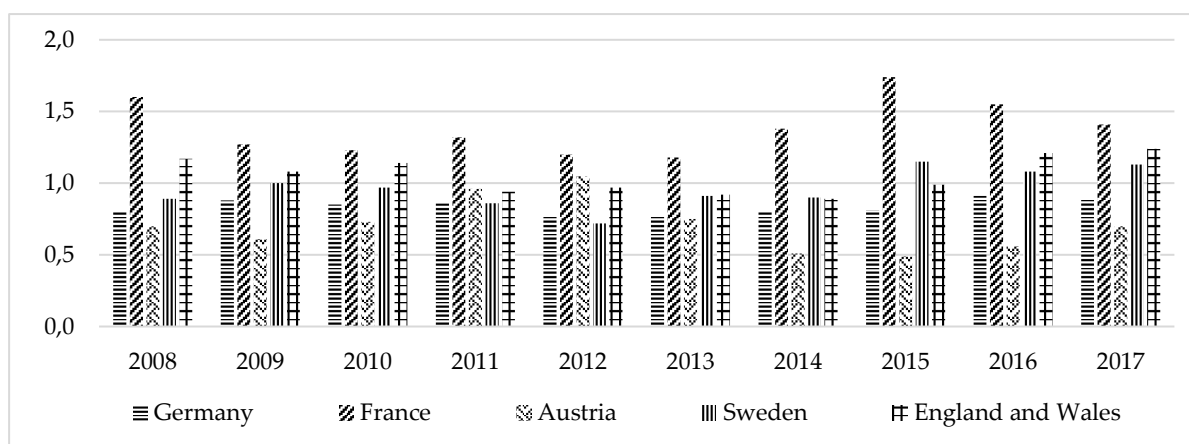
From the figure it follows that the greatest number of murders both in 2008 and throughout the study period was noted in France. In second and third places are Germany and England. The number of intentional killings in Austria and Sweden is not the highest.

In 2008, there were 1,021 murders in France, 656 in Germany, and 638 in England.

In 2017, the number of murders in France was 942, in Germany - 738, in England - 726.

Consider the value of the indicator of the number of murders per 100 thousand inhabitants (Figure 6).





**Figure 6.** Recorded offences by offence category - Intentional homicide (per hundred thousand inhabitants).

From the data presented in the figure it follows that, per 100 inhabitants in 2008, the largest number of killings occurred in France - 1.6, in England - 1.2, in Sweden - 0.9, in Germany - 0.8. By 2017, France began to account for 1.4 cases of recorded killings, in England - 1.2, in Sweden - 1.1, in Germany - 0.9, in Austria - 0.7.

Among all the criminal events taking place in the countries of the European Union, the largest number of crimes are attacks and sexual violence.

In the following table, we consider the number of criminal attacks on people from 2008 to 2017 in the five leading asylum countries (table 3).

From the data in Table 3 it can be seen that during the period from 2008 to 2017, the largest number of attacks was carried out in England (3938044), then in France (2302237), in Germany (1743978), in Sweden (51067), in Austria (36937).

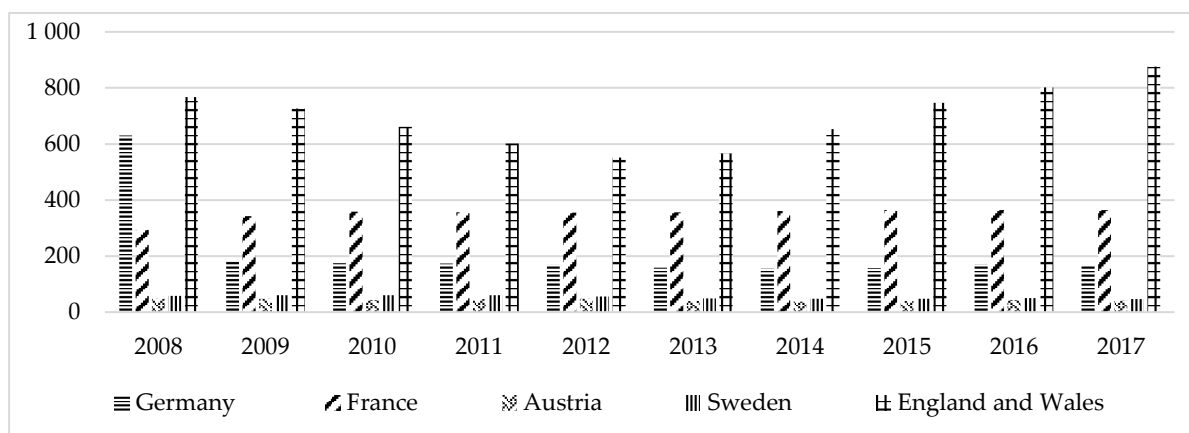
From the data presented in the table 3 it follows that the largest number of attacks on people in 2008 occurred in Germany – 518 499, in England – 419 119 and in France – 187 937.

In 2017, the largest number of attacks began to fall on England (512 631), then on France (242 910) and Germany (137 058).

**Table 3.** Recorded offences by offence category – Assault (Number).

GEO/ TIM E	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total 2008- 2017
Germ any	51849 9	14930 1	14290 3	13909 1	13607 7	12786 9	12575 2	12739 5	14003 3	13705 8	1743978
Engla nd and Wales	41911 9	39971 3	36687 8	33686 7	31095 3	32153 5	37346 4	43052 7	46635 7	51263 1	3938044
Franc e	18793 7	22012 6	23190 96	23130 7	23173 3	23330 4	23791 6	24218 5	24291 0	24291 0	2302237
Swed en	5332	5600	5594	5684	5338	4659	4570	4646	4959	4685	51067
Austri a	3945	4023	3606	3897	4030	3327	3230	3461	3793	3625	36937

The indicator of the number of attacks per 100 population in the leading countries for the reception of refugees for the period from 2008 to 2017 is presented in Figure 7.



**Figure 7.** Recorded offences by offence category - Assault (Per hundred thousand inhabitants).

From the data presented in the figure it follows that, per 100 inhabitants in 2008, the largest number of attacks on people occurred in England (767), Germany (631), France (294). By 2017, the crime rate in England increased and began to amount to 875 cases per 100 population. In second place is France (364), in third is Germany (166), in fourth place is Sweden (47), in fifth is Austria (41).

In the following table 4, we consider the number of cases of sexual abuse of people from 2008 to 2017 in the five leading countries for asylum.

From the data in Table 4, it can be seen that between 2008 and 2017, the largest number of cases of violence were committed in England (654794), then in Germany (391600), then in France (292267), in Sweden (160455), in Austria (38981). From the data presented in the table it follows that the largest number of cases of violence against people in 2008 occurred in Germany – 56 784, in England – 35 310, in France – 24 031, in Sweden – 14 058.

By 2017, the situation changed and the largest number of cases of violence began to occur in England (134 292), then in France (41 751), Germany (34 815), Sweden (18 874).

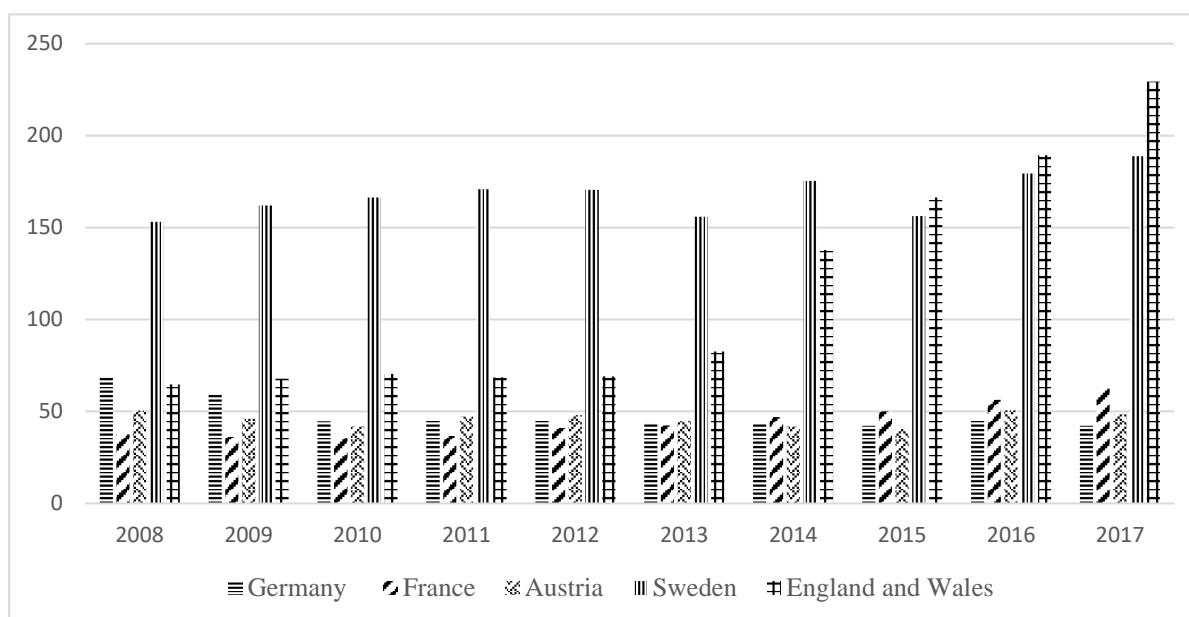
**Table 4.** Recorded offences by offence category – Sexual violence (Number).

GEO/ TIME	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total 2008- 2017
England and Wales	35310	37307	39114	38298	38930	46866	78787	95853	11003 7	13429 2	654794
Germany	56784	49084	36566	36354	36277	35330	34959	34265	37166	34815	391600
France	24031	23253	22963	23871	26783	27778	30959	33283	37595	41751	292267
Sweden	14058	14998	15537	16095	16174	14891	16910	15237	17681	18874	160455
Austria	4185	3836	3496	3957	4040	3780	3564	3479	4391	4253	38981

Consider the indicator of the number of cases of violence per 100 people in the leading countries for the reception of refugees for the period from 2008 to 2017 in Figure 8.

From the data presented in the figure it follows that, per 100 inhabitants in 2008, the largest number of cases of violence occurred in Sweden (153), Germany (69), England (65), Austria (50), France (38).

By 2017, the crime rate in England increased and began to amount to 875 cases per 100 population. In second place is France (364), in third is Germany (166), in fourth place is Sweden (47), and fifth is Austria (41).



**Figure 8.** Recorded offences by offence category - Sexual violence (Per hundred thousand inhabitants).

A comparison of the number of attacks and cases of violence in relation to the number of positive decisions by asylum countries will be carried out in the following table 5.

Thus, the data in Table 5 shows that the number of attacks and cases of sexual violence is several times greater than the number of positive asylum decisions issued between 2008 and 2017. The exception to the data presented in the table is France. Unfortunately, we do not have accurate data confirming that among the 44950 people who received asylum in the period from 2008 to 2017, that these people committed the attacks and sexual violence. But according to the figures, the number of cases of violence in France is 82.2% of the number of shelters granted over the years, and the number of cases of sexual assault is 86.7%.

**Table 5.** Comparison of the number of attacks and incidents of violence in relation to the number of positive asylum decisions by countries, total for the period from 2008 to 2017.

Indicators	Assault	Sexual violence	Final decisions on asylum applications - annual data	The excess of the number of cases over the number of asylum permits, times	
				Assault	Sexual violence
Sweden	3938044	654 794	7175	548.9	91.3
United Kingdom	2302237	292 267	47165	48.8	6.2
Germany	1743978	391 600	59610	29.3	6.6
Austria	51067	160 455	15520	3.3	10.3
France	36937	38 981	44950	0.8	0.9

### 3.1. Correlation-regression models

In Austria, Sweden, Germany, the UK, the number of cases of sexual violence and assaults cannot hypothetically belong to the same people.

To identify the relationship of factors that can provide asylum decision-making, we conducted several pairwise correlation-regression models. We have studied data for 28 countries of the European Union. The indicator of decision-making on granting asylum was chosen as the dependent variable "U", as the number of cases of attack on 100 thousand people from 28 countries of the European Union as X1; X2 - the number of cases of sexual violence per 100 thousand of the population of 28 countries

of the European Union; X3 - unemployment rate among people with an educational level of 3-4 (in percent); X4 - unemployment rate among people with a level of education 0-2 (in percent); X5 - social protection costs per person in 28 countries of the European Union. As a result of pairwise correlations, the tightness of the relationship between the studied factors ( $R^2$ ) was quite low, within 1-3%, which indicated the absence of a direct relationship between the factors. However, the influence of the indicator X1 on Y demonstrated a bond tightness of  $R = 0.25$ ,  $R^2 = 0.06$ , which is also very low.

In another correlation model, the indicator of social protection expenditures per 1 person in 28 countries of the European Union was chosen as the dependent variable "U", and the poverty risk indicator (in percent) was selected as X1. As a result, the influence of factor X1 on Y was established that the connection tightness is  $R = -0.48$ ,  $R^2 = 0.23$ , which indicates that there is an average communication tightness, but it is the inverse between the poverty risk indicator and the social protection spending indicator. This is very logical, since the lower the costs for social protection, the higher the risk of poverty.

In the third correlation model, the poverty risk indicator (in percent) was chosen as the dependent variable "Y"; X1 is the unemployment rate among people with an educational level of 0-2 (in percent). As a result, the influence of factor X1 on Y was found that the tightness of the relationship  $R = 0.27$ ,  $R^2 = 0.07$ , which indicates that there is a direct low relationship between the indicator "unemployment rate among people with educational level 0-2" and the indicator "poverty risk". This conclusion is also very logical, the higher the unemployment rate among people with a level of education 0-2, the higher the risk of poverty. The relatively low tightness of the relationship between the studied factors indicates the presence of other hidden factors. The search for which will be devoted to other studies.

#### 4. Conclusions and Discussion

The total number of asylum applications in the countries of the European Union for the period from 2008 to 2018 amounted to 6.4 million. More than 90% of asylum seekers first submitted their applications to the governments of 10 countries: Germany (34.4%), France (12.1%) Italy (9.4%), Sweden (8.3%), Great Britain (5.1%), Hungary (4.5%), Austria (4.5%), Greece (4.3%), Belgium (4.2%), Switzerland (3.8%).

More than 90% of positive asylum decisions for refugees belong to only five countries: Germany (47.9%), Great Britain (14.8%), France (14.4%), Austria (10.1%), Sweden (4.8%).

The increase in the number of refugees in host countries is most often associated in recent years with an increase in crime and unrest. Among the data of official statistics of the European Union there is information about the number of crimes, namely, intentional killings, assaults, sexual violence and some others. The largest number of murders both in 2008 and throughout the study period is recorded in France. In second and third places are Germany and England. The number of premeditated killings in Austria and Sweden is not the highest.

In 2017, the largest number of criminal attacks on people per 100 inhabitants in 2008 were in England (767), Germany (631), France (294). By 2017, the crime rate in England increased by 14% and began to amount to 875 cases per 100 population. In second place is France (364), in third is Germany (166), in fourth place is Sweden (47), in fifth is Austria (41).

According to official figures, the crime rate has sharply increased in terms of the number of cases of violence. Per 100 inhabitants in 2008, the largest number of cases of violence occurred in Sweden (153), Germany (69), England (65), Austria (50), France (38). By 2017, the number of cases of violence in England had increased 13.5 times and amounted to 875 cases per 100 population. In second place is France (364), where the level of violence has increased by more than 10 times. Germany is in third place (here the level of violence has increased by 2.4 times and has become equal to 166 per 100 thousand inhabitants). In Sweden and Austria, the level of violence, on the contrary, decreased. In Sweden (by 3.3 times - 47), in Austria (by 18% - 41).

Between 2008 and 2017, the largest number of attacks were carried out in England (3938044), then in France (2302237), in Germany (1743978), in Sweden (51067), in Austria (36937).

Between 2008 and 2017, the largest number of cases of violence were committed in England (654794), then in Germany (391600), then in France (292267), in Sweden (160455), in Austria (38981).

The number of attacks on people and the number of cases of sexual violence in the leading countries for the reception of refugees is many times higher than the number of positive asylum decisions issued between 2008 and 2017. This indicates that the crime rate in these countries is high not only due to the influx of refugees. Perhaps there are other factors, including illegal migration, deviant behavior by local residents and others. The number of attacks on people and the number of cases of sexual violence in France alone does not exceed the number of positive asylum decisions issued between 2008 and 2017. Unfortunately, we do not have accurate data confirming that among the 44,950 people who received asylum in the period from 2008 to 2017, it was the refugees who committed the attacks and sexual violence. The number of cases of violence in France is 82.2% of the number of shelters granted over the years, and the number of cases of sexual assault is 86.7%.

The local population of European countries in every way prevents the influx of migrants, especially without education, as this violates the usual way of life and lifestyle, motivates to take a variety of precautions. The question in the discussion is how to change the situation in the European Union after leaving the UK?

The successful adaptation of refugees granted asylum depends on five key factors: 1) the actual level of education of refugees and their competencies; 2) good knowledge of the language of the host country; 3) gender and age of migrants; 4) psychological moods; 5) the desires of the refugees themselves for integration and work.

In all cases when it comes to training, all necessary measures must be taken to ensure access to jobs that do not require the involvement of the local population, which reduces the cost of social protection of people and public support, consequences for all socio-economic consequences.

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# Employees Satisfaction Determines Their Performance

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**Abstract:** Performance is the ability to perform work tasks and is not only related to the knowledge and skills of an employee. Quality performance is influenced by technical and economic conditions. Job satisfaction is a key moment of a positive attitude towards task fulfillment. Satisfaction is related to motivation, work attitude and emotions play their part. Relationships between employees and employers are a major contributor to satisfaction. Employee satisfaction is growing proportionally to low unemployment, as employers struggle with the lack of employees expanding care for them. Job satisfaction is also the key to job happiness. The aim of the paper is to verify whether employees employed in the field of selected services are satisfied based on factors contributing to their job satisfaction. Is a wage a decisive factor for satisfaction? The presented information was obtained by collecting primary data. As a result, job satisfaction in the monitored area is not dependent only on income. Satisfaction with working life outweighs dissatisfaction. Employee loyalty is crucial for employers; it is in the interest of companies to retain their employees. Hiring new employees is very expensive. A survey of companies focused on employee satisfaction is a way how to combat fluctuation.

**Keywords:** job satisfaction; employee; performance; benefits

**JEL Classification:** J2; M3; M54

## 1. Introduction

The problem of satisfaction is very intensively dealt with in specialized literature. There are numerous studies that map the area. A wide range of opinions of experts who are interested in this issue can be traced. Scientific approaches have emerged, they are the fundament of the theoretical basis and their practical implementation. People who are not exposed to undue stress at work, who do not feel tired, do not feel unnecessary, can work effectively. Feelings of satisfaction can be brought about by the meaningfulness of the work done, which meets the needs of employees, their wishes and goals. Managing interpersonal relationships in the workplace, working effectively on one's professional growth is a way how to achieve job satisfaction (Hannelore 2007). Overloading or boring work puts employees in stressful situations that, without the support of their superiors, create dissatisfaction and consequently lead to a decline in performance. Performance is measurable, there are a number of specific indicators (KPIs) by which performance can be quantified (Levičková and Mičková 2019). The indicator that is related to the level of work is labor productivity. There are many reasons for measuring performance, Marr (2006) has defined three basic areas that need to be monitored, reporting, strategic decision making and learning within the organization. The third of the pillars, which is a major contributor to performance, identifies the streamlining of the behavior of managers and employees. Work is a necessity to satisfy the basic physiological needs, but it also gives room for the employee to get recognition from the company. It gives him/her space for self-realization, can exercise their abilities, work can bring fulfillment of mission and life goal. Working through basic existential needs brings satisfaction of mental needs and can bring into a sense of self-realization (Maslow 1943).

In contrast to quantifiable performance, job satisfaction is an expression of subjective feelings in a particular environment and is related to an internal personality type. Personality traits, internal settings, affect personal and professional life. Each profession requires specific characteristics and abilities, others are for healthcare workers, the others will be for service positions that are subject to

review of the submitted paper. Properly selected employee personality in relation to the type of profession is important for work performance. It affects an overall job and employer satisfaction. The identification of a suitable personality for a particular position using suitable tools is solved by the so-called Big Five model, known as the Big Five, in detail by Barrick and Mount (1991). Using the model, five selected personality characteristics are searched for based on the linguistic opposite meanings of the five words. An open personality is open to new things, a team and knowledge. A counterpart is made up of people characterized by conservatism, they do not like to adapt to new procedures. The dimension of conscientiousness does not correspond to carefree, an extrovert is a communicative person, energetic active, social, opposite to closeness, withholding is typical for an introverted person. Emotionally stable employees are beneficial for their balance, optimism, unlike neuroticism leads employees to be moody and easy to get out of the way, they are unbalanced. In services, this factor is decisive for filling positions, as a satisfied customer affects the effectiveness of business activity. The job motivation and consequently the performance that brings the economic prosperity of the company grows with satisfaction. Satisfied employees also make their employer happy.

Job satisfaction is an indicator of job happiness. Perceived job satisfaction of the employees is a good indicator of job satisfaction measured by the index. Satisfaction with working life is linked to the quality of life in general. Research (Svobodová 2015) in the framework of a grant project supported by TA CR Changes in the quality of working life carried out by the Center for Public Opinion Research in cooperation with the Institute of Sociology of the ASCR analyzed in detail the quality of working life within a range of selected categories related to work-life happiness. Satisfaction with working life prevails over dissatisfaction, increasing with higher education, and specialists with higher responsibility. According to the data, on the other hand, it is lower in public, social and catering services. Job satisfaction as a subset of quality of life is linked to job satisfaction (Vinopal 2011). In his paper (Večerník 2006) Jiří Večerník focuses on the topic of satisfaction in the dimension of changes in the Czech society in connection with the accession to the European Union.

The paper will focus on the satisfaction of employees in services, specifically dealing with services in the field of gastronomy and hotel industry. Services are traditionally perceived as a field of activities that is demanding on the psyche of a person and therefore job satisfaction is a decisive element for the desired performance in this position. The quality of work with the client is decisive for the efficiency of a company, it participates in the creation of its profit. Although this field is characterized by high fluctuation and according to published statistics, lower wage evaluation in relation to average national values (CZSO 2019), it was found that satisfaction in this field prevails over dissatisfaction.

## **2. Methodology**

The questionnaire survey method was used on the theoretical basis to determine the level of satisfaction with the employment of employees in the field of selected services and to determine which factories are crucial for the feeling of satisfaction. The questionnaire survey addressed a total of 74 respondents within one week who provided relevant answers. They are practitioners who hold various positions in companies of selected services and increase their qualifications by studying at a university. The respondents have at least secondary education. They evaluated their satisfaction through a score scale from excellent to inadequate. Satisfaction at work was verified by choosing appropriately selected questions to provide information to evaluate the factors that are most important for the sense of job satisfaction. The aim was to verify whether satisfaction prevails over dissatisfaction. The output is to find out which attributes are essential for staying in employment that prevail. Output values are given both in absolute values and also by proportional representation within the monitored quantity. Although it is generally perceived by the company that income conditions are decisive for job satisfaction. This has not been confirmed by the survey conducted in the services addressed.



### 3. Results

Every activity a person carries out is either pleasant or unpleasant. Employee satisfaction and corporate loyalty are crucial for businesses. Investments in recruiting new staff represent high costs. Attention to employee satisfaction is a way for companies to find out what they like and what they do not like. The results of satisfaction in a particular field of activity are presented in the following overviews which are processed on the basis of a questionnaire survey.

**Table 1.** Representation of respondents, research data.

Field of activity	Men	Woman	Total
Hospitality	10	30	40
Hotel industry	10	24	34

Table 1 demonstrates that in the monitored services the representation of women, in hospitality account for 75 % and in the hotel industry for 71 %. It is true that women are always happier than men are, this means more outcomes with a potential probability are affected by them.

Table 2 shows employee satisfaction based on the situation at the workplace. The working climate is very important for work performance and satisfaction.

**Table 2.** Satisfaction rating according to selected criteria, research data.

Evaluation criterion	Rating scale				
	1	2	3	4	5
Job satisfaction	24	22	22	4	2
Relationship of the supervisor to you	32	26	10	4	2
Relationship of the employer to employees	22	26	18	4	4

The respondents rated satisfaction as excellent, very good, good, satisfactory and negative. From the above overview it is clear that satisfaction according to selected criteria outweighs dissatisfaction. Employers were slightly worse evaluated in relation to their employees, which can be reflected in the working atmosphere. Employees do not feel well if they are not sufficiently informed about important matters.

**Table 3.** Factors influencing job satisfaction, research data.

Satisfaction depends on	Number	%
Work team	50	68
Direct supervisor	4	5
Offered benefits	2	3
Higher wage evaluation	18	24

When asked which of the motives are most influenced by job satisfaction, good relationships in the team clearly prevail. Ineffective relationships between people are the reason for a change of a job. Evaluators, on the other hand, do not see in inappropriate relationships with the manager as decisive for staying in employment. An unsatisfactory working team that causes disagreements at the workplace would lead to change as it would cause dissatisfaction (CVVM, 2018). Similar results were presented by a survey conducted by the STEAM/MARK agency, where poor relationships between people would result in 16 % of employees changing jobs. Working alongside people with no good communication cannot work without a conflict for a long time. A good working atmosphere significantly exceeds the ranking of wages, 24 % of respondents. This is different from the surveys conducted by Grafton Recruitment finance (2019) among Czech employees in 2018. According to the survey, the change in employment does not depend only on the wage level, it is not only money. Wages would have to change significantly in order to become a key factor in thinking about changing jobs.

**Table 4.** Length of employment and age limit, research data.

<b>Length of employment</b>	<b>Number</b>	<b>Age limit</b>	<b>Number</b>
within one year	16	less than 26 years	36
1 – 5 years	44	26 – 35 years	24
5 and more years	14	36 – 45 years	8
		more than 45 years	6

The largest age group consists of employees less than 26 years of age, with the youngest generation accounting for 49 % of the total number of the respondents. At the same time, employees with five-year employment predominate, with a total of 60 % of the total sample. The reason for staying in the current job is due to a number of attributes, but a dissatisfied employee would not delay the search for a new employer. This indicator can be perceived as important in assessing job satisfaction. Following the fact that the youngest generation, who has a tendency to change jobs because of seeking new opportunities was mostly represented in the sample. We find out that the values found remain at the workplace with career advancement or higher remuneration, or that employees are simply satisfied with their work. Satisfaction increases with increasing age as the employee is already in a certain position. On the contrary, dissatisfaction brings fluctuations.

**Table 5.** Educational attainment and job position, research data.

<b>Highest education attainment</b>	<b>Number</b>	<b>Job position</b>	<b>Number</b>
Secondary school graduation	32	Top manager	4
Bachelor's education	42	Middle manager	18
		Line manager	14
		Ordinary employee	36
		Self-employed person	2

The questionnaire survey was carried out at the university; therefore, the trainees achieved at least full secondary education. Among the interviewed respondents ordinary employees prevail. For their career growth they realize that it is necessary to upgrade their qualifications, which is the reason for studying at university. Research carried out in the company confirms that higher education is a prerequisite for higher satisfaction; in more detail a survey of the Occupational Safety Research Institute (Svobodová 2015). Higher education opens the way to promotion, to higher positions, where work is more meaningful for employees and their job satisfaction is increasing in proportion to their willingness to participate in the creation of corporate values.

Job satisfaction is also related to motivational tools. They are presented by various forms of benefits. There are differences between employers according to the scope, types and amount of benefits provided. The following overview (Table 6) provides information on what benefits are offered to the interviewed employees and which they would welcome.

**Table 6.** Overview of offered and requested benefits, research data.

<b>Types of benefit</b>	<b>Number of employees</b>	
	<b>Provided</b>	<b>Required</b>
Education	42	26
Meal tickets	38	26
Mobile phone	38	18
Extra holiday	24	44
Health care	24	40
Contribution to language courses	24	48
Company car	22	30
Pension insurance	20	42
Clothing allowance	16	22

Contribution to cultural events	14	26
Higher salary	12	30
No benefit	16	0

Traditionally, education and catering allowances have the highest value. The popularity of these benefits is associated with tax benefits on the part of both employer and employee (Levičková and Mičková 2016). Due to the job position of the interviewees, the advantages associated with mobile phones and company cars are relatively represented. There is no more than one week of extra leave, contributions to language courses, but also savings for supplementary pension insurance. Employees would therefore like to welcome a longer holiday. Only 12 respondents would prefer a higher remuneration at the expense of the benefits provided, by far this does not show a priority value. Employees who are noticeably lacking many benefits, such as language courses, health care would also welcome an income increase. But even here it has not been confirmed that the real wage level is perceived as the ultimate criterion for the feeling of job satisfaction within the offered or required benefits as motivators to satisfaction and consequently to support work performance.

**Table 7.** Reasons to stay with your employer, research data.

<b>Reason</b>	<b>1</b>	<b>2</b>	<b>3</b>
Overall satisfaction	20	0	12
Work team	24	10	12
Company stability	12	2	0
Collecting experience	16	24	6
I do not like changes	2	2	4
Work satisfies me	6	18	6
Work is the source of my income	12	8	18

Table 7 presents what is the top priority for staying with the current employer. The interviewees were asked to choose three reasons with their ranking from one to three, that is to say, what is the highest, medium and lower priority to not change their current job. As can be seen, the highest value was reported by the work team, which exceeded overall satisfaction. Work as a source of income was rated grade three in eighteen cases, which again suggests that wages are not always a decisive criterion for finding a new job. Relatively high values occur when gaining experience. This corresponds to the age limit of the respondents, when it is assumed that young people want to know and try new job challenges and are ready to learn new things.

#### 4. Discussion

Wages are a strong motivator at work. Wages are a source of income and benefits in terms of scale, level and quality of satisfaction needs. In the Czech Republic, hospitality, hotels and restaurants (CZ-NACE 55-56) is expected to be far below the average in 2017. An average gross wage per head of the individual is CZK 16 704, balance CZK 14 820 for 2016. Since 2005 wages tend to grow with the national average wage above CZK 28 704 per natural person in 2017 (CZSO 2019). Visitors can use the lagging services, the sample of answers did not give rise to dissatisfaction which would mainly stem from the level of wages achieved. As for final conclusions it is necessary to take into account that we addressed employees in higher positions who would expect higher incomes for their work.

Recruiting a quality employee is the most difficult in the long term in technical fields, but also in information technology. Benefits in the form of benefits are currently perceived as a tool for creating stable work teams in the current state of unemployment. However, this is not about the many benefits, such as the ability to target employee satisfaction. According to surveys, companies that are well versed in motivating their employees achieve up to 21 % higher productivity, about 37 % less absence, and lower turnover of up to 65 % is important (Sorensen, 2013). A possible option for a satisfied employee is working from home. It is one of the forms of benefit and the number of companies offering it is growing. However, it is not suitable for everyone and for every profession. In

gastronomic or hotel services cannot be applied, because of the nature of services performance is directly linked to the place.

## 5. Conclusions

We stay at work for at least a third of the day, or a substantial part of our lives, and therefore job satisfaction is a factor for every employed individual that will be decisive for staying in an existing company or looking for employment elsewhere. A satisfied employee is willing to sacrifice some of his/her personal life as it brings him/her overall satisfaction, and it is not always the case that he/she is not only financially rewarded. On the other hand, the effects can be drawn by the employer as a result of a higher commitment and thus in the form of a profit increase. In catering and accommodation services, where the human factor is still a determining element, despite digitization, employee satisfaction translates into the quality of services provided to customers and revenue growth.

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# The Evaluation of the Policy Effect for the Influence of Western Development Drive Policy on the Opening Up of Western China

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**Abstract:** (1) Based on the background of the western development drive policy for 20 years, this paper identifies the net effect of this policy on the regional opening from the perspectives of opening to the outside world and opening to the domestic, and further evaluates and ranks the western provinces' opening to the outside world from the macro perspective, trying to grasp the general situation of the western region's internal and external development. (2) This paper analyzes the net effect of the policy by the method of DID (Differences-in-Differences). After that, a series of robustness tests are carried out, including parallel trend, counterfactual, substitution variable and so on. Entropy method is used in the comprehensive evaluation of provinces. (3) Through regression analysis, this paper finds that the implementation of the western development drive policy has an inhibitory effect on the opening to the outside world in western region, while has a positive role in promoting the opening to domestic. Further research finds that the cause of this result may be the "squeeze effect" of capital. In addition, Sichuan, Chongqing and other regions ranked higher in opening up in the western region, while Qinghai, Ningxia ranked lower.

**Keywords:** western development; policy effect evaluation; opening up; opening to domestic

**JEL Classification:** C51; O12; O18

## 1. Introduction

The western development drive strategy as an important part of the national modernization strategy originated in 1999. In 1999, "the resolution of the Central Committee of the Communist Party of China on several major issues concerning the reform and development of state-owned enterprises" made it clear for the first time that the western development drive strategy should be carried out in order to transfer the surplus economic development capacity of the eastern coastal areas to the western areas, realize the transformation and upgrading of the industrial structure of the eastern areas, improve the economic and social development level of the western areas, and coordinate the regional economic development. After 20 years development, the western region has made great achievements in economic strength, infrastructure guarantee ability, characteristic advantageous industries and opening economy level. From the perspective of economic aggregate, the GDP of the western region increased from 12.7 trillion yuan to 17.1 trillion yuan in 2013-2017. In terms of economic growth rate, the economic growth of the western region surpassed the eastern region for the first time in 2007, and has been maintained up to now. GDP of the western region maintained an average annual growth rate of 8.8% from 2013 to 2017. The introduction and implementation of the "the Belt and Road" initiative has brought new opportunities for development in the western region. However, for the western development drive policy, one of its objectives is to improve the level of western development, and for the western development, strengthening foreign exchange is one of the essential ways, so it is very important to evaluate the openness development of Western China. Based on this, this paper attempts to identify the net effect of the policy implementation from the two perspectives of opening to the outside world and opening to the domestic, and accurately evaluate the development of the western

region in the past 20 years, so as to provide useful policy suggestions for improving the level of regional development.

## 2. Literature Review

The western development drive strategy is one of the most important policies formulated at the beginning of the 21st century in China. Its purpose is to improve the development level of the western region of China and improve the imbalance of regional development in China. Therefore, a lot of research has been done around the western development drive policy. Through combing the existing literature, this paper finds that it mainly focuses on the following three aspects. The first is the study of the relationship between the implementation of the western development drive policy and regional economic growth. Liu Ruiming and Zhao Renjie (2015), Wang Xiaoli et al. (2019) found that the implementation of this policy did not effectively promote the development of regional economy by testing the effect of the western development drive policy on economic growth. In contrast to this conclusion, Ru Shaofeng and Zhou Zikai (2019), Ren Baoping and Zhang Qian (2019), Gan Weiyu et al. (2011), Zhou Duanming et al. (2014), Kong Yang et al. (2018), found that the western development drive policy promoted the economic development of the western region, especially the high-quality development of the regional economy. Based on the economic development situation, Chen Taiming (2017) studied the western development drive strategy from the perspective of welfare, and found that the difference of urban residents' welfare has been improved, but the welfare of farmers has deteriorated in different degrees. In addition, other scholars have identified the net effect of this policy, including Li Hui (2006), Peng Xi and Chen Zhongchang (2016), Tan Zhouling and Cheng Bao (2018). At the same time, some scholars have evaluated the performance of the western development drive strategic, including Cai Huazhou (2002), Zeng Kunsheng (2002), Wei Houkai and Sun Chengping (2004), Lin Jianhua and Ren Baoping (2009), Peng Hui and Zhang Lishu (2009), Wei Houkai and Zhao Yong (2014), Wang Yongjing and Ge Wenfang (2016), Bai Yongxiu and He Hao (2019). Finally, some scholars try to identify the policy effect of the western development drive from the perspective of government intervention, including Bai Yongxiu and Ren Baoping (2000) through the discussion of government functions and positioning, and put forward the necessity of the transformation of government functions under the background of this strategy and market economy. At the same time, some scholars use the method of multiple difference to study the scale change of local government under the background of the implementation of the western development drive strategy, and through the analysis, it is concluded that the implementation of the strategy has expanded the scale of the government, including Shao Chuanlin (2014).

It can be seen that the discussion of this strategy is mostly focused on the policy itself or the impact on regional economic growth, less from the perspective of opening up, and one of this policy objectives is to improve the level of western development, which is essential to achieve through strengthening external ties. In the traditional sense, the definition of opening to the outside world still stays between countries. There are few researches on opening development between a micro region and all other regions, that is to say, few researches on opening to the domestic have been done at present. One reason is that it is not easy to define this indicator, and the other and most important reason is the unavailability of data. Based on this situation, this paper, from two perspectives of the opening to the outside world and to the domestic in the western region, discusses the changes of the opening up level in the western region under the background of the western development drive policy, and attempts to identify the net effect of this policy on the regional opening up to the outside world and to the domestic, so as to provide good policy suggestions for regional development.

## 3. Methodology

### 3.1. Model building

Based on the background of the western development drive policy, this paper discusses the policy effect of the influence of policy on the regional opening. In this paper, from the two perspectives of opening to the outside world and opening to domestic, we use the city panel data, combined with the

DID(Differences-in-Differences) method to evaluate the policy effect. DID method can effectively eliminate the influence of other factors, so as to accurately identify the net effect of policy implementation, so this paper adopts this method to measure. In this paper, the DID model is established from the perspectives of opening to the outside world and opening to domestic as follows:

$$Y_{it} = \alpha_0 + \alpha_1 TD_{it} + \sum Control_{it} + \mu_i + \sigma_t + \varepsilon_{it} \quad (1)$$

$Y_{it}$  represents city opening, including opening to the outside world and opening to the domestic, among them, opening to the outside world is measured by the proportion of fdi to GDP of each city, and opening to the domestic is measured by railway transportation volume;  $TD_{it}$  represents the core explanatory variables, that is, is city the policy implementation area, intervention group takes 1, and others 0;  $Control_{it}$  represents the control variables that can affect the opening up degree;  $\mu_i$  and  $\sigma_t$  represent the fixed effect of city and year respectively;  $\varepsilon_{it}$  is a random disturbance term.

The model (1) discusses the relevant information of policy effect evaluation from the perspectives of opening to the outside world and opening to the domestic, and the relationship between foreign investment and domestic investment is also worthy of attention in this policy background. Therefore, from the perspective of the linkage between foreign investment and domestic investment, this paper attempts to analyze the impact of domestic investment on foreign investment. Because there is no direct domestic data, this paper uses the railway transportation volume as an indicator to replace. The reason why this indicator is adopted is that the width of railway tracks in different countries is not uniform, while the width of domestic tracks in different countries is completely uniform, so that most of the bulk transactions of goods through railway transportation mode are carried out in China, which is also a good way to effectively identify the domestic capital represented by domestic trade. Therefore, this paper uses the railway transportation volume to replace domestic investment as follows:

$$Open_{it} = \beta_0 + \beta_1 \ln railway_{it} + \sum Control_{it} + \mu_i + \sigma_t + \varepsilon_{it} \quad (2)$$

In the model (2),  $Open_{it}$  represents the opening to the outside world; and  $\ln railway_{it}$  represents the opening to domestic.  $Control_{it}$  represents the control variables that can affect the opening;  $\mu_i$  and  $\sigma_t$  represent the fixed effect of city and year respectively;  $\varepsilon_{it}$  is a random disturbance term.

### 3.2. Data sources

This paper studies the data of China's prefecture-level cities from 1995 to 2015, all of which are from China's urban statistical yearbook and the official website of the National Bureau of Statistics. Some missing data also refer to the corresponding city Yearbook and province Yearbook. Because of the disunity of units in the indexes, this paper adjusts them by calculation.

### 3.3. Index selection

The explained variables in this paper include opening to the outside world and opening to the domestic. The former is measured by the proportion of fdi to GDP (open), and the latter by railway transportation volume (lnrailway). Because of the unavailability of domestic capital data, the measurement indicators of domestic capital are also replaced by railway transportation volume. The core explanatory variable in this paper is the implementation of the western development drive policy(TD). If the city is the intervention group of this policy, the value is 1, and other cases are 0. In addition, this paper also selects other factors that may affect the regional opening as control variables to be fixed, including regional per capita GDP (lnperGDP), fixed asset investment (lnfixedinvest), fiscal revenue (fiscalrevenue), fiscal expenditure (lnfiscalexpenditure), regional population (Intotalpopulation) and urbanization level (urbanization) to control.

### 3.4. Model hypothesis

This paper puts forward the model hypothesis from the perspective of policy effect evaluation and the relationship between domestic and foreign investment.

Hypothesis 1: the implementation of the policy may have a restrictive effect on the external development of the western region, but it may have a positive role in promoting the internal opening.

Hypothesis 2: internal development may inhibit external development, that is, from the perspective of the relationship between domestic investment and foreign investment, domestic investment may have a "squeeze effect" on foreign investment.

#### 4. Results

##### 4.1. The influence of the western development drive policy on the opening up of the western region

Firstly, this paper makes a descriptive statistical analysis of variables, through the definition of variables and statistical observation, to prove the scientificity of variable selection. It can be seen that the standard deviation of the selected variables is small, which reflects the relatively stable characteristics of the data and can be used for regression. As shown in Table 1.

**Table 1.** Descriptive statistical analysis of variables.

Variable	Variable Meaning	Computing Method	Mean Value	Std. Deviation
Open	Opening degree to the outside world	Fdi/GDP	1.5524	2.4861
Lnrailway	Opening degree to domestic	Logarithm of railway transportation volume	6.1072	1.4278
TD	Western development drive policy	Whether it is the implementation area of the policy, virtual variable (0,1)	0.2974	0.4571
LnperGDP	Per capita economic development level	GDP / population	9.5867	0.9449
Lnfixedinvest	Fixed assets investment	Logarithm of fixed assets investment	64.5922	77.8621
Lnfiscalrevenue	Fiscal revenue	Logarithm of regional fiscal revenue	12.1652	1.6320
Lnfiscalexpenditure	Fiscal expenditure	Logarithm of regional fiscal expenditure	12.8505	1.6553
Lntotalpopulation	Total population	Logarithm of total regional population	5.7664	0.7261
Urbanization	Urbanization level	Urban population / total population	17.7304	16.0025

Since the policy was first formally put forward in September 1999, this paper identifies 2000 as the year of implementation. Through the DID(Differences-in-Differences) method, this paper evaluates the influence of the western development drive policy on the regional opening up to the domestic and outside world. It can be seen that the (1) and (2) columns are the regression results without adding control variables. The implementation of the policy has a significant inhibitory effect on the western region's opening to the outside world, but it has a positive role in promoting the regional opening to domestic. Columns (3) and (4) are regression results after adding control variables. It can be seen that the results have not changed after adding control variables. Policies have a certain inhibition on opening to the outside world of the western region, but play a positive role in opening to domestic development. One of the purposes of this policy is to realize the transfer of surplus Industries in the eastern developed areas, improve the level of economic and social development in the western areas, and balance the regional development. Based on this, due to the influence of the preferential policy focus, compared with the impact on external development, the policy pays more attention to the impact of interregional development, so this may be one of the reasons for this result. As shown in Table 2.



**Table 2.** DID regression results of the influence of the western development drive policy on the opening up of the western China.

Variable	Open	Lnrailway	Open	Lnrailway
	(1)	(2)	(3)	(4)
TD	-1.1229*** (-6.92)	0.3491*** (6.45)	-0.9206*** (-7.51)	0.2863*** (5.33)
_Cons	0.4355*** (3.45)	5.6605*** (130.62)	0.7331 (0.59)	-1.3203** (-2.06)
LnperGDP			0.1683 (1.51)	0.3971*** (6.89)
Lnfixedinvest			0.0013*** (3.08)	0.0003 (1.18)
Lnfiscalrevenue			0.5949*** (6.68)	-0.0023 (-0.05)
Lnfiscalexpenditure			-0.6021*** (-6.27)	0.0335 (0.72)
Lntotalpopulation			-0.1652 (-1.62)	0.5558*** (11.07)
Urbanization			-0.0192*** (-6.77)	0.0084*** (5.78)
City fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
N	5376	4491	5344	4445
R2	0.2116	0.1391	0.3379	0.1685

<sup>1</sup> Note: \*, \*\*, \*\*\* are significant at the level of 10%, 5% and 1% respectively; In parentheses is the value of t statistic.

#### 4.2. A study on the "squeezing effect" of domestic investment on foreign investment

From the results of the previous policy evaluation, we can see that the western development drive policy has certain hindrance to opening to the outside world, and has a positive role in promoting the opening to the domestic of the region, so what is the cause of this result worth further discussion. Foreign investment and domestic investment play an important role in the process of regional development. Clarifying the relationship between them will have a clearer perspective to grasp the different effects of the policy results. Therefore, this paper studies the relationship between regional domestic investment and foreign investment to grasp whether there is a "squeeze effect" between them, thus affecting the results. As domestic data cannot be obtained, railway transportation volume is used instead. The reason why this indicator is adopted is that the width of railway tracks in different countries is not uniform, while the width of domestic tracks in different countries is completely uniform, so that most of the bulk transactions of goods through railway transportation mode are carried out in China, which is also a good way to effectively identify the domestic capital represented by domestic trade. Through the results, we can see that the development of domestic investment in the western region has a restraining effect on foreign investment, which shows that the "squeeze effect" of regional capital exists. Although the result does not reach the significant expectation, it provides a certain explanation for the game between regional capitals, and also provides a new perspective for the different results of policy effect evaluation. The possible reason for the "squeeze effect" of domestic capital on foreign investment is that the original basis of regional capital inflow is different. There is still a large gap between the economic development of the western region and the eastern region of China. Therefore, the vast majority of foreign investment forces entering China are attracted by the eastern region of China. However, the western region has a weak attraction base for capital, so the total inflow of foreign investment in the western region is relatively low. Based on this fact, when the western development drive policy was implemented, domestic investment was active, which occupied the narrow space for foreign investment activities in the western region, resulting in the "squeeze" result. At the same time, the policy has a tilt effect on the transfer of surplus Industries from the east

to the west, which intensifies the competition of capital activities in the west, and thus accelerates the emergence of "squeeze effect". As shown in Table 3.

**Table 3.** An analysis of the " squeezing effect " of capital.

Variable	Open	Open
	(1)	(2)
Lnrailway	-0.0472 (-1.31)	-0.0479 (-1.30)
_cons	0.4916** (2.05)	-0.0251 (-0.01)
lnperGDP		0.3677** (2.32)
Lnfixedinvest		-0.0011* (-1.79)
Lnfiscalrevenue		0.2826*** (2.58)
Lnfiscalexpenditure		-0.5449*** (-4.49)
Lntotalpopulation		0.0512 (0.34)
Urbanization		0.0011 (0.25)
City fixed effect	Yes	Yes
Time fixed effect	Yes	Yes
N	985	968
R2	0.2071	0.2380

<sup>1</sup> Note: \*, \*\*, \*\*\* are significant at the level of 10%, 5% and 1%, respectively; In parentheses is the value of t statistic.

## 5. Discussion

Through the analysis of the impact of the western development drive policy on regional opening up, this paper has a comprehensive understanding on the spillover effect of the policy implementation. However, the scientific discussion of the results and the test of method application need to be verified by the robustness test. Furthermore, this paper selects six indicators related to foreign development from 1999 to 2015, uses entropy method to make a comprehensive evaluation on the foreign development of western provinces, ranks the western provinces according to the evaluation results, and tries to discuss the heterogeneity of each province by comparing the opening up of western provinces. Due to space constraints, only the results of the five-year assessments in 2000, 2004, 2008, 2012 and 2015 are reported here.

### 5.1. Robustness test

Parallel trend test. The application of DID method must meet certain preconditions, that is, the intervention group and the control group have the same development trend. Therefore, this paper pushes forward the implementation time of the policy by two years (TD-1, TD-2). If the test results are significant, it shows that the development trend of intervention group and control group has been different before the implementation of the policy. Otherwise, it can be proved that they have parallel trend characteristics. It can be seen from the results that before the implementation of the policy in 2000, the impact of the policy on the opening-up of the region was not significant, indicating that the natural trend of the development between the intervention group and the control group over time was the same, meeting the hypothesis of parallel trend. As shown in Table 4.

**Table 4.** Parallel trend test.

Variable	Open	Lnrailway	Open	Lnrailway
	(1)	(2)	(3)	(4)
TD	-1.1678*** (-5.87)	0.4181*** (6.36)	-0.9462*** (-6.32)	0.3462*** ( 5.32)
TD-1	-0.1377 (-0.37)	0.1794 (1.51)	-0.0919 ( -0.33)	0.1635 ( 1.42)
TD-2	-0.0916 ( -0.24)	0.1714 (1.41)	-0.0360 ( -0.13)	0.1362 ( 1.15)
_Cons	0.4387*** ( 3.47)	5.6585*** (130.55)	0.7428 ( 0.60)	-1.3400** ( -2.09)
Control variable	No	No	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
N	5376	4491	5344	4445
R2	0.2116	0.1398	0.3379	0.1691

<sup>1</sup> Note: \*, \*\*, \*\*\* are significant at the level of 10%, 5% and 1%, respectively; In parentheses is the value of t statistic.

Counterfactual test. Whether the influence of the western development drive policy on the internal and external opening up includes other factors is also the focus of this paper. In order to identify this situation, this paper uses the regional counterfactual test to identify. In this paper, based on the number of cities in the western region, the approximate number is randomly selected from the whole sample, and the selected cities are used as virtual city samples (TDtotal) to get the policy impact, and the virtual effect is evaluated by the DID method. It can be seen that the results of policy evaluation are not significant, so other factors can be eliminated, that is, the results of regional opening completely come from the impact of the policy. As shown in Table 5.

**Table 5.** Counterfactual test.

Variable	Open	Lnrailway	Open	Lnrailway
	(1)	(2)	(3)	(4)
TDtotal	0.0089 (0.14)	0.0148 (0.61)	-0.0369 (-0.77)	0.0051 ( 0.22)
_Cons	0.3658*** (2.89)	5.6703*** (130.28)	1.6073 ( 1.29)	-1.6372** (-2.55)
Control variable	No	No	Yes	Yes
City fixed effect	Yes	Yes	Yes	Yes
Time fixed effect	Yes	Yes	Yes	Yes
N	5376	4491	5344	4445
R2	0.2042	0.1307	0.3306	0.1628

<sup>1</sup> Note: \*, \*\*, \*\*\* are significant at the level of 10%, 5% and 1%, respectively; In parentheses is the value of t statistic.

Substitution variable test. This paper attempts to replace the index of openness to the outside world, and the purpose of regression again is to ensure the stability of the results. Because the scale of foreign-funded enterprises can represent the region attraction to foreign investment, and then represent the situation of regional opening to the outside world, this paper selects the total industrial output value of regional foreign-funded enterprises to measure the situation of regional opening to the outside world. Through the replacement variable regression, we get the same significant results as the main body of the article, which shows that the main body results are robust.

Elimination other policy interference test. In order to further eliminate the influence of other factors on the opening up of the western region and ensure the net effect of the western development drive policy on the opening up to the domestic and outside world, this paper further combs the other possible influences in the research time. In 2013, China put forward the "the Belt and Road" initiative.

In this initiative, China's westward development has an important influence on the opening up of the western region. Therefore, this article eliminates the key provinces in the western region, which are related to the "the Belt and Road" initiative. The results of this paper are still significant after removing the samples, which shows that even after removing the policies or events that potentially affect the opening up of the western region, the impact of the western development drive policy on the opening up of the western region has not changed significantly, indirectly proving the reliability of the above results.

Addition extra covariates and missing variables test. In addition, in order to control the natural factors of regional change, this paper uses the method of Moser & Voena (2012) for reference, adds the variable of regional change with time to the benchmark model. Due to the influence of degrees of freedom, this paper chooses to test at the provincial level. And variables are added to control, including the provinces trend of the primary term and the provinces trend of the secondary term that can be influenced by time. The results show that the results are still significant after considering these factors, indicating that the results are reliable. Furthermore, in order to ensure the scientific results, a series of missing variables are added to the benchmark model for testing, and the results are still significant.

### 5.2. Comprehensive evaluation of the opening up of western provinces

The absolute quantity of each index in western China's foreign development is slightly behind that of other regions in China, but its development speed is remarkable. Therefore, the accurate evaluation of each province opening up can better understand the characteristics of the heterogeneity within the region, so as to better balance the regional development. Based on this, this paper selects six indicators: the number of foreign-funded enterprises, total imports, total exports, the international tourism revenue, technology import funds for enterprises at scale and export delivery value of enterprises at scale to measure the external development of the western region, and evaluates the opening up of each province comprehensively by entropy method, and then obtains the ranking of the external development of each province. Due to the lack of data in Tibet Autonomous Region, there is no report here. Due to the lack of data in Tibet Autonomous Region, there is no report here. It can be seen from the comparison that the ranking of Sichuan province has always been in the first place, reflecting the strong vitality of its external development; subsequently, Chongqing city, Shaanxi province and Guangxi Zhuang Autonomous Region rank relatively high, among which Chongqing's ranking rises steadily with the change of external development, while Shaanxi province ranks opposite, and its ranking is in a state of fluctuation; Furthermore, Ningxia Hui Autonomous Region and Qinghai province are lower in the comprehensive ranking of the western region, and they have not been greatly improved, reflecting their weak external development strength and low external attraction. The details are shown in Table 6.

**Table 6.** Comprehensive evaluation ranking of western provinces' foreign development.

Province	2000	2004	2008	2012	2015
Sichuan	1	1	1	1	1
Inner Mongolia	7	6	7	6	6
Shaanxi	2	2	4	3	4
Ningxia	10	10	10	10	10
Chongqing	4	5	3	2	2
Gansu	6	7	8	8	8
Guizhou	8	8	9	9	9
Guangxi	3	3	2	4	3
Qinghai	11	11	11	11	11
Xinjiang	9	9	6	7	7
Yunnan	5	4	5	5	5

## 6. Conclusion

This paper discusses the net effect of the western development drive policy on the development of China's western region from the perspectives of internal and external opening. Through regression,

it is found that the implementation of this policy has a restraining effect on the opening to the outside world in western region, but significantly improves the level of opening to domestic in the western region. In order to further explore the reasons for this result, this paper, through the grasp of the relationship between domestic and foreign capital in the western region, finds that there is a "squeeze effect", that is, regional domestic capital have a restraining effect on foreign capital. It can be seen that the implementation of this policy has a significant impact on the regional development, and achieve a policy effect, but at the same time, the policy's inhibition on regional opening to the outside world development is also the "double-edged sword" result of the implementation of this policy. In addition, this paper makes a comprehensive evaluation on the opening to the outside world development of the western provinces, and identifies the differences in regional heterogeneity, trying to grasp the development of the western provinces more accurately. Based on all the analysis, this paper puts forward relevant policy suggestions in order to better improve the level of high-quality opening to the outside world and opening to the domestic in the western region.

First of all, the government should vigorously improve the level of infrastructure in the western region and develop a variety of external connection channels. To expand opening to the outside world and opening to domestic development of the western region, first of all, we should strengthen and improve the regional infrastructure construction, including the improvement of the expansion of air, railway, highway and other means of transportation, broaden the regional trade channels to other provinces, and provide the carrier foundation for the province to "go out" and "bring in". At the same time, we should develop a variety of channels of foreign relations, including the combination of expanding the traditional trade mode and developing the emerging e-commerce mode. The development of e-commerce provides convenience for regional trade, and the mode of e-commerce trade is also constantly updating. The western region should strengthen the learning of the emerging mode and keep up with the development pace of the new era.

Secondly, the regional government should create a good environment for foreign investment, including policy preferences, system improvement and service efficiency improvement. The attraction of foreign capital, technology, talents and so on in the western region is weak, which results in the low total attraction of foreign investment. So, the western region can increase the preferential policy of foreign investment, and give the corresponding preferential policy support to drive the flow of capital to the western region. At the same time, the region should also improve system construction, improve the efficiency of government services, simplify procedures and processes, and provide a convenient service environment for attracting capital investment.

Finally, combined with regional location advantages and industrial advantages, we should seize the opportunity of "the Belt and Road" initiative to develop regional characteristic industries and increase the added value of products. The proposal of the "the Belt and Road" initiative is a favorable opportunity for the western region's external development, especially for the relatively backward provinces on opening up, such as Qinghai, Ningxia, Xinjiang and so on. In addition, the opening of China Railway express (CR express) has provided a strong support for the western region to open up the European market, which provides an excellent import and export opportunity for the western provinces, especially for the underdeveloped western provinces. These provinces have the development basis of characteristic agriculture, so we should base on this, combine agriculture with science and technology, extend the industrial chain, and make good use of this opportunity to realize the promotion of added value of agricultural industry.

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# China's Responsibility for the Growth of Global Economy and People's Welfare: Facing the Challenges of Trade War Provoked by the United States

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**Abstract:** Since 2017, the United States has unilaterally provoked trade wars with many countries, including China, and has brought severe challenges to the growth of the global economy and people's welfare. China, which advocates and commits to building Community with a Shared Future for Humanity, has the responsibility to take proactive measures to minimize the negative effects of the trade war and contribute to the growth of the global economy and people's welfare. To this end, China needs, taking a long-term view, to make full use of the forced mechanism of the trade war, mobilize national consensus and enthusiasm, and firmly implement the innovation-driven development strategy. And to accelerate the transformation and upgrading of China's manufacturing, and promote China's manufacturing towards the mid- high end of the global value chains by resolutely guarding against systemic financial risks, strengthening national productivity, cultivating national value chains, and expanding global value chains.

**Keywords:** Trade War; Made in China 2025; Manufacturing Upgrade

**JEL Classification:** F130; O24

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## 1. Introduction

With the evolution of international industrial division of labor from inter-industry division of labor to intra-industry division of labor, then to intra-product division of labor, economic globalization and trade liberalization have brought sustained growth in the global economy and people's welfare. However, since 2017, in spite of the strong opposition of countries in the world, the United States has provoked a trade war unilaterally, especially the Sino-US trade war has intensified and escalated. The current trade war between the two economic powers brings severe challenges to the growth of economy and people's welfare for the two countries and even the world.

Since the 18th National Congress of the Communist Party of China, China has always advocated and committed to building a Community with a Shared Future for Humanity. Facing the Sino-US trade war provoked by the United States, China has the responsibility to clarify the nature of the Sino-US trade war, adopt long-term effective measures, minimize the negative effects of the trade war, and contribute to the growth of the global economy and people's welfare. For this reason, this paper attempts to reveal the nature of the Sino-US trade war on the basis of carding out the trade war process, and proposes a path for China to respond to the challenges of the Sino-US trade war.

## 2. Methodology

Objective things are developing and changing, in order to understand their essence and reveal their development trends, we must connect and compare the different stages of their development. Historical analysis is a method of analyzing objective things and social phenomena from the perspective of development and change.

This paper uses historical analysis to analyze the history of the rise and decline of world powers, the history of the United States in maintaining world hegemony, and the evolution of the Sino-US

trade war, reveal the nature of the Sino-US trade war, and propose a path for China to respond to the challenges of the trade war.

After World War II, the United States maintained its indestructible world hegemony through scientific and technological hegemony, industrial hegemony, financial hegemony, and military hegemony. From the middle of the 20th century to the 1990s, the United States brought down the Soviet economy and led to the disintegration of the Soviet Union through the arms race. In the 1990s, the United States forced the yen to appreciate through the Plaza Accord, leading to a lost decade for the Japanese economy. At the beginning of the 21st century, the United States significantly weakened the competitiveness of the European Union by inducing the European debt crisis and Brexit. Judging from the changes in the world's economic and political pattern after World War II, any country, which challenges the global hegemony of the United States, suffered a heavy blow from the United States.

Since the reform and opening up, China's overall national strength and world influence have been continuously improved. Although China hopes to rise in peace, does not deliberately challenge the global hegemony of the United States, and is not willing to dominate the world economic and political structure, the United States deeply feels that its hegemonic position has been severely threatened by China in the fields of science and technology, industrial systems, finance, and military, and therefore, regards China as the most important global strategic rival. In Trump's first National Security Strategy of the United States of America (The White House 2017), he believed that China challenged the rights and influence of the United States in an attempt to erode American security and prosperity, and regarded China as its main global strategic opponent.

### *2.1 Challenges to the science and technology hegemony*

From the perspective of R&D investment, in recent years, the Chinese government and enterprises have continued to increase the emphasis on scientific research and innovation investment. In 2017, the total investment in R&D reached 1.76 billion Yuan, second only to the United States, the proportion of R&D investment in GDP increased from 0.94% in 2001 to 2.13% in 2017, and the gap with the United States is gradually decreasing.

From the perspective of patent applications, in 2017, China's PCT patent applications reached 48882, second only to 56142 in the United States, which is the only country with double-digit annual growth rate. HUAWEI and ZTE respectively ranked first and second in the world in terms of the number of PCT patent applications.

From the perspective of corporate growth, among the world's top 500 companies that can best represent the status of the industry, in 2017 there were 53 companies with operating revenues of more than 100 billion US dollars, of which 22 were in the United States and 13 were in China. Japan, which ranks third, has only five. In addition, according to the Sino-US Unicorn Research Report jointly issued by Deloitte and CVINFO (Deloitte & CVINFO 2017), as of June 30, 2017, there are 252 Unicorn enterprises in the world, 106 in the United States, accounting for 42.1% of the total, ranking first in the world, and 98 in China, accounting for 38.9% of the total, ranking second in the world. And China and the United States each have five of the top ten unicorn companies in the world.

From the perspective of technological progress, China has been at the world's leading level in the fields of high-speed rail, quantum communication, 5G, nuclear power, mobile Internet, etc., and AI, VR/AR, big data, aerospace technology, biotechnology, new energy vehicles, etc. are all on the eve of breakthroughs.

In terms of scientific research talents, although China's demographic dividend is gradually disappearing, talents and engineer dividends are being highlighted.

To sum up, although there is still a large gap between the comprehensive scientific and technological strengths of China and the United States, China is rapidly changing from following to leading in some important areas, which has aroused great vigilance in the United States.



## *2.2 Challenges to the industrial system hegemony*

With the deepening of industrialization, China already has all the industrial categories in the United Nations Industrial Classification, becoming the only country in the 21st century that has been certified by the United Nations with a complete industrial system. In 2010, China's total industrial output value exceeded that of the United States for the first time, and in 2015, its total industrial output value exceeded that of the United States and Japan.

From the perspective of the restructuring of the international industrial system, in 2013, China proposed the Belt and Road initiative, which not only helps countries along the Belt and Road to improve their infrastructure, but also helps them establish their own industrial systems. The establishment of industrial systems in these countries will inevitably subvert the core logic of the world economic structure since the birth of capitalism, and impact the global industrial system led by the United States.

From the perspective of the global value chain, China's manufacturing industry has been increasingly embedded in the global value chain, and it is gradually moving from the low-end of the global value chain to the mid- high end (Hong, 2017; Wang et al. 2017), and impacting on the high-end status of the global value chain where the United States has long been. This is the national manifestation of Christensen's low-end market disruptive innovation.

From the perspective of economic aggregate, on April 11, 2018, Dr. Shanwen Gao, chief economist of ESSENCE SECURITIES Co. Ltd., predicted in a speech at Tsinghua University that around 2028, China's economic aggregate will surpass the United States and become the world's largest economy, and the world economy inevitably forms the G2 pattern.

## *2.3 Challenges to financial hegemony*

After the collapse of the Bretton Woods system, in 1973, the United States forced OPEC to accept the settlement of global oil transactions in US dollars, and realized the link between US dollars and oil, making each country's development linked with US dollars through oil, so as to truly establish a financial hegemony dominated by US dollars. At present, the financial hegemony of the United States is facing three challenges from China.

First, challenges from the new energy industry and the new energy automobile industry. In recent years, China has spared no effort to develop new energy industry and new energy automobile industry, tried to get rid of the dependence on fossil energy such as oil and coal, and promoted the adjustment of global energy structure, it has become an irreversible trend that new energy replace traditional fossil energy. When the economic development of all countries is no longer dependent on oil, the US dollar as the basis of oil settlement currency will no longer exist. The financial hegemony dominated by US dollars will be shaken and the internationalization of RMB will be accelerated.

Second, the challenges from Internet +. At present, Internet + has risen to China's national strategy. Mobile payments and virtual currencies generated under the background of Internet + have a disruptive impact on traditional payment methods. Currency has begun to withdraw from the circulation market. With the widespread use of mobile payments and virtual currencies around the world, the role of the US dollar as a means of currency payment will be significantly weakened.

Finally, challenges from the opening up of China's financial industry. In recent years, China is accelerating the opening up of the financial industry. After the successful operation of the Shanghai-Hong Kong stock connect and Shenzhen-Hong Kong stock connect, A-share is successfully incorporated into MSCI. China's crude oil futures are officially listed, and the Shanghai-London stock connect and CDR are expected to be realized one after another. Clearly, China's financial market keeps opening up, it is more convenient for international capital to enter and exit the Chinese market. With the continuous improvement of the international influence of China's financial market, as a baton for international capital flows, the role of the US dollar will be greatly diminished, and the United States' domestic consumption and economic development supported by increasing debt will be unsustainable.

## *2.4 Challenges to military hegemony*

With economic development and scientific and technological progress, China's military strength has increased significantly in terms of scientific and technological equipment and modernization, the United States feels that its military hegemony has been severely challenged by China. In the 2017 annual report submitted to Congress by the U.S. Congress China Economic and Security Review Committee (USCC) on November 15, 2017, separate chapter on Chinese advanced weapons appeared for the first time, specifically introducing the development of China's advanced weapons and military technology in six fields, and vigorously rendering that the rapid development of China's advanced weapons in recent years may have significant impact on the United States. On May 21, 2018, the USCC issued a report completed by IHS Jane's, comparing the development of China's advanced weapon systems with the corresponding weapons of the United States. The report states that although the United States is still the world's only superpower, with the gradual decline of influence, the focus of world power is changing, the development of China's advanced weapon systems in the next 10 years will have a strategic impact in the Western Pacific.

To sum up, the United States has regarded China as the biggest threat and strategic rival to its global hegemony, then it will do the best to restrain the rise of China, and the Sino-US trade war has become the first step. Since 2017, the United States has carried out 232 and 301 investigations on China, suppressed HUAWEI, ZTE and other Chinese enterprises, restricted the Made in China 2025 plan, imposed tariffs on Chinese products exported to the United States and a series of other means, not only undermining the Sino-US economic and trade cooperation, but also bringing challenges to global economic development and people's welfare growth.

## **3. Results**

By analyzing the evolution of the Sino-US trade war, it can be conclude that the United States has provoked the US-China trade war to achieving at least the following three goals.

### *3.1 To solve the US-China trade imbalance.*

According to statistics from the US Department of Commerce, the US-China trade deficit increased from US \$ 600 million in 1985 to US \$ 375.2 billion in 2017, and reached a record high. Data from the General Administration of Customs and the National Bureau of Statistics of China show that the US-China trade deficit increased from US \$ 29.7 billion in 2000 to US \$ 275.8 billion in 2017. Although the statistics of the two sides are different, the United States believes that the overall trade deficit between the United States and China continues to expand and is not good for the United States. Therefore, the United States ignores its own reasons for the formation of the US-China trade deficit and hopes to resolve the trade imbalance between the United States and China through the US-China trade war and regain its leadership in international trade.

### *3.2 To Undermine the Made in China 2025 plan*

From the perspective of the evolution and content of the Sino-US trade war, the United States not only imposed a large amount of tariffs on Chinese products, but also focused the list of tariffs on high-tech industries related to the Made in China 2025 plan; it not only imposed a technical blockade on China by protecting American technology and intellectual property rights, but also demanded Chinese government to stop the industry subsidies and other types of government support immediately related to the Made in China 2025 plans; it not only sanctions HUAWEI and ZTE, the leader 5G, but also prevents Chinese technology companies such as Ant Financial, HNA Group and NavInfo Group from entering the U.S. market; it not only restricts the investment of Chinese companies in US technology enterprises, but also strengthens the control of technology export to China, and strictly reviews the visit of researchers and managers of Chinese companies to the U.S. It can be seen that rather than solving the trade imbalance is the purpose of the Sino-US trade war, it is better to say that is an excuse for the United States. The deep purpose of the Sino-US trade war is to restrain the progress of science and technology and the upgrading of the Chinese industries by using

5G as a starting point to destroy the Made in China 2025 plan, and to suppress the Chinese industries in the mid-low end of the global value chain for a longer time.

### *3.3 To plan a destructive financial war*

Although the United States wants to comprehensively restrain the rise of China through scientific and technological hegemony, industrial system hegemony, and military hegemony, what concerns the author most is the financial hegemony of the United States. The bursting of the Japanese economic bubble in the 1980s, the Asian financial crisis in 1997, the European debt crisis in 2009, and even the Hong Kong event in 2014 were all closely related to the flow of international financial capital affected by the United States. But so far the United States has not been able to create a financial crisis in China, the fundamental reason is that China's financial market has not been fully liberalized. If the United States uses the trade war as a means to force China's financial market to be more open to the world, especially to the United States, allowing more international financial capital to flow freely, then the United States will have the opportunity to use its financial hegemony to plan a financial war against China. Coincidentally, since 2017, China is significantly relaxing financial market access to international capital, orderly opening up bank card market, liberalizing the business scope of foreign insurance brokers, and relaxing or eliminating the restrictions on foreign shareholding ratio in banks, securities, fund management, futures, financial asset management etc.. On June 29, 2018, Bridgewater, the world's largest hedge fund, officially entered China as a wholly foreign-owned enterprise. On January 15, 2020, the Economic and Trade Agreement between the both requires China to fully open banking, insurance, securities, funds, futures and other financial fields to the United States.

For the current China, not only the capital market is not strong enough, but the potential systemic risk of the real estate market needs to be resolved urgently. If a large number of international capital flows into capital market and real estate market, the bubbles will be larger and larger, when international capital quickly withdraw from China, the bubble will burst and lead to systemic financial risk, it will be very hard for local governments, real estate enterprises, banks and residents to bear, and China's financial market and economic system will be severely damaged, even foreign exchange reserves will be plundered. By this way, the ultimate goal of the United States to restrain the rise of China will be temporarily achieved.

By analyzing the causes and purposes of the Sino-US trade war provoked by the United States, it is found that the essence of the Sino-US trade war is that the United States uses 5G as a starting point to destroy the Made in China 2025 plan and even possible to plan a highly destructive financial war, thus to restrain the progress of science and technology and the upgrading of the Chinese industries and suppress the Chinese industries in the mid-low end of the global value chain for a longer time, so as to restrain the rise of China and maintain the global hegemony of the United States. Therefore, the Sino-US trade war is no longer a simple trade war, but a war of national destiny and a lasting war without gunpowder smoke, which brings severe challenges to the growth of global economy and people's welfare.

## **4. Discussion**

In the short term, the Sino-US trade war will not benefit the economic and social development of China, the United States and even the world. However, in the long run, the Sino-US trade war is a double-edged sword for China, which makes the Chinese government and people more aware of the huge gap between China and the United States in the fields of scientific and technological innovation, key core technology, high-end manufacturing, military strength, financial services, quality education, talent integration, etc., so that in the process of the game with the United States, the Chinese government and people can neither feel resentful and discouraged, nor blind optimism and confidence. It is necessary for the Chinese government and people to maintain objective determination, make full use of the forced mechanism of the Sino-US trade war, mobilize the consensus and enthusiasm of the whole nation, form a national joint effort to support independent

innovation and the development of high-tech industries, and strive for self-reliance of science and technology.

The manufacturing is the main body of the national economy and the foundation of the nation. Since the beginning of industrial civilization in the middle of the 18th century, the history of the rise and fall of world powers and the history of the development of the China have repeatedly proven that without a powerful manufacturing, there will be no country's prosperity. After clarified the essence of the Sino-US trade war and the basic attitude China should hold, in the current situation, China should not focus on the short-term trade war but on the long-term, firmly implement the innovation-driven development strategy, accelerate the transformation and upgrading of China's manufacturing and move towards the mid-to-high end of the global value chain.

#### *4.1 Resolutely guarding against systemic financial risks*

General Secretary Jinping Xi emphasized that finance is an important core competitiveness of the country and financial security is an important part of national security. Facing the powerful financial hegemony of the United States, only by firmly holding to the bottom line that no systemic financial risks occur, can China build a solid defense line to win the Sino-US trade war and provide the necessary time for the full rise of China's manufacturing. For the current economic structure and financial structure of China, the most likely systemic financial risk is not in the capital market, but in the real estate market, only by keeping the real estate market without rapid decline, can China keep the defense lines of local government debt risk, commercial bank risk, capital market risk and economic risk, and keep the most important point of the Sino-U.S. trade war. Therefore, China must highly recognize and fully evaluate the influence of American financial hegemony, not only the financial sector, but also the power of the country to coordinate planning, top-level design, national layout, and systematic prevention. It is necessary to establish and improve a financial supervision system and tightly control internal risks, and fully prevent the input risks in the context of the two-way deep opening of the financial industry.

#### *4.2 Strengthening national productivity*

In order to cope with the Sino-US trade war, it is not enough to promote the upgrading of China's manufacturing from the perspective of enterprises and industries. It should be promoted from the perspective of national productivity through breakthroughs in key areas such as education reform, scientific and technological innovation, institutional change and cultural cultivation, and promote the state, industry, enterprise and resident together to strengthen the country's material, spiritual and institutional productivity.

- Education reform

Education and talent are the cornerstones of the United States' global hegemony, and it is also the inexhaustible strength of China's manufacturing upgrade and the rise of great powers. At present, the socialization of education complaints in China and the larger scale and lower age of studying abroad reflect the query of Chinese parents on the current education system. China must place education in the strategic position of priority development, and build a country with high-level education and talents. The author believes that the key to solving China's education problem is not to repair the education system and mechanism, but to fundamentally change the talent evaluation and selection mechanism. The comprehensive innovation of the talent evaluation and selection mechanism is used as a catalyst to implement improvement project of national innovation starting from early education and kindergarten, cultivate continuously children's innovative spirit, innovative consciousness and innovative ability, drive the active adjustment of the entire education system and mechanism. By this way, more practical talents with moral character, critical spirit, exploration and research ability will be cultivated, and the fading demographic dividend will be transformed to the talents and engineer dividend.

- Scientific and technological innovation

As General Secretary Jinping Xi said, the core technology is the most important strength for a country, and only by mastering the core technology can we truly grasp the initiative of competition and development, and fundamentally guarantee the economic, military and other security. To this end, China must regard comprehensive innovation centered on scientific and technological innovation as the primary driving force for manufacturing upgrades. In addition to focusing on education and talents, it is also necessary to seek breakthroughs in the following aspects. First, strengthen basic scientific research. Increase investment in human, material and financial resources in the field of basic scientific research, pay more attention to original innovation and disruptive technologies, open the green channel connecting basic research and technological innovation, and strive to drive breakthroughs in applied technology groups with basic research. Second, fully implement the open innovation. Facing the US technology and talents blockade, China should more actively integrate into the global innovation network, participate in the allocation of global innovation resources, and accelerate the integration of external and internal technology resources. Third, strengthen the construction of the standard system. Adhere to quality as the lifeline of building a manufacturing power, and build an international standard system. On the one hand, guide and support the company's product quality to actively integrate with international standards. On the other hand, strive to create a number of internationally recognized Chinese standards to promote the transformation of China's speed to Chinese quality, and Chinese products to Chinese brands. Fourth, make breakthroughs in key areas. Give play to the institutional advantages of focusing the full resources of the country on major tasks, select a batch of bottleneck technologies, support a group of leading enterprises, cultivate several key industries, integrate resources and strengths, so make multidimensional breakthroughs. Fifth, cultivate more and more industrial workers. Establish a cultivating system for industrial workers' knowledge and skills, significantly increase the income level and social status of industrial workers, build a knowledgeable, skilled and innovative group of industrial workers for China's manufacturing upgrading and independent on science and technology.

- Institutional change

During the game with the United States, China must not be threatened to reduce supports for the industries related to the Made in China 2025 plan. Instead, China need make greater efforts to remove the institutional obstacles to innovation, entrepreneurship and the upgrading of manufacturing, and release more institutional dividends. Firstly, deepen government management and service system reform. Break administrative monopolies and industry barriers, and let the market truly become the decisive force for the allocation of innovative resources, so that enterprises can truly become the subject of technological innovation. Secondly, optimize the incentive mechanism for the subject of innovation. Use fiscal, tax, and financial policies to encourage enterprises to increase innovation input, reduce their overall costs, and enhance their innovative profitability. Thirdly, perfect the coordinated promotion mechanism for the transformation of scientific and technological achievements. Strengthen the protection and operation of intellectual property rights, guide the government, enterprises and research institution to strengthen cooperation in accordance with market rules, and accelerate the transformation of scientific and technological achievements. Fourthly, improve debt and equity financing mechanisms. Expand direct financing channels for enterprises, and promote financial services to better serve the real economy. Fifthly, further optimize the business environment for innovation and entrepreneurship, and promote the in-depth development of mass entrepreneurship and innovation. Finally, strengthen the construction of social integrity and promote the institutionalization of integrity construction.

- Cultural cultivation

Innovation is the soul of a nation's progress and an inexhaustible source of prosperity for China. To achieve the upgrading of China's manufacturing and the great rejuvenation of the Chinese nation, it urgently need to create a harmonious social atmosphere that encourages innovation and tolerates failure, let innovation prevail in whole society. Vigorously promote the scientific spirit of seeking truth and being pragmatic, courageous to innovation, pursuit of excellence, solidarity and

cooperation, selfless dedication, encourage academic contention, stimulate critical thinking, and promote academic freedom that is lively, unconstrained, and daring to invent and create. Establish a value orientation of advocating innovation and entrepreneurship, and guide more talents for innovation and entrepreneurship. Strengthen the publicity of scientific and technological innovation, report on typical stories about innovation and entrepreneurship, and further form a fashion of respecting labor, knowledge, talents and creativity. Carry forward the spirit of model workers and craftsmen, and create a glorious social fashion of work and a professional fashion of striving for perfection.

#### *4.3 Cultivating national value chains*

The ultimate goal of China's manufacturing upgrade is to move towards the mid- high end of the global value chain, but it must be based on current realistic conditions and comparative advantages. If China's manufacturing move blindly to the mid-to-high end of the global value chain, it will not only be difficult to achieve a upgrade of comparative advantage, but may lose its existing advantages and new development opportunities brought about by the division of global value chains. Many researches show that although the China's manufacturing is increasingly participating in the division of global value chains, it is still generally in the mid-low end of the global value chains (Chen 2015; Yin 2016; Fan et al. 2016; Su et al. 2017), and has been strongly hindered by developed countries (Huo and Zhang 2016; Wang et al. 2017). In the Sino-US trade war, it is very obvious that the United States wants to suppress China's manufacturing in the mid-low end of the global value chain for a long time.

Facing the dilemma of low-end lock-in and high-end blockade, China's manufacturing should make full use of the advantages of the industrial system and domestic market, focus on the Made in China 2025 plan, and actively cultivate and build national value chains led by domestic enterprises. First, build an excellent industrial system. With the help of the complete industrial sector, China need to build and optimize the industrial chain and industrial network of the manufacturing, play the role of the industrial technology innovation alliance and industry associations, and promote the integration of enterprise resources and capabilities by taking the enterprise as the subject and the market as the guide, so that accelerate the high-quality development of the manufacturing. Second, cultivate leading enterprises. Make full use of the advantages of domestic market, grasp the trend of consumption upgrading, actively cultivate competitive leading enterprises and unicorn enterprises, build national brands, and lay a solid foundation for China's manufacturing to move towards the mid-high end of the global value chains. Third, accelerate the upgrading of regional value chains. Actively guide the value interaction and circulation among different regions, and realize the multi-level and all-round value chain upgrading of all regions in China. At last, promote the coordinated upgrading of industries and cities. Starting from the division of labor and cooperation between industries and cities, promote the integration of China's manufacturing development and urban function with the help of the development of the advanced modern producer service.

#### *4.4 Expanding global value chains*

While cultivating national value chains, China's manufacturing should grasp the new opportunities brought about by the deep evolution of global value chains, actively integrate into global value chains, promote the efficient connection between national value chains and global value chains, and accelerate the progress towards the mid-high end of the global value chains. Firstly, accelerate the transformation and upgrading of traditional manufacturing. Deeply integrate the new generation of information technology with traditional manufacturing, promote the smile curve of traditional manufacturing rise at the bottom and extend at both ends, and continuously expand and increase the added value of the manufacturing. Secondly, vigorously develop strategic emerging industries. Get out of the comparative advantage trap of resources, actively cultivate advanced production factors such as human capital, knowledge, technology and systems, strengthen independent innovation capabilities, and accelerate the development of strategic emerging industries and high-tech industries with higher added value. Thirdly, actively restructure global value chains.

Make full use of the opportunities brought by the Belt and Road initiative to actively build a new global value chains.

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# An Empirical Study on the Impact of Climate Change on Farmers' Income

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**Abstract:** This article counts the climate factors into farmers' income decision function, aiming to empirically tests the impacts of climate factors and climate change on farmers' net income respectively, based on the survey data of Shanxi and Henan provinces, two major agricultural provinces in China, from 1993 to 2017. The study found that the impact of climate factors and climate change on farmers' income is structural that will affect the operational income and wage income, in turn, the net income of rural residents. The average annual temperature rise and precipitation increase have a non-linear positive impact on farmers' income. At the same time, compared with the temperature change trend, more attention should be paid to the significant beneficial impact of the increased precipitation change trend on farmers' net income. According to the research result, this paper proposes that puts forward that we should attach importance to farmers' adaptation measures to different climate change characteristics, promote new technologies and development policies, and improve the income level of rural residents through various channels.

**Keywords:** climate change; net income of rural residents; farmer's operational net income

**JEL Classification:** Q54

## 1. Introduction

As early as 1988, American meteorologist James Hansen first proposed the theory of global warming, followed by various scholars who carried out a series of discussions on the trend of temperature change. Global warming has aroused global consensus since the 20th century, especially on temperature rise, the most important feature of climate change. According to the IPCC report, the global temperature rises by about 0.2°C every ten years. At present, it has risen by 1 C. Following this trend, it will reach 1.5 C between 2030 and 2052. The unfavorable climate change has caused intense attention from all countries and international organizations. In 1988, the U.N. Intergovernmental Panel on Climate Change (IPCC) came into being, becoming an important position for the public to understand the common sense of climate change. The 2018 annual report "Temperature Control of 1.5 C" sounded a great alarm for all countries. After the 1992 U.N. Framework Convention on Climate Change, the 1997 Kyoto Protocol and the 2015 Paris Agreement have become legally binding agreements. China participated in the signing of two agreements in 2002 and 2015 and earnestly fulfilled a series of commitments. Many scholars focus on the exploration impact of climate change, presenting from the research that it will significantly affect the climate resource, as well as other aspects of social production, among them, the most obvious impact is on agriculture that is closely relied on the climate. Favorable climate can promote the growth of crops, while extreme climate can slow down the growth of crops, so climate change has become an important barrier on the development of agriculture and farmers' income.

Based on this, scholars have provided a series of deep research on the impact of climate change on agriculture, initially the impact on the yield of agricultural products stated in a large number of literatures, mainly different on the selected research methods and technical treatment. On one hand, natural scientists adopt experimental simulation and obtain data through actual or simulated experiments, with the aim of mastering the responses of different crops to different climate variables (Jiang et al. 2007; Zhang et al. 2018; Zhao et al. 2019; Liu et al. 2019). On the other hand, scholars in the economic field take econometric analysis methods to create models to predict climate change trends, estimating the relationship between climate change and agricultural production in a more systematical



and reliable way varied with regional climate demand (Zimmermann et al. 2017; Zhou et al. 2017; Zhou et al. 2018). It is worth noting that scholars may reach very different conclusions. At the same time, Liu et al. (2004) and Wang et al. (2009) all with the help of the Ricardian Model in the research of China's agriculture, two opposite conclusions are drawn that are whether climate change, especially temperature rise, is beneficial or harmful to agricultural economy.

Later, a few literatures focused on the impact of climate change on the price of agricultural products, showing in the research that the impact is mainly through adjusting market supply and demand. First, it will affect the yield, in turn the price of crops. Under a certain impact, for example, the continuous high temperature will cause the agricultural output reduce to a certain extent, and the shortage of supply relative to demand will lead to an increase in food prices (Thomas et al. 2019). Second, with the formation of a globalized market, the impact will lead to price differences and trade between countries, thus creating new crop prices (Li 2017; Xie et al. 2018). Recently, scholars have turned their attention to the impact of climate change on farmers' income, and found that climate change directly affect the planting structure, crop yield and quality, and planting cost, in turn, the farmers' income. This kind of research mainly adopts three means, the first is production function, adding climate change factors to the C-D production function, establishing a new evaluation model by comparing the C-D-C model with the C-D model (Chou and Du 2006). Second, by ricardian model, Mendelsohn et al. (1994) creatively presented the variation in economic benefits caused by climate change from the land value, using US cross-sectional data, reaching the conclusion that global warming can bring economic benefits to agriculture. Scholars then successively expanded ricardian model, Deschênes and Greenstone (2007) improved the major deficiency of missing important variables in ricardian model, applying panel data to study the sensitivity of agriculture to cross-time weather variation. At the same time, in order to discuss the different impacts of short-term and long-term climate changes, Kelly et al. (2005) and others used mixed data to respectively model and analyze. Vaseghi and Esmaeili (2008) chooses the net income of wheat as the breakthrough point to demonstrate the impact of climate change on income, but it only considers the net income of the agricultural system and ignores per unit area yield. Because the unit yield can better show the impact of climate change, Chen et al. (2013) showed in the grade research on agriculture that the annual impact of air temperature on unit crop income is positive, while the annual impact of precipitation increase is negative, and holds that climate change may create potential advantages for agricultural development. Besides the test of historical facts, part of scholars takes the mechanism model to predict the future change in the simulating experiment.

Though present literatures have made theoretical and empirical studies on the impact of climate change on agricultural economic benefits, there are still some problems to be resolved. Some potential factors may be omitted, resulting in errors, leading to overestimation or underestimation of the effects of climate change on agriculture. At the same time, when the global scholars have concentrated on the study of farmers' adaptive behavior, domestic scholars still directly imitate the study of ricardian model. Refer to the above problems, this article made the relevant improvement. First, about the research method, the income decision model is modified and expanded to meet the actual Chinese condition. Next, about the research variable, the climate factors and changes are distinguished to enable the research variable selection more comprehensive in relation with other production conditions. At last, on the research angle, the adaptive adjustment farmers possibly made for long term shall be considered, so as to correctly distinguish the impact of short and long term climate change on agricultural income, providing suggestions to the government on the implementation of feasible economic and agricultural policy.

## **2. Methodology**

### *2.1. Method*

As the income usually conforms to the normal distribution (Shorrocks and Wan 2005), This is also confirmed by the normal test of the income variables in the data of this paper. This article chooses the income determination econometric model (Morduch and Sicular 2000), this model was first applied to

analyze the relationship between political status and Chinese citizen's income. Then, after being extended by Cheng et al. (2014), the equation is as follows:

$$\ln Y_{it} = \beta_0 + \sum \beta_k HC_{itk} + \sum \beta_l PC_{itl} + \sum \beta_m FA_{itm} + \sum \beta_n SC_{itn} + \sum \beta_o ES_{ito} + \sum \beta_p SP_{itp} + \sum \beta_q EP_{itq} + \sum \beta_r FC_{itr} + \sum \beta_s CV_{its} + \varepsilon_{it} \quad (0)$$

Among them,  $\ln Y_{it}$  is the explained variable, which represents the logarithm of the per capita income of farmers. HC, PC, FA, SC, ES, SP, EP, FC and CV respectively represent human capital, material capital, financial capital, social capital, employment behavior, system and policy, regional economic situation, family characteristics and control variables.  $\varepsilon_{it}$  is a random disturbance term, and each group of explanatory variables is equipped with the following subdivision variables.

In the full consideration of the research object, this article will set the measurement model specifically as follows.

$$\ln PY_{it} = \partial_0 + \sum \partial_k X_{itk} + \sum \partial_l HC_{itl} + \sum \partial_m PC_{itm} + \sum \partial_n EP_{itn} + \sum \partial_o X_{ito} + \varepsilon_{it} \quad (1)$$

In this model,  $i$  represents  $i$  province and  $t$  represents  $t$  period. The explained variables  $\ln PY_{it}$  represent the logarithm of farmers' per capita income, among which  $X_{itk}$  are the core explanatory variables, including average temperature and average precipitation. In this paper, the annual average temperature and precipitation in the region and their quadratic terms are used to express. and  $HC_{itl}$ 、 $PC_{itm}$ 、 $EP_{itn}$ 、 $CV_{ito}$  individually represent a group of human capital variables, physical capital variables, regional economic variables and control variables, among them, the variables of human capital include the education rate and education expenditure of rural residents, the variables of material capital include cultivated land area, productive capital, total mechanical power and fixed asset investment, and the regional economic characteristics include urbanization rate and urban-rural income gap.  $\varepsilon_{it}$  are random error terms.

It should be noted that take the temperature and precipitation of that year as climate factors alone can reflect the impact of external climate conditions on the net income of farmers. Therefore, we independently set up model 2 to test the impact of climate factors on the income without considering other control variables, but this reflection can't objectively describe the climate conditions on Farmers' net income. Therefore, we introduce the change degree of temperature and precipitation as the core variables into the equation, and obtains model 3.

$$\ln PY_{it} = \partial_0 + \sum \partial_k X_{itk} + \sum \partial_l CV_{itl} + \varepsilon_{it} \quad (2)$$

$$\ln PY_{it} = \partial_0 + \sum \partial_k XV_{itk} + \sum \partial_l HC_{itl} + \sum \partial_m PC_{itm} + \sum \partial_n EP_{itn} + \sum \partial_o X_{ito} + \varepsilon_{it} \quad (3)$$

Here, among them,  $XV_{itk}$  indicates the change degree of climate variables, that is, the deviation between the temperature and precipitation of the province in the current year and the average level of the previous five years. The meaning of other variables and parameters is the same as that of model 1,  $\varepsilon_{it}$  which is a random error term.

In a word, model 1 and model 2 are used to analyze and compare the impact of annual climate factors on the per capita net income of rural residents, and model 3 is used to analyze the impact of annual climate changes on the per capita net income of rural residents.

## 2.2. Data source and variable selection

The data used in this article are mainly from Shaanxi Statistical Yearbook, Henan Statistical Yearbook, China Rural Statistical Yearbook and the National Bureau of Statistics. The data sample interval is 1993-2017, spanning 24 years, with 72 samples. Shanxi Province and Henan Province with similar agricultural natural conditions are selected. By the end of the 2017, the rural population of the two provinces totaled 68.66 million. The cultivated land area is up to 12398.608 thousand hectares. Therefore, it has certain representativeness interpreted variable. Select the per capita net income of farmers in Shaanxi Province and Henan Province to represent the farmers' income, this is consistent

with the literature study on the factors affecting farmers' income (Cheng et al. 2014; Vaseghi and Esmaeili 2008). The main reason is that the net income can better reflect the actual income level of farmers. Considering the adaptability of farmers to climate change, the net income can better reflect the impact. The purpose of split the net income into per capita operating income, capital income and wage income is to reflect the structural impact. Due to the different statistical caliber, the net income data selected before 2013 is the per capita net income variable, and the net income data after 2014 is derived from the per capita disposable income variable, all use rural consumer price index (CPI) which make 1978 as the base period for conversion.

Explain variables and control variables. According to the research objectives of this paper, climate variables are the core variables, owing to the temperature, precipitation and their changes will have a huge impact on agricultural production, and then affect the income of farmers. We consider not only the general absolute climate variables of temperature and precipitation and add the square terms of temperature and precipitation to study whether there is a U-shaped change relationship, but also the impact of relative climate variables (the changes of temperature and precipitation). The calculation method mainly refers to Feng (2017).

Based on the classical economic growth theory, there are many factors that affect income, among which capital, labor force and regional characteristics are the most important three. According to the theory of Schultz (1961), human capital includes the quantity and quality of labor force. This paper measures the quality of labor force by the proportion of education above junior high school in the province. Unlike other scholars, the data of six lag in the current period are selected considering the lag effect of education. The quality of labor is also reflected in the level of health, given Shaanxi Province and Henan province belong to different development areas, they pay different attention to education, we adopt the sum of "education and training" and "medical treatment" in per capita consumption expenditure as the current level of physical and mental health to reflect the input gap of labor force in per capita situation. As far as capital input is concerned, it can be divided into material capital and financial capital (mainly according to Gao and Yao 2006). The most important capital related to farmers' income is land, this is also the core of Ricardo Model (Mendelsohn et al. 1994). Therefore, planting area is used to measure the sustainable input of land elements, On the other hand, because the samples studied in this paper are inland areas, the capital invested in production and the total mechanical power can well represent the impact of capital investment. The original value of per capita productive fixed capital and fixed capital investment can also represent the external production investment of the two areas. Finally, considering that even if there are similar agricultural conditions, regional factors are still important factors restricting farmers' income, this paper uses the commonly used urbanization rate and urban-rural income gap to represent regional development, the calculation method of these two variables is consistent with the existing literature.

**Table 1.** Statistical variable description.

Variable	Meaning	Mean value	Standard deviation
Explained variable			
Net income per capita of farmers	Average net income per farmer ( yuan per person )	821.6105	592.7557
Per capita operational net income of farmers	Average net income per person from operation ( yuan per person )	329.2594	337.3551
Per capita wage net income of farmers	Average net income per person from wages ( yuan per person )	299.1622	218.6893
Per capita capital net income of farmers	Average net income of farmers from property investment ( yuan per person )	19.31506	7.66171
Explanatory variable			
Climate variables			

Annual average temperature	Annual average temperature of the province (°C)	16.18646	15.68569
Annual average temperature change	Difference between provincial average temperature and five-year average temperature (°C)	0.5275	0.865068
Annual average precipitation	Annual average precipitation in the province (mm)	828.0169	768.3429
Annual average precipitation change	Difference between provincial average precipitation and five-year average precipitation (mm)	11.41541	164.7153
<hr/>			
Human capital variable			
Education rate	Education rate above junior middle school lagging behind six periods in the province	61.50417	12.02476
Education expenditure of rural residents	"Education and training" and "medical treatment" expenditure of rural residents' consumption	207.9287	195.9783
Material capital variable			
Cultivated land area	Total cultivated area of province (mu)	9198.369	4743.489
Productive capital	Original value of productive fixed capital per capita at the end of the year (yuan)	6369.409	3385.218
Total mechanical power	Mechanical power input a year in the province (Million kilowatts)	4667.69	3749.469
investment in fixed assets	investment in fixed assets of rural farmers a year in the province(Billion yuan)	311.949	267.7923
Regional economic conditions			
Urbanization rate	Proportion of urban population to total population	0.39024	0.134298
Income gap between urban and rural areas	Proportion of urban per capita disposable income to rural per capita disposable income	28.00047	32.41569

### 2.3. Panel stability test

In this paper, LLC and IPS are selected to carry out unit root test. In this test, the per capita net income of farmers is logarithmized to reduce the volatility of variables. When the unit root test results are inconsistent, the data can be deemed unstable, as the results shown in Table 2. It can be seen that the data after the first-order difference of variables is stable, and after the panel cointegration test, variables present a cointegration relationship.

**Table 2.** Panel stability test result.

Variable	Original sequence		First difference series	
	LLC	IPS	LLC	IPS
Annual average temperature	-4.38179***	-3.81527***	-7.60464***	-7.90523***
The quadratic of annual average temperature	-7.39621***	-7.80268***	-7.39621***	-7.80268***
Annual average precipitation	-6.27575***	-6.27575***	-12.8790***	-12.3634***

The quadratic of annual average precipitation	-6.30668***	-5.69426***	-7.71665***	-8.48414***
Urbanization rate	1.26363	1.56262	-3.66843***	-3.49521***
Total mechanical power	-2.64819***	-2.14902**	-3.54805***	-2.25515**
Income gap between urban and rural areas	-5.44351***	-6.54505***	-3.33056***	-5.60924***
Education rate above junior middle school	-2.93258***	-1.20253	-6.07884***	-6.09022***
Education expenditure of rural residents	-0.70230	0.78079	-3.01156***	-3.73602***
Investment in fixed assets of rural farmers	-0.22713	1.26595	-3.29396***	-2.44536***
Cultivated land area	-1.33688	-0.50332	-4.44042***	-4.61456***
Original value of productive fixed capital	-0.21576	1.20155	-3.19790***	-3.57828***
Net income per capita of farmers	-0.52237	1.59557	-3.61181***	-2.47397***

<sup>2</sup> The superscript \*\*\*, \*\*, \* are significant at the level of 1%, 5%, and 10%, respectively.

### 3. Results

#### 3.1. Climate change and farmers' net income

Since this paper adopts panel data, the fixed effect model is selected after the test. As the regression results shown in Table 3, except for Model 2, the adjusted R<sup>2</sup> is greater than 0.9, indicating that the model as a whole has great explanatory power.

In terms of climate variables, the set temperature and precipitation variables are significant in the three models, indicating that climate variables are important factors affecting farmers' income level. Model 2 analyzes the impact of climate variables on farmers' net income without controlling variables. The annual average temperature has a positive impact on farmers' net income and passes the 10% significance test. The annual average precipitation has a negative impact on farmers' net income and passes the 5% significance test. From the regression results of model 2, it can be seen that the quadratic coefficient of temperature and precipitation is opposite, and the absolute value of the quadratic coefficient is small, which indicates that the average annual temperature rise and the average annual precipitation decrease have a non-linear positive impact on farmers' net income. In model 3, the regression coefficient of annual precipitation change to farmers' net income is -0.000379. passed the significance test of 10%, at the same time, the regression coefficient of annual temperature change to farmers' net income is 0.059147, which shows that compared with the adverse effect of increasing precipitation change trend, the increasing trend of temperature change can have a greater positive impact on farmers' net income.

As far as human capital is concerned, the two sub-variables are both significant in model 1 and model 3, which shows that human capital is also an important factor affecting farmers' income level. For every 1% increase in the rate of education delayed by six periods, the income of farmers decreased by 3.7%, indicating that education expenditure is still a major part of farmers' income expenditure. At the same time, for every 1% increase in current expenditure on education and medical training, the net income of farmers will increase by 0.5%. Therefore, it will be greatly meaningful to pay attention to the cultivation of human capital in rural areas to improve the net income per capita in rural areas.

As far as material capital is concerned, two of the four sub-variables have passed the significance test in different degrees in different models. Among them, for each additional mu of sown area, the per capita net income of farmers will increase by 0.09%, for per capita fixed capital investment increased by 1%, per capita net income of farmers will increase by 2.3%. This shows that increase of capital investment plays an important role in improving farmers' income, and at the same time, the dependence of farmers on land in China has decreased.

In terms of the level of regional economic development, although the two variables are not significant, the regression coefficient of urbanization rate is the largest in the two models, which shows that in the progress of urbanization, it is a better and fast way to increase the net income of rural residents while narrowing the income gap between urban and rural residents.

**Table 3.** Analysis of the impact of annual climate factors and changes on per capita net income of rural residents.

Variable	Model 1	Model 2	Model 3
Annual average temperature	0.000332	0.018193*	
The quadratic of annual average temperature	-0.010148**	-0.00398	
Annual average precipitation	-0.000936**	-0.00322**	
The quadratic of annual average precipitation	1.43E-07**	5.19E-07**	
Urbanization rate	0.882635		0.333505
Total mechanical power	-5.74E-05		-0.000155
Income gap between urban and rural areas	-0.003384		-0.001554
Education rate above junior middle school	-0.037545***		-0.056224***
Education expenditure of rural residents	0.005405		0.006136***
Investment in fixed assets of rural farmers	0.002301*		0.002190**
Cultivated land area	0.000892*		0.000991***
Original value of productive fixed capital	-0.000151		-0.000146***
Temperature change			0.059147*
Precipitation change			-0.000379*
C	5.445869**	10.47195	1.949420
The adjusted R2	0.978001	0.601841	0.975257

<sup>3</sup> The superscript \*\*\*, \*\*, \* are significant at the level of 1%, 5%, and 10%, respectively.

### 3.2. Climate change and farmers' net operational income

The impact of annual climate factors and changes on rural residents' net operating is considered, in the same way the fixed effect model is also selected after passing the test. As the regression results shown in Table 4, except for Model 2, the adjusted R<sup>2</sup> is greater than 0.9, indicating that the model as a whole has great explanatory power.

In terms of climate variables, the set temperature and precipitation variables are remarkable in the three models, showing that climate variables are key factors affecting farmers' income level. Model 2 analyzes the impact of climate variables on farmers' net income without controlling variables. The quadratic term of annual average temperature has a positive impact on farmers' net income, passing the significance test of 1%, and the first degree is not significant, which indicates that there is an inverse U relationship between annual average temperature and farmers' net income from operations. The impact of annual precipitation on farmers' net income is positive, has passed the 5% significance test, meanwhile the coefficient of the quadratic term of annual precipitation is negative, and has passed the 5% significance test. In model 1, the coefficients of average annual temperature and its quadratic term, and average annual precipitation are positive and significant. From the regression results of models 1 and 2, it can be seen that the coefficients of temperature quadratic term and precipitation are positive, and the absolute values of the coefficients of quadratic term are large. These indicate that with the increase of average annual precipitation, the farmers' operational income presents increasing trend, and the average annual temperature rise has a non-linear positive impact on the farmers' net income. In the model 3, the regression coefficient of annual precipitation change to farmers' net income is 0.000192, passed the significance test of 1%, the average annual temperature change coefficient is larger

but not significant, showing that the increase of temperature change may cause positive impact, so the increasing trend of precipitation change will have benefit on farmers' net income.

As per the human resources, segmentation variable is notable in model 2 and model 3, indication the human resources are key to farmers' operational income level. Different from the impact of education delayed for six periods on the per capita net income of farmers, for every 1% increase in education rate, the operational income of farmers will 1.5% increase by 1.5%. It shows that the larger the proportion of education, the more favorable it is for rural residents to carry out various business activities such as agricultural production. In terms of material capital, only the net present value of productive capital among the four segmentation variables is significant at the significance level of 1%. For every 1% increase in net present value of productive fixed capital per capita, the net income per capita of farmers will increase by 0.01%. This shows that the value of productive fixed assets owned by residents can better promote the improvement of operational income of rural residents in the current period compared with the investment in fixed assets in the current period. From the perspective of regional economic development level, the urbanization rate is significant in the two models, and its regression coefficient is the largest, which indicates that the degree of urbanization is also an important factor affecting the net operating income of rural residents.

**Table 4.** Analysis of the impact of annual climate factors and changes on per capita net operating income of rural residents.

Variable	Model 1	Model 2	Model 3
Annual average temperature	0.002687**	-0.002334	
The quadratic of annual average temperature	0.006787***	0.017340***	
Annual average precipitation	0.000302*	0.001680**	
The quadratic of annual average precipitation	-4.22E-08	-2.70E-07**	
Urbanization rate	0.569712*		0.780915**
Total mechanical power	-1.27E-05		-1.13E-05
Income gap between urban and rural areas	0.001165		0.001251
Education rate above junior middle school	0.01492***		0.02367***
Education expenditure of rural residents	0.000372		0.001081
Investment in fixed assets of rural farmers cultivated land area	-0.00056		-0.0005
	-0.00015		-0.00021*
Original value of productive fixed capital	0.000128***		0.000102***
Temperature change	0.002687**		0.015908
Precipitation change			0.000192***
C	4.309198***	2.063895	5.823414***
The adjusted R2	0.959272	0.205273	0.937361

<sup>4</sup> The superscript \*\*\*, \*\*, \* are significant at the level of 1%, 5%, and 10%, respectively.

### 3.3. Climate change and farmers' net wage income

The impact of annual climate factors and changes on rural residents' net wage income is considered, in the same way the fixed effect model is also selected after passing the test. As the regression results shown in Table 5, except for Model 2, the adjusted R<sup>2</sup> is greater than 0.9, indicating that the model as a whole has great explanatory power.

In terms of climate variables, the set temperature and precipitation variables only have higher significance in model 2, and their coefficients and significance are the same as the impact of climate variables on farmers' operational income. From the models 1 and 2, if the first degree of temperature change is not significant, the quadratic term of annual average temperature will have a positive effect on farmers' net income, and has passed the significance test of 1%, which shows that there is an inverse

U relationship between annual average temperature and farmers' wage income. In model 3, the regression coefficient of annual precipitation change to farmers' wage net income is 0.001741, passing the significance test of 5%, but the annual average temperature change is not significant. It indicates that the greater the change trend of annual precipitation, the more favorable the increase of farmers' wage net income. This may be because of the drastic change of precipitation that drives farmers to give up business activities.

In terms of human capital, the segmentation variable is significant in model 3. For every 1% increase in the education rate, the operational income of farmers will increase by 5.5%, indicating that the larger the proportion of education, the more favorable it is for rural residents to obtain employment and wage income. In terms of material capital, only the net present value of productive capital among the four segmentation variables is significant at the level of 1% under the two models. For every 1% increase in net present value of productive fixed capital per capita, the net income per capita of farmers will increase by 0.02%, while the current fixed asset investment is adverse to the increase of wage income. This shows that once the current investment in fixed assets is made, the probability of residents engaging in production and business activities will increase, and the ratio of working will decrease relatively. Based on this, possession of more productive fixed assets will promote their participation in working activities. In terms of regional economic development, the urbanization rate is not remarkable in both models, but the regression coefficient of urbanization rate is the largest, which indicates that urbanization degree is also an important factor affecting rural residents' net income.

**Table 5.** Analysis of the impact of annual climate factors and changes on wage net income of rural residents.

Variable	Model 1	Model 2	Model 3
Annual average temperature	-0.00064	-0.00823	
The quadratic of annual average temperature	0.011301***	3.66E-02***	
Annual average precipitation	0.000428	0.00331**	
The quadratic of annual average precipitation	-5.92E-08	-5.26E-07**	
Urbanization rate	0.373231		0.554217
Total mechanical power	-5.86E-06		0.000143
Income gap between urban and rural areas	0.003242		0.000469
Education rate above junior middle school	0.040887		0.055032***
Education expenditure of rural residents	0.001347		-0.00333
Investment in fixed assets of rural farmers	-0.00128***		-0.00034
Cultivated land area	-4.27E-05		-0.00037
Original value of productive fixed capital	0.000207***		0.000145***
Temperature change			-0.015884
Precipitation change			0.001741**
C	-0.299694	-3.233161	6.076092
The adjusted R2	0.946989	0.297915	0.934889

<sup>5</sup> The superscript \*\*\*, \*\*, \* are significant at the level of 1%, 5%, and 10%, respectively.

### 3.4. Climate change and farmers' net property income

The impact of annual climate factors and changes on rural residents' net property income is considered, in the same way the fixed effect model is also selected after passing the test. As the



regression results shown in Table 6, except for Model 2, the adjusted R<sup>2</sup> is greater than 0.9, indicating that the model as a whole has great explanatory power.

In terms of climate variables, the set temperature and precipitation variables have higher significance only in model 2, which shows that climate change hardly affects the property income of rural residents. As per human capital, a segmentation variable is notable in model 1. For every 1% increase in rural residents' consumption of education and medical care, the operational income of farmers will increase by 0.39%, indicating that the larger the education expenditure, the more favorable it is for rural residents to make property investment and obtain property income. As for physical capital, only fixed asset investment among the four segmentation variables has passed the significance test at 10% level under both models. In terms of regional economic development, the urban-rural income gap has passed the significance test of 1% in both models, and the larger the urban-rural income gap is, the lower the rural residents' property net income, because the premise of fixed asset investment is to have capital. The larger the urban-rural income gap is, the lower the rural per capita disposable income is, and the lower the amount that can be invested naturally. The rural residents' wage net income be increased only when the urban-rural income gap is greatly narrowed.

**Table 6.** Analysis of the impact of annual climate factors and changes on the property net income of rural residents.

Variable	Model 1	Model 2	Model 3
Annual average temperature	0.002692	-0.007727	
The quadratic of annual average temperature	0.003767	0.053066***	
Annual average precipitation	0.000469	0.003952**	
The quadratic of annual average precipitation	-6.53E-08	-6.40E-07**	
Urbanization rate	0.863514		0.636201
Total mechanical power	-7.99E-05		-0.000158
Income gap between urban and rural areas	-0.008728***		-0.007661***
Education rate above junior middle school	0.009418		0.015006
Education expenditure of rural residents	0.003937**		0.073265
Investment in fixed assets of rural farmers	0.001660*		0.001603*
Cultivated land area	-4.67E-05		9.48E-05
Original value of productive fixed capital	0.000219***		0.636201
Temperature change			0.000222
Precipitation change			0.062122
C	0.306601	-8.504075	-0.137941
The adjusted R <sup>2</sup>	0.912565	0.411173	0.919679

<sup>6</sup> The superscript \*\*\*, \*\*, \* are significant at the level of 1%, 5%, and 10%, respectively.

#### 4. Discussion and Conclusion

on the one hand, the research results of this paper show that the average annual precipitation has a negative effect on the rural residents' per capita net income, which means that the average annual precipitation increases, the rural residents' per capita net income demonstrates a downward trend. It is consistent with the conclusion of Chen et al. (2013), the possible reason is that the selected sample is mainly cultivated with dry crops in the inland area, and the increase of precipitation is not favorable to the increase of production, which affects the per capita net income of rural residents; The change of annual precipitation has negative influence on the per capita net income of rural residents, which is consistent with the conclusion of Feng (2017), the possible reason is that there is seasonal variation in crop water demand, the degree of its reflection to the reality is reduced by the explanation of the deviation of precipitation.

On the other hand, the second term of annual mean temperature has a negative effect on the per capita net income of rural residents, indicating that the effect of temperature on the per capita net income of rural residents is non-linear, that is the increase of temperature under other conditions unchanged, farmers' net income first increases and then decreases, which is in line with the law of cultivation. The annual mean temperature change has a positive effect on the per capita net income of rural residents, which is consistent with the conclusion of Liu et al. (2004).

In conclusion, this article applies the provincial panel data of Shanxi Province and Henan Province from 1993 to 2017. It builds a fixed effect model by expanding the income model, empirically analyzes the economic impact of climate change on the net income of rural residents in the two provinces, and identifies the key climate factors that affect the net income of farmers in the two provinces. At the same time, it decomposes the income results and studies the ways the climate change affects the per capita net income of rural residents. The study found that: (1) Climate factors and their changes have a significant impact on the net income of rural residents in the two provinces. In general, the average annual temperature rise and the average annual precipitation increase have a non-linear positive impact on farmers' net income, while the increasing trend of precipitation change will have a favorable impact on farmers' net income. (2) Climate factors mainly affect the rural residents' operational income and wages of rural residents in two provinces, in turn, the net income of rural residents. (3) Among other controlling variables, each factor has a key factor that affects the net income of rural residents in the two provinces. The higher the urbanization rate, the greater the proportion of education, and the more fixed capital investment, the more conducive to promoting the income increase of rural residents. In accordance to the above conclusions, this article suggests that farmers and local governments should pay attention to adaptive measures for different climate change characteristics. In recent years, China's agriculture-related technologies are making quick progress, with new crop varieties and agricultural production technologies emerging one after another. However, more attention should be attached to adaptation to climate change trends in the process of research and development of new crop varieties, development and popularization of new technologies. Otherwise, the positive benefits brought by scientific and technological progress to agricultural production may be greatly reduced, and farmers' operating income may be lost. For regions with obvious climate change trends, varieties that can be adapted to climate change should be adopted as far as possible.

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# Sortino's Ratio for Oriented Fuzzy Discount Factor

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**Abstract:** Financial equilibrium criteria are very important tool for generating investment strategy. Obtained in this manner investment strategies base on analysis of distinguished profit index. In the article, investment strategies use a comparison of a profit index and related value limit. In considered formal model, the imprecise present value is evaluated by means of a trapezoidal oriented fuzzy number (Tr-OFN). Then expected discount factor is evaluated by Tr-OFN too. Its imprecise value can be used as a premise for financial decision making. For this reason, the Sortino's Ratio criterion is generalized for the case of expected discount factor described by Tr-OFN. Then proposed investment strategies use a comparison of oriented fuzzy profit index and related crisp value limit. In this manner an investor can obtain imprecise investment recommendation described by a fuzzy subset in rating scale. Results obtained show that generalized Sortino's Ratio may be applied in support systems for investment making. All theoretical results are illustrated by simple examples.

**Keywords:** Sortino's ratio criterion; oriented fuzzy number; fuzzy oriented discount factor

**JEL Classification:** C44; C02; G10

## 1. Introduction

In general, present value (PV) is determined as current equivalent of evaluated cash flow (Piasecki 2012). It is widely accepted that PV of future cash flow can be evaluated by fuzzy number (FN). Then an expected return rate is described by fuzzy subset in the family of all real numbers. This fact is a theoretical base for investment strategies presented by Piasecki (2014). Moreover, Piasecki and Siwek (2018) show that the fuzzy expected discount factor is a better tool for securities management than the fuzzy expected return rate. For this reason, an expected discount factor is applied here as premise for investment making.

Ordered FN is defined by Kosiński et al (1993; 2002; 2003). For formal reason, Piasecki (2018) revise the original Kosiński's theory. Let us note that if any ordered FN is determined with use the revised theory then it is called Oriented FN (OFN).

The aim of this paper is extension of introduced by Piasecki (2014) investment strategies for the case when PV is evaluated by OFN. Then PV is additionally equipped with forecast of PV's changes. The first attempt to this subject was presented in (Łyczkowska-Hanćkowiak and Piasecki 2019). Here, we use our experience gathered during our work on the other criteria. Therefore, here it is presented a revised approach to considered extension. All obtained results are used for extension the Sortino's Ratio criterion (Sortino and Price 1994) to the case of PV described by OFN.

This paper is organized in following way. Section 2 describes OFNs and their chosen properties. In Section 3 PV is presented with use trapezoidal OFNs. In Section 4, the formula for oriented fuzzy expected discount factor is derived. An upgraded model for investment recommendations is presented in Section 5. The extended Sortino's Ratio Criterion is given in Section 6. Final conclusions and proposed future research directions are given in Section 7

## 2. Oriented Fuzzy Numbers – Basic Facts

Considered objects can be modelled as elements of given space  $X$ . The widely accepted tool for any imprecise classification of these elements is fuzzy subset (Zadeh 1967). Each fuzzy subset  $\mathcal{A}$  is unambiguously distinguished by its membership function  $\mu_{\mathcal{A}} \in [0,1]^X$ . From the point-view of

multi-valued logic (Łukasiewicz 1922/23), the value  $\mu_A(x)$  may be interpreted as a truth value of the sentence " $x \in \mathcal{A}$ ". The symbol  $\mathcal{F}(\mathbb{X})$  denotes the family of all fuzzy subsets of the space  $\mathbb{X}$ .

Dubois and Prade (1978) have introduced fuzzy number (FN) as such fuzzy subset in the space  $\mathbb{R}$  which can be considered as an imprecise estimation of real number. The ordered FNs are defined as an FN extension (Kosiński et al. 1993, 2002, 2003). Ordered FNs helpfulness is the result of interpretability them as FNs additionally equipped with information about the location of estimated number. Currently, ordered FNs defined by Kosiński are frequently called the Kosiński's numbers (Prokopowicz and Pedrycz 2015, Prokopowicz 2015, Piasecki 2019). A discussion on the present state of knowledge on Kosiński's numbers is presented in (Prokopowicz et al. 2015). A major disadvantage of Kosiński's theory is existence such Kosiński's numbers which cannot be represented by membership function. (Kosiński 2006). Therefore, this theory is revised by Piasecki (2018a). If an ordered FN is determined with use of the revised definition, then it is called Oriented FN (OFN).

In this article, all considerations are restricted to the case of Trapezoidal OFN (TrOFN) defined as follows.

**Definition 1.** (Piasecki 2018a) For any monotonic sequence  $(a, b, c, d) \subset \mathbb{R}$ , the TrOFN  $\overrightarrow{Tr}(a, b, c, d) = \vec{\mathcal{F}}$  is determined as the pair of the orientation  $\langle a \rightarrow b \rangle = (a, d)$  and the fuzzy subset  $\mathcal{F} \in \mathcal{F}(\mathbb{R})$  distinguished by its membership functions  $\mu_{\mathcal{F}} \in [0,1]^{\mathbb{R}}$  given as follows

$$\mu_{\mathcal{F}}(x) = \mu_{Tr}(x|a, b, c, d) = \begin{cases} 0, & x \notin [a, d] \equiv [d, a], \\ \frac{x-a}{b-a}, & x \in [a, b] \equiv [b, a], \\ 1, & x \in [b, c] \equiv [c, b], \\ \frac{x-d}{c-d}, & x \in ]c, d] \equiv [d, c[. \end{cases} \quad (1)$$

By symbol  $\mathbb{K}_{Tr}$  we denote the space of all TrOFNs. For  $a < d$ ,  $\overrightarrow{Tr}(a, b, c, d)$  is positively oriented. Then  $\overrightarrow{Tr}(a, b, c, d)$  is an image of term "about or slightly above  $z$ " expressed for any  $z \in [b, c]$ . For  $a > d$ ,  $\overrightarrow{Tr}(a, b, c, d)$  is negatively oriented. Then  $\overrightarrow{Tr}(a, b, c, d)$  is an image of term "about or slightly below  $z$ " expressed for any  $z \in [b, c]$ . For  $a = d$ ,  $\overrightarrow{Tr}(a, a, a, a) = \llbracket a \rrbracket$  describes un-oriented real number  $a \in \mathbb{R}$ .

On the space  $\mathbb{K}_{Tr}$  the relation  $\vec{\mathcal{K}}. \vec{GE}. \vec{\mathcal{L}}$  is defined in following way

$$\vec{\mathcal{K}}. \vec{GE}. \vec{\mathcal{L}} \Leftrightarrow "TrOFN \vec{\mathcal{K}} \text{ is greater or equal to } TrOFN \vec{\mathcal{L}}." \quad (2)$$

Above relation is a fuzzy preorder  $\vec{GE} \in \mathcal{F}(\mathbb{K}_{Tr} \times \mathbb{K}_{Tr})$  described by its membership function  $v_{GE} \in [0,1]^{\mathbb{K}_{Tr} \times \mathbb{K}_{Tr}}$  firstly considered by Piasecki (2018a; 2019). Due these results, for any pair  $(\overrightarrow{Tr}(a, b, c, d), h) \in \mathbb{K}_{Tr} \times \mathbb{R}$  we have:

$$v_{GE}(\overrightarrow{Tr}(a, b, c, d), \llbracket h \rrbracket) = \begin{cases} 0, & h > \max\{a, d\}, \\ \frac{h - \max\{a, d\}}{\max\{b, c\} - \max\{a, d\}}, & \max\{a, d\} \geq h > \max\{b, c\}, \\ 1, & \max\{b, c\} \geq h, \end{cases} \quad (3)$$

$$v_{GE}(\llbracket h \rrbracket, \overrightarrow{Tr}(a, b, c, d)) = \begin{cases} 0, & h < \min\{a, d\}, \\ \frac{h - \min\{a, d\}}{\min\{b, c\} - \min\{a, d\}}, & \min\{a, d\} \leq h < \min\{b, c\}, \\ 1, & \min\{b, c\} \leq h. \end{cases} \quad (4)$$

### 3. Oriented Fuzzy Present Value

Any PV can be imprecise. It implies that PV must be evaluated by FN. Kuchta (2000) justifies the using trapezoidal FNs for PV evaluating. Moreover, PV estimation should be equipped with prediction of next PV changes. For these reasons, PV is estimated by TrOFN.

$$\overrightarrow{PV} = \overrightarrow{Tr}(V_s, V_f, \check{C}, V_l, V_e), \quad (5)$$

where the monotonic sequence  $(V_s, V_f, \check{C}, V_l, V_e)$  is defined as follows

- $\check{C}$  – market price,
- $[V_s, V_e] \subset \mathbb{R}^+$  is given interval of all possible PV values,
- $[V_f, V_l] \subset [V_s, V_e]$  is given interval of all prices not significantly different from the market price  $\check{C}$ .

If  $V_s < V_e$ , then the positive PV orientation is a prediction of the PV increase. For  $V_s > V_e$ , the negative PV orientation is the forecast of the decrease in PV. Such PV is called the oriented PV (OPV).

**Example 1:** (Łyczkowska-Hanćkowiak 2019): We consider the financial portfolio  $\pi$  containing the shares in following stock companies: Assecopol (ACP), ENERGA (ENG), JSW (JSW), KGHM (KGH), LOTOS (LTS), ORANGEPL (OPL) and PKOBP (PKO). All above stock companies are quoted on the Warsaw Stock exchange (WSE). Based on session closing on WSE on January 15, 2018, for each evaluated share we determine its OPV as TrOFN representing its Japanese candle (Nison 1991). Determined in this manner shares' OPVs are shown in Table 1 (Łyczkowska and Piasecki 2018a). For each portfolio component, we determine its market price  $\check{C}_s$  as initial price on 16.01.2018.

**Table 1.** Evaluation of stocks from portfolio  $\pi$ .

Stock Company	OPV $\overrightarrow{PV}_s$	Market Price $\check{C}_s$	Expected Return Rate $\bar{r}_s$	Downside Semi Variance $\zeta_s^2$
ACP	$\overrightarrow{Tr}(45.90; 45.90; 45.50; 45.48)$	45.70	0.0300	0.000050
CPS	$\overrightarrow{Tr}(22.92; 22.82; 22.82; 22.76)$	22.82	0.0355	0.000100
ENG	$\overrightarrow{Tr}(10.22; 10.19; 10.17; 10.14)$	10.18	0.0150	0.000015
JSW	$\overrightarrow{Tr}(92.24; 92.54; 92.54; 92.80)$	92.54	0.0400	0.000150
KGH	$\overrightarrow{Tr}(102.65; 103.05; 103.60; 103.90)$	103.33	0.0390	0.000105
LTS	$\overrightarrow{Tr}(56.70; 56.56; 56.40; 56.28)$	56.48	0.0450	0.000210
OPL	$\overrightarrow{Tr}(5.75; 5.76; 5.90; 5.90)$	5.83	0.0360	0.000160
PGE	$\overrightarrow{Tr}(10.39; 10.39; 10.35; 10.33)$	10.37	0.0235	0.000100
PKO	$\overrightarrow{Tr}(42.61; 42.61; 43.22; 43.22)$	42.91	0.0420	0.000205

We notice that the stock companies JSW, KGH, OPL and PKO are evaluated by OPV having positive orientation. Then OPV predicts a rise in market price. Similarly, the stock companies ACP, CPS, ENG, LTS and PGE are evaluated by OPV with negative orientation. In this case, OPV predicts a fall in market price.

#### 4. Oriented Fuzzy Discount Factor

We use the simple return rate as basic characteristic of benefits from owning considered security. Let the uncertainty risk be described by probability distribution of return rate. If expected value of this distribution exists, then it is equal to expected return rate  $\bar{r}$ . Then expected discount factor (EDF)  $\bar{v} \in \mathbb{R}$  is defined as follows:

$$\bar{v} = \frac{1}{1+\bar{r}}. \quad (6)$$

It is obvious that the maximum criterion formulated for an expected return rate may be equivalently replaced by the minimum criterion formulated for EDF.

**Example 2:** In all examples, we consider quarterly duration of investment. For each component of portfolio  $\pi$ , we calculate its return rate and related downside semi variance. All results of these calculations are shown in Table 1.

In (Łyczkowska-Hanćkowiak and Piasecki 2018b) it is proved that if oriented EDF (OEDF) is determined by OPV (5) then it is described by TrOFN

$$\vec{V} = \overrightarrow{Tr}\left(\frac{V_s}{\check{c}} \cdot \bar{v}, \frac{V_f}{\check{c}} \cdot \bar{v}, \frac{V_l}{\check{c}} \cdot \bar{v}, \frac{V_e}{\check{c}} \cdot \bar{v}\right). \quad (7)$$

**Example 3:** Using (6) and (7), we calculate EDF and OEDF for each share belonging to considered portfolio  $\pi$ . Obtained in this manner evaluations are shown in Table 2.

The discount factor calculated in this manner is TrOFN with the identical orientation as OPV used for estimation.

## 5. Investment Recommendations

We consider a recommendation given by an advisor to an investor. Any recommendation is a subset of rating scale. In this paper, all recommendations are formulated with use rating scale applied in (Piasecki 2014). Used rating scale is described by the set  $\mathbb{A} = \{A^{++}, A^+, A^0, A^-, A^{--}\}$ , where

- $A^{++}$  is the advice "Buy";
- $A^+$  is the advice "Accumulate";
- $A^0$  is the advice "Hold";
- $A^-$  is the advice "Reduce";
- $A^{--}$  is the advice "Sell".

Let fixed security  $\check{S}$  be represented by the pair  $(\bar{r}_s, \varpi_s)$  of the expected return  $\bar{r}_s$  and the parameter  $\varpi_s$  characterizing the uncertainty risk related to investing in represented security  $\check{S}$ . The symbol  $\mathbb{S}$  denotes the portfolio containing all considered securities. Any recommendation depends on the mentioned above pair of parameters. The criterion for advices choice may be presented as a comparison between the profit values  $g(\bar{r}_s|\varpi_s)$  and the profitability threshold (PT)  $\check{G}$ . Introduced above function  $g(\cdot|\varpi_s): \mathbb{R} \rightarrow \mathbb{R}$  increases with the expected return rate. Then any recommendation is formulated with use the choice function  $\Lambda: \mathbb{S} \times \mathbb{R} \rightarrow 2^{\mathbb{A}}$  was given in following way (Piasecki 2014)

$$\bullet A^{++} \in \Lambda(\check{S}, \check{G}) \Leftrightarrow g(\bar{r}_s|\varpi_s) > \check{G} \Leftrightarrow \neg g(\bar{r}_s|\varpi_s) \leq \check{G}, \quad (8)$$

$$\bullet A^+ \in \Lambda(\check{S}, \check{G}) \Leftrightarrow g(\bar{r}_s|\varpi_s) \geq \check{G}, \quad (9)$$

$$\bullet A^0 \in \Lambda(\check{S}, \check{G}) \Leftrightarrow g(\bar{r}_s|\varpi_s) = \check{G} \Leftrightarrow g(\bar{r}_s|\varpi_s) \geq \check{G} \wedge g(\bar{r}_s|\varpi_s) \leq \check{G}, \quad (10)$$

$$\bullet A^- \in \Lambda(\check{S}, \check{G}) \Leftrightarrow g(\bar{r}_s|\varpi_s) \leq \check{G}, \quad (11)$$

$$\bullet A^{--} \in \Lambda(\check{S}, \check{G}) \Leftrightarrow g(\bar{r}_s|\varpi_s) < \check{G} \Leftrightarrow \neg g(\bar{r}_s|\varpi_s) \geq \check{G}. \quad (12)$$

This way was assigned the subset  $\Lambda(\check{S}, \check{G}) \subset \mathbb{A}$  describing the recommendation granted the security  $\check{S}$ .

The security  $\check{S}$  may be equivalently represented by the ordered pair  $(\bar{v}_s, \varpi_s)$ , where  $\bar{v}_s$  is EDF determined by (6). Then we have

$$g(\bar{r}_s|\varpi_s) \geq \check{G} \Leftrightarrow \bar{v}_s \leq \frac{1}{1+g^{-1}(\check{G}|\varpi_s)} = H_s(\check{G}), \quad (13)$$

$$g(\bar{r}_s|\varpi_s) \leq \check{G} \Leftrightarrow \bar{v}_s \geq H_s(\check{G}). \quad (14)$$

The value  $H_s(\check{G})$  may be applied in any comparison with EDF as such profitability threshold (SPT) which is specified for each security  $\check{S}$  separately. Then the choice function  $\Lambda: \mathbb{S} \times \mathbb{R} \rightarrow 2^{\mathbb{A}}$  is equivalently determined as follows

$$\bullet A^{++} \in \Lambda(\check{S}, \check{G}) \Leftrightarrow \neg \bar{v}_s \geq H_s(\check{G}), \quad (15)$$

$$\bullet A^+ \in \Lambda(\check{S}, \check{G}) \Leftrightarrow \bar{v}_s \leq H_s(\check{G}), \quad (16)$$

$$\bullet A^0 \in \Lambda(\check{S}, \check{G}) \Leftrightarrow \bar{v}_s \leq H_s(\check{G}) \wedge \bar{v}_s \geq H_s(\check{G}), \quad (17)$$

$$\bullet A^- \in \Lambda(\check{S}, \check{G}) \Leftrightarrow \bar{v}_s \geq H_s(\check{G}), \quad (18)$$

$$\bullet A^{--} \in \Lambda(\check{S}, \check{G}) \Leftrightarrow \neg \bar{v}_s \leq H_s(\check{G}). \quad (19)$$

Let the security  $\check{S}$  be represented by such ordered pair  $(\vec{V}_s, \varpi_s)$  that  $\vec{V}_s \in \mathbb{K}_{Tr}$  is OEDF calculated with use (7). Then any value of choice function  $\tilde{\Lambda}(\check{S}, \check{G})$  is described by fuzzy subset in rating scale  $\mathbb{A}$ . This fuzzy subset is determined by its membership function  $\lambda(\cdot|\check{S}, \check{G}): \mathbb{A} \rightarrow [0,1]$  defined in line with (15) – (19) as follows:

$$\bullet \lambda(A^{++}|\check{S}, \check{G}) = 1 - \nu_{GE}(\vec{V}_s, \llbracket H_s(\check{G}) \rrbracket), \quad (20)$$

$$\bullet \lambda(A^+|\check{S}, \check{G}) = \nu_{GE}(\llbracket H_s(\check{G}) \rrbracket, \vec{V}_s), \quad (21)$$

$$\bullet \quad \lambda(A^0|\check{S}, \check{G}) = \min\{v_{GE}(\llbracket H_s(\check{G}) \rrbracket, \vec{V}_s), v_{GE}(\vec{V}_s, \llbracket H_s(\check{G}) \rrbracket)\}, \quad (22)$$

$$\bullet \quad \lambda(A^-|\check{S}, \check{G}) = v_{GE}(\vec{V}_s, \llbracket H_s(\check{G}) \rrbracket), \quad (23)$$

$$\bullet \quad \lambda(A^{--}|\check{S}, \check{G}) = 1 - v_{GE}(\llbracket H_s(\check{G}) \rrbracket, \vec{V}_s). \quad (24)$$

From the point-view of investment-making, the value  $\lambda(A|\check{S}, \check{G})$  is interpreted as a degree of advice support  $A \in \mathbb{A}$ , i.e. a declared adviser's participation in responsibility for the final investment decision in accordance with the recommendation  $\{A\} \subset \mathbb{A}$ .

## 6. The Sortino's Ratio

The Sortino's Ratio (Sortino and Price 1997) is a tool for risk management under financial equilibrium. In any financial equilibrium criterion, this model, we compare the expected return rate  $\bar{r}_s$  from considered security and the expected return rate  $\bar{r}_M$  from the distinguished market portfolio. We consider the advice choice function where profit index and limit value are determined by Sortino's Ratio. Then profit index evaluates amount of specific unit premium for loss risk. Moreover, the limit value evaluates amount of the market unit premium for loss risk. The benchmarks of our assessment is a market portfolio represented by such ordered pair  $(\bar{r}_M, \zeta_M^2)$ , where the downside semi variance  $\zeta_M^2$  evaluates the market loss risk. The reference point is a risk-free bond instrument represented by the ordered pair  $(r_0, 0)$ , where  $r_0$  is a free of risk return rate.

**Example 4:** We focus on the WSE. We consider risk-free financial instrument determined as quarterly treasure bound with return rate  $r_0 = 0.0075$ . The market portfolio is defined as portfolio designating stock exchange index WIG20. The market portfolio is represented by the ordered pair  $(r_M, \zeta_M^2) = (0.0200, 0.000015)$ .

Considered security  $\check{S}$  is represented by the ordered pair  $(\bar{r}_s, \zeta_s^2)$ , where downside semi variance  $\zeta_s^2$  evaluates a loss risk. Then Sortino and Price (1997) define the profit index  $g(\cdot | \zeta_s): \mathbb{R} \rightarrow \mathbb{R}$  and the limit value PT  $\check{G}$  as follows:

$$g(\bar{r}_s | \zeta_s) = \frac{r_s - r_0}{\zeta_s}, \quad (25)$$

$$\check{G} = \frac{r_M - r_0}{\zeta_M}. \quad (26)$$

For this case, we calculate SPT  $H_s(\check{G})$  as follows

$$H_s(\check{G}) = \frac{\zeta_M}{\zeta_s \cdot (r_M - r_0) + \zeta_M \cdot (r_0 + 1)}. \quad (27)$$

**Example 5:** Using (27), we calculate SPT for each security belonging to the portfolio  $\pi$ . Evaluations obtained in this way are presented in Table 2.

**Table 2.** EDFs and OEDFs of securities belonging to the portfolio  $\pi$ .

Stock Company	EDF $\bar{v}_s$	OEDF $\vec{V}_s$	SPT $H_s$
ACP	0.9709	$\vec{T}r(0.9751; 0.9751; 0.9666; 0.9662)$	0.9706
CPS	0.9657	$\vec{T}r(0.9699; 0.9657; 0.9657; 0.9632)$	0.9618
ENG	0.9852	$\vec{T}r(0.9891; 0.9862; 0.9842; 0.9813)$	0.9804
JSW	0.9615	$\vec{T}r(0.9584; 0.9615; 0.9615; 0.9642)$	0.9551
KGH	0.9625	$\vec{T}r(0.9592; 0.9599; 0.9650; 0.9678)$	0.9610
LTS	0.9569	$\vec{T}r(0.9606; 0.9583; 0.9555; 0.9535)$	0.9485
OPL	0.9652	$\vec{T}r(0.9520; 0.9536; 0.9768; 0.9768)$	0.9539
PGE	0.9770	$\vec{T}r(0.9789; 0.9789; 0.9751; 0.9732)$	0.9618
PKO	0.9597	$\vec{T}r(0.9530; 0.9530; 0.9666; 0.9666)$	0.9490

For each considered security, by means of (20) – (24) we calculate membership functions of investment recommendations presented in Table 3.



**Table 3.** Membership functions of recommendations.

Stock Company	Investment Recommendation				
	$A^{--}$	$A^{-}$	$A^0$	$A^{+}$	$A^{++}$
ACP	0	1	1	1	0
CPS	1	1	0	0	0
ENG	1	1	0	0	0
JSW	1	1	0	0	0
KGH	0	1	1	1	0
LTS	1	1	0	0	0
OPL	0	1	1	1	0
PGE	1	1	0	0	0
PKO	1	1	0	0	0

We see that obtained recommendations are ambiguous. These recommendations are only the opinion of the adviser. The final investment decision should be made by investor.

## 7. Conclusions

Presented results can be used in behavioural finance quantitative theory of behavioural finance as a part of model of investors' decisions. These results can also form theoretical basis for construction of investment decision-making support system.

For these portfolio, Sharpe's Ratio gave recommendations (Łyczkowska-Hanćkowiak 2019) which are different from the recommendations obtained by means of Sortino's Ratio. This fact results from the difference between the economic nature of both ratios. Sharpe's Ratio assesses the unit premium for risk, while Sortino's Ratio assesses the unit premium for loss risk.

Presented results can be a well starting point for future investigation of the impact of oriented imprecision on risk burdening investment decision making.

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# Age Structure of Inhabitants in the Czech Republic in Relation to ICT Usage for Searching for Travel and Accommodation Information

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**Abstract:** At the present time we can observe significant changes in customers' behavior in creating demand for particular goods. ICT usage plays more and more important role in this process. Information technologies bring higher availability of information necessary to apply a purchase decision, which increases demand elasticity. This article analyses the ICT usage development in regard to an age structure of inhabitants in the Czech Republic since 2009 to 2018. Crucial role in this development has been played by availability of a mobile internet connection. In the article there were used source data of the Czech Statistical Office. In the observed period there was found out an increasing linear trend in all age categories for the variable "Individuals using ICT for searching for travel and accommodation information in the Czech Republic" in percents. All regression functions have shown high values of coefficients of determination (0.675 - 0.933). The method of double sorting analysis of variance at the level of importance  $\alpha = 0.05$  found out statistically conclusive F-tests for the sorting criteria "Age Category" and "Year". Detailed evaluation of the analysis of variance differentiated individual pairs of averages of the analyzed sorting categories.

**Keywords:** Time series; ICT; Age; the Czech Republic; statistical analysis

**JEL Classification:** C10; D83; J1

## 1. Introduction

Creation of demand for particular goods has been undergoing significant changes in the last decade. The crucial role in this process is played by ICT usage and related higher availability of information necessary to apply a purchase decision. However, access to ICT and its use in the Czech Republic is very various as per the age of inhabitants. In the observed period there can be found significant differences between averages of component groups of inhabitants, divided into seven basic age groups, and also between the years of the analyzed time series.

Using ICT by respective age groups in the observed period has been considerably variant. Crucial factor for ICT availability was the price. In the beginning of the observed period financial possibilities to get access to Internet were limited, and hardware (PC, laptop, mobile phone) was hardly accessible or almost inaccessible for the groups with lower income. Especially older inhabitants (age groups 55-64, 65-74 and 75+) could hardly get access to Internet; the individuals so far economically active compensated it by using such technologies in their employment.

Problematic access to Internet has been quite long-lasting in the Czech Republic. The first connection to Internet was carried out in the former Czechoslovakia as early as on 13/02/1992; however, until the end of 1995 there was a data-transmission monopole of the telecommunication company Eurotel in the Czech Republic. Such a situation strongly limited availability of Internet connectivity, as the prices for data transfer were relatively high. Even after partial liberalization of telecommunication market at the turn of 1995 and 1996 the number of Internet access points was not growing very quickly and remained deeply below the international average. Faster development of Internet connectivity came as far as after the full liberalization of telecommunication services between 2002 and 2005. Until 2009 the number of constant internet access points increased to 1.8 million; and

until 2018 to almost 3.5 million. At the same time the prices for standard connection (50 Mb/s) decreased significantly by 65.46% (Lupa 2019). Price development of constant internet connection led to strongly higher accessibility of Internet also for groups of inhabitants for whom the Internet had not been considered as a priority till then. It concerned especially the older age groups for whom the penetration by Internet connectivity had been distinctively lower at the beginning.

Even more important than increase in constant access points was a fast increase in mobile connectivity in the observed period. At the beginning its general usage had been inhibited by very low transmission speed of the network in the major part of the Czech Republic. However, at the present the high-speed mobile connection is quite common within entire Czech Republic. Number of mobile internet users reached almost 9 million in 2018, which exceeded the number of constant network access points. Significant limit of even faster development of mobile internet is its price, which is still far higher than the EU average. According to Ruiz-Gomez (2018) differences have been detected between the more developed and less developed areas of Europe, which could indicate a digital divide. Therefore, the results indicate divergent behaviour patterns in digital travel and accommodation, as well as divergent trends in different EU geographical areas.

Development in ICT usage by the general public also relates with searching for the travel and accommodation information. There we can identify several aspect of ICT usage. One of them is a support of searching, booking and payments for services. In the customers perspective ICT provides numerous information on conditions of the visit with regard to season, natural and geographic conditions in the destination – weather within a year, current weather forecasts, holidays, snow conditions, vegetative season, eco-touristic conditions, traffic accessibility to- and within the destination, local culture info, visualization (virtual sightseeing, video-presentations etc.).

Development in ICT usage for travel and accommodation information relates directly with availability of information technologies. While in 2005 ICT was used by only 12.3% people searching for travel and accommodation information, in 2018 it was already 52.4% (ČSÚ 2019). At the beginning of the observed period ICT was used for searching for travel and accommodation information especially by the people of the three youngest age categories (16-24, 25-34 and 34-44 years), thus the people who use ICT and Internet familiarly. For example, Wu (2019) studies ICT usage in adult young. Remaining age categories fell short in ICT usage. However, there came significant increase in ICT usage also in the three older age categories in the following period.

It bears evidence of a grand change of the consumers in the travel market and accommodation services. In addition, such a trend is accentuated by the fact that as early as in 2017 there were 19.1% customers purchasing accommodation services directly on Internet; in the same year there were 9.4% customers purchasing travel passes and fly tickets through ICT. Nevertheless, a general usage of ICT for searching for travel and accommodation information has an evident impact on a demand elasticity, which is becoming more and more sensitive towards price changes and other factors affecting the consumers' decision-making.

Regarding the development in accessibility of ICT in the Czech Republic and its usage for searching for travel and accommodation information we can presume that such a trend would strengthen also in the following period, and would gradually prevail. Decisive factor for this development would probably be a development in ICT usage by particular groups of consumers groups, which is the scope of the following analysis.

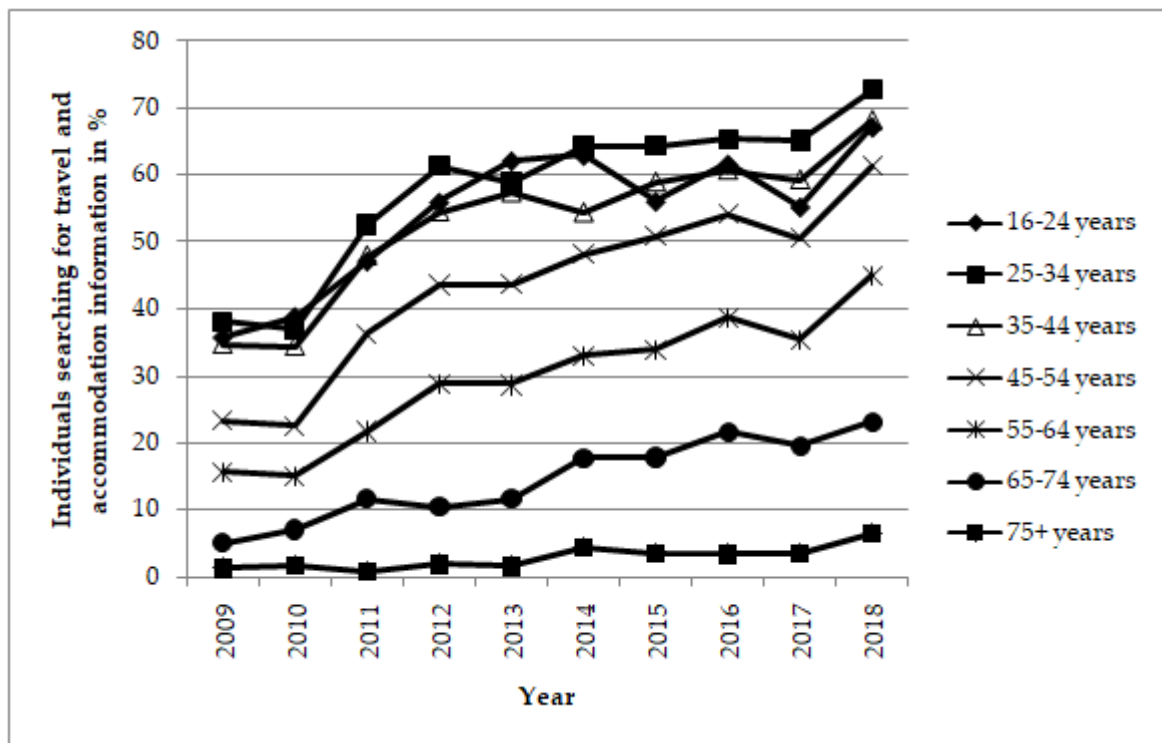
## 2. Methodology

Out of the Czech Statistical Office source data there was analyzed the time series of the number of individuals searching for travel and accommodation information (in %). The trend was examined in the time series 2009 – 2018 for seven age categories (16-24, 25-34, 35-44, 45-54, 55-64, 65-74 and 75+ years) (ČSÚ 2019). Quality of the regression model was verified with the determination index (Novák, 2015). Regression and correlation analyses have been described for instance by Hendl (2004) or Johnson & Wicher (2007). Time series analyses have been summarized for example by Arlt & Artlová (2009). Linear regression and correlation in the time series have been described by Skupinová (2012). Using the double sorting analysis of variance at the level of importance  $\alpha = 0.05$  it was searched

whether there exists at least one pair of statistically conclusively varying averages for the variable „Individuals searching for travel and accommodation information“ (in %) it the light of the two sorting criteria – „Age category“ and „Year“. In order to evaluate the analysis of variance in detail there was used the Tukey method. Techniques of the analysis of variance have been described for instance by Hebák et al. (2007). Analysis of variance has been processed with usage of the statistical program Statgraphics.

### 3. Results

The trend analysis in the time series 2009 – 2018 has been carried out for the variable “Individuals searching for travel and accommodation information” (in %). Out of the Graph 1 it results that in the current time series 2009 – 2018 we can observe a linear increasing trend for all the examined categories.



**Figure 1.** Linear increasing trend in the current time series 2009 – 2018 for the variable „Individuals searching for travel and accommodation information“ by the age groups.

Quality of the regression model has been evaluated with the coefficient of determination; in all categories the regression model shows good or very good quality. The coefficients of determination in time for particular age categories are summarized in the Table 1. The trend which is possible to be described with the regression line is an appropriate function in time for all the age categories. Interesting was the year 2017 when there occurred a slight decrease of individuals searching for travel and accommodation information in all the age categories, except the 75+ category which was equal to 2016. However, this fluctuation has no definite economical nor social background.

**Table 1.** Determination Index for Particular Age Categories in the Time Series.

Age Category	16-24 years	25-34 years	35-44 years	45-54 years	55-64 years	65-74 years	75+ years
Determination Index	0.675	0.814	0.836	0.889	0.927	0.933	0.713

Out of the double sorting analysis of variance it results that in both sorting categories (Age category and Year) there was found out statistically conclusive F-test at the level of importance  $\alpha = 0.05$  (Figure 2).

Analysis of Variance for HED.Data					
Source of variation	Sum of Squares	d.f.	Mean square	F-ratio	Sig. level
MAIN EFFECTS	32583.842	15	2172.2561	107.974	.0000
HED.Rok	4974.298	9	552.6998	27.472	.0000
HED.Vek	27609.544	6	4601.5906	228.726	.0000
RESIDUAL	1086.3906	54	20.118344		
TOTAL (CORR.)	33670.233	69			

**Figure 2.** Double Sorting Analysis of Variance According to Age Category and Year – Conclusive F-test.

Using the Tukey method detailed evaluation there were differentiated statistically conclusively varying averages at the level of importance  $\alpha = 0.05$  in both sorting categories. The detailed evaluation by the Tukey method for the sorting criterion „Year“ is shown in the Table 2; for the sorting criterion „Age“ in the Table 3.

**Table 2.** Tukey Method Detailed Evaluation of Analysis of Variance for Sorting Criterion "Year".

Time t	Average	Homogeneous Groups
1	21.94	*
2	22.33	* *
3	31.17	*
4	36.61	* *
5	37.69	* *
6	40.70	*
7	40.76	*
9	41.19	* *
8	43.66	* *
10	49.11	*

Key: 1: 2009; 2: 2010; 3: 2011; 4: 2012; 5: 2013; 6: 2014; 7: 2015; 8: 2016; 9: 2017; 10: 2018

The years 2009 and 2010 do not differentiate with one another, but they conclusively vary from the other years. The years 2018, 2017 and 2016 do not differ from one another, but they vary from 2011, 2010 and 2009. The year 2018 differs from 2015 – 2019. The years 2012 – 2017 create a homogeneous group with no statistically conclusive variations. No conclusive variations were found also between the years 2011, 2012 and 2013. Thus, out of the detailed evaluation there conclusively results a variation of averages of individuals searching for travel and accommodation information (in %) between the early years (2009 and 2008) and the most recent years (2016, 2017 and 2018).

**Table 2.** Tukey Method Detailed Evaluation of Analysis of Variance for Sorting Criterion „Age”.

Age	Average	Homogeneous Groups
7	2.85	*
6	14.53	*
5	29.55	*
4	43.41	*
3	53.06	*
1	54.24	*
2	57.97	*

Key: 1: 16 - 24 years; 2: 25 - 34 years; 3: 35 – 44 years; 4: 45 – 54 years; 5: 55 – 64 years; 6: 65 – 74 years; 7: 75+ years

At the level of importance  $\alpha = 0.05$  the age categories 75+, 65-74, 55-64 and 45-54 years are statistically conclusively varying from one another; along with it all these categories statistically conclusively differentiate from the categories 35-44, 25-34 and 16-24 years. The age categories 35-44, 25-34 and 16-24 years show no statistically conclusive variations at the level of importance  $\alpha = 0.05$ . Thus, out of the analysis of variance it results that the individuals of the age category 16-44 years, searching for travel and accommodation information (in %), create one homogeneous group varying from older people.

#### 4. Discussion

Out of the regression analysis of the variable “Individuals searching for travel and accommodation information” (in %) in the time series it results that there have been found a linear increasing trend for all the age categories in 2009 – 2018, which can be described with a regression line. As all seven trend models by the age groups show high values of the coefficient of determination, the recognized models can be considered as of a high quality. Accordingly, we can presume that an increase in the number of individuals searching for travel and accommodation information (in per cents) would grow in all the age categories in the following year as well. Besides, this fact is conditioned by constantly developing ICT market and price availability of such technologies also for the citizens of older age categories.

Increase in living standards of the Czech citizens and increase in pensions unambiguously support the theory that the recognized trend would retain also in 65-74 and 75+ categories for at least two more periods. Out of the double sorting analysis of variance it results that there are statistically conclusive variations in the age categories 45+. However, thanks to a positive economic background we can presume that especially 65-74 and 75+ categories would also create a homogeneous group, such as the 16-44 age categories. It is evident that we will find statistically conclusive variations between the age categories also in future; nevertheless, the number of homogeneous groups will increase.

The statistically conclusive variations in the sorting category “Year” will differ older age categories from the younger ones even more sharply in the future; however, it is unambiguous that the younger age categories will only display one homogeneous group in the future, which will relate not only with financial availability of ICT but also with educational rate, when current technologically educated scholars will come to the age category 16+. Also, the fact is that the current young population educated in ICT will simply grow old and there will be a majority of the retired capable to use ICT. Thus, the future time series will only show conclusive variations between the oldest and the youngest age categories.

#### 5. Conclusions

Development in ICT usage to search for travel and accommodation information have been considerably unequal by particular age categories in the observed period. The age category 25-34 displayed the largest usage of ICT almost all of the time. This group also displayed the most rapid

increase in the beginning of the observed period. The age categories 16-24 and 35-44 then display similar, slightly lower ICT usage. In the age category 16-24 the development is considerably less stable and display distinctive fluctuation. However, these three categories significantly converge by the end of the observed period.

The age category 45-54 display lower usage of ICT all along. However, at the same time it shows similar development as in the categories 16-24 and 35-44, to which it approximated by the end of the observed period. We can presume that it will approximate even nearer in the following period.

Accordingly, the category 55-64 displays an increasing trend similar to a development in the category 45-54. Also, in this category we can presume a significant increase in ICT usage; however, it will probably keep certain distance from the younger age groups in the following period.

The oldest age categories (65-74 and 75+) display just a slow increase in ICT usage, starting at almost zero values. In these categories we can expect more significant increase in ICT usage as far as in longer time horizon in context of a demographic development and a shift of people from younger age categories.

We discovered that the recognized trend would retain also in 65-74 and 75+ categories for at least two more periods. And we also could state positive economic background we can presume that especially 65-74 and 75+ categories would also create a homogeneous group, such as the 16-44 age categories.

Generally, we can agree that the ICT usage to search for travel and accommodation information is currently considerably inhomogeneous in relation to the age structure of inhabitants. However, we can presume the future gradual approximation of the younger age categories, together with a gradual increase in ICT usage by the oldest categories. It would apparently lead to partial decrease of inhomogeneity.

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# Cheap or Expensive Mortgages? A Case from the Czech Republic

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**Abstract:** Czech mortgage market currently experiences extraordinary period. Since the mortgage market was restored after the Velvet Revolution, interest rates have never been at such low levels as these times. From this point of view, mortgages have never been cheaper. On the contrary, property prices are significantly increasing and are at record high levels. Therefore, the aim of this article was to assess which of these two factors prevails. In other words, are mortgages cheaper or more expensive these times? In order to reach the main goal, we set a set of assumptions related to mortgage installments. The period examined was years 2009-2019. The data were collected from the Czech National Bank, Czech Statistical Office and Hypoindex.cz. Our results show that even if the property prices are approximately 1.5times higher in 2019 in comparison to 2009, the proportion of interest on the first installment is lower. From this perspective mortgages remain cheap even now; especially thanks to very low interests rates. However, thanks to the high principal, debtors are exposed to higher interest rate or refinance risks now. From the debtor's point of view, the most favorable periods were 2015 and 2016.

**Keywords:** interest rates; installment; mortgage; property prices; loan to value; debt to income ratio

**JEL Classification:** G21; G51; R21

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## 1. Introduction

People very often finance their housing needs by a mortgage. As with other products, the demand for mortgages is naturally influenced by the price of this financial instrument. And, as with other credit products, the price of a mortgage is also determined by interest rate, amount of principal and maturity period. This article describes more in detail issues of interest rates and property prices on the example of the Czech Republic. The maturity period will be considered as given.

Due to the divergent development of interest rates and property prices (interest rates are very low and property prices are very high (see chapter 2); and at the same time, these two variables have a contradictory effect on the price of the mortgage) the main aim of this article is to answer the research question **“Are mortgages cheap or expensive nowadays?”** And because the Great Recession might be considered as a major driver, the analysis is concentrated in 2009-2019.

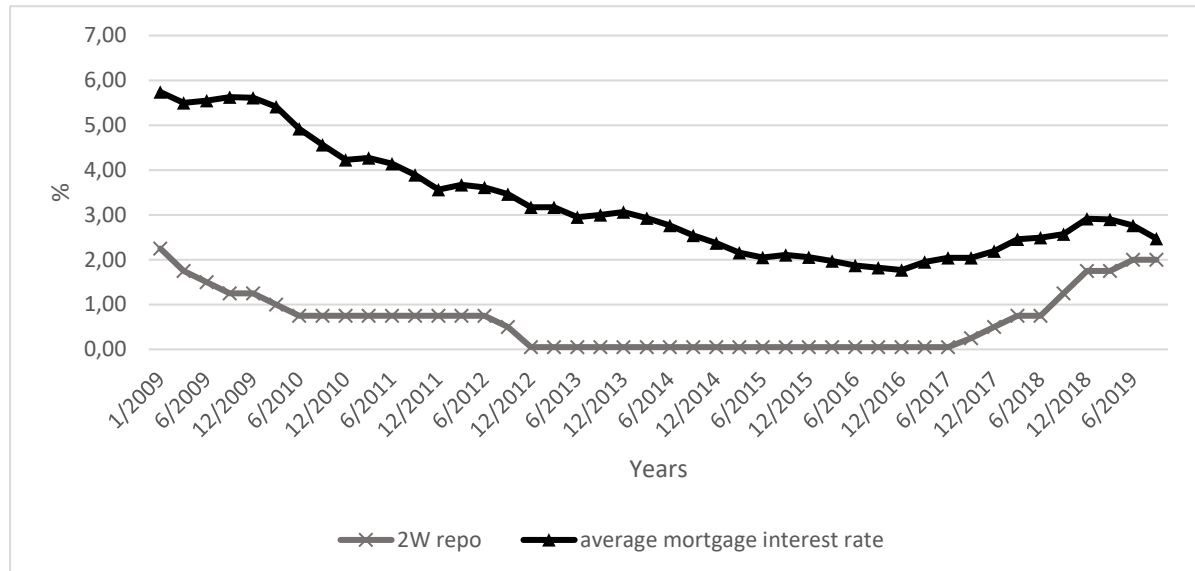
In order to answer the research question, the paper is organized as follows. First, current state in the analyzed area supplemented with a brief literature review on interest rates and property prices in relation to mortgages is made in chapter 2. Chapter 3 describes the research methodology. Research results are presented in chapter 4. A discussion is made in chapter 5. The article concludes with a short conclusion.

## 2. A Current State in the Analyzed Area and Literature Review – Interest Rates and Property Prices in Relation to Mortgages

Interest rates in developed countries nowadays remain at very low levels. This state might be considered as a consequence of the Great Recession and the subsequent Debt Crisis in the European Monetary Union. Researchers and analysts all around the world are trying to reveal and estimate, if this

is a new normal, or if it is a temporary phenomenon. Anyway, this feature has different impacts and manifestations on different parts and actors of the financial market.

From the perspective of the Czech mortgage market, on which is this article focused on, interest rates remain rather low despite the fact that the Czech National Bank (CNB) already increased its basic interest rate (2W repo) several times from the minimum of 0.05% (effective from 11/2012 to 8/2017) to nowadays level of 2.00% (effective since 6/2019); see Figure 1. (CNB 2019)



**Figure 1.** The development of the Czech main interest rate (2W repo) and average mortgage interest rates in the years 2009-2019. Source: own based on the data from the Czech national bank and Hypoindex.cz

According to the “old normal”, the rise of basic rate should lead to a noticeable increase in commercial interest rates, including mortgages. And this increase should reduce the demand for mortgages (see e.g. DeFusco and Paciorek 2017). However, as can be seen in Figure 1 that presents data for the last month of the quarter in years 2009-2019, at the end of 4Q 2012 average mortgage rate was 3.17%; nowadays (i.e. 09/2019) it is 2.47% (Hypoindex.cz 2019). So the fundamental reaction of commercial banks to central bank actions has not yet come.

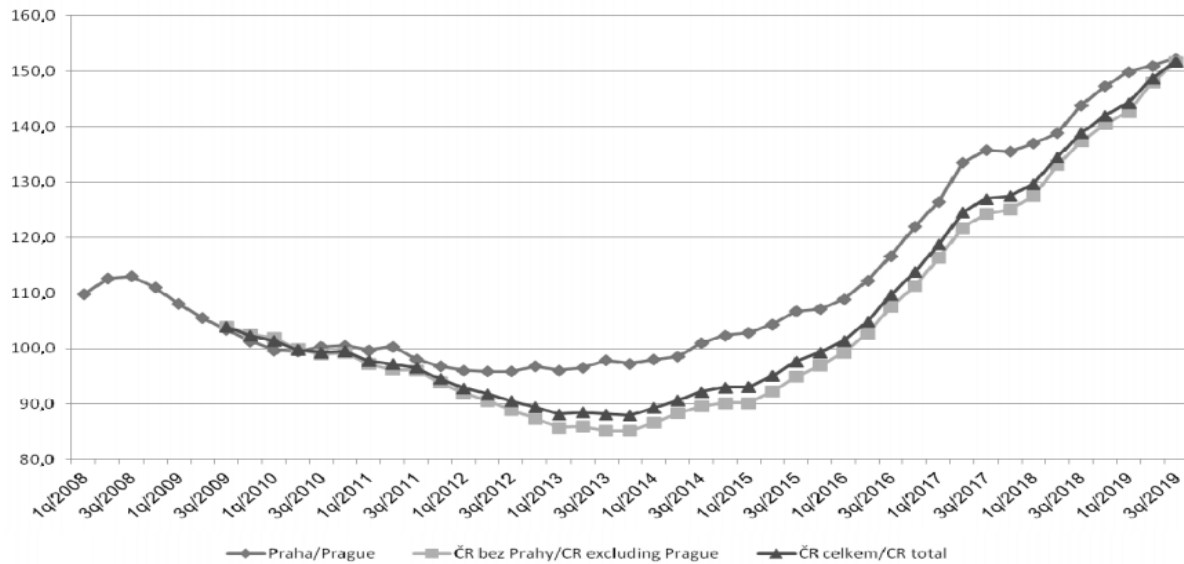
This mismatch in the power of transferring the base interest rate to commercial, respectively to mortgage rates (see Figure 1 and compare the spread during the time) is in accordance with Gregor's study (Gregor 2018a); the study points out that interest rate pass-through efficiency for mortgages decreased after the global financial crisis. In addition, the same author in his another study (Gregor, 2018b) presents the conclusion that unlike Germany, in the Czech Republic there is at least “a significant long run relationship between the monetary policy rate and commercial bank lending rates”. In the recent and current Czech banking environment, a shift in transparency and competition than reported by Hedvičáková and Soukal (2012) may be one of the reasons for the phenomenon described above.

Therefore, in terms of interest rates, mortgages remain cheap despite the CNB's monetary tightening. Thus it does not seem that the trend on mortgages reported by Hedvičáková and Svobodová (2016) should be significantly disrupted even now. However, let's take a look at property prices.

Regarding the property prices, unlike interest rates, after years without significant changes (2009-2013), property prices are increasing sharply. Real estate prices were slightly above 130% in 4Q 2018 in comparison to the year 2010 (CZSO, 2019b) and these prices increased even in 2019. The situation of older flats, which fits with our research aim (see the end of Introduction and Methodology) is captured in Figure 2. In this segment of the market the growth is even slightly higher.

Zhu, Betzinger and Sebastian (2017) on the evidence from the euro area, where the house prices are significantly rising as well, suggest that “a one-time monetary-easing shock can significantly trigger house price booms in countries with liberal mortgage markets”. On the other hand, the same authors (Zhu, Betzinger and Sebastian 2017) claim that “more regulated mortgage market may reduce the

significance of monetary policy stance". Czech monetary authority (CNB) perceives potential future problems of such price-rising phenomenon in a longer term (see e.g. CNB 2019, March 27) and already set a set of recommendations and regulations in order to avoid future systemic problems (e.g. following ratios had been recommended by the CNB: loan to value (LTV) max. 90, resp. 80%, debt to income (DTI) max. 8, debt service to income (DSTI) max. 45%; see CNB (2019, December 3)). The justification why to set LTV in relation to mortgage defaults contains e.g. the work of Hatchondo, Martinez and Sanchez (2015) or Wu and Dofrman (2018).



**Figure 2.** Index of realized prices of second-hand flats (average of 2010 = 100). Source: Czech statistical office (2019b)

This chapter demonstrated that there is a divergent development regarding interest rates and property prices. At the same time, as mentioned in the Introduction, these two variables have a contradictory effect on the price of the mortgage. Therefore, the rest of this article seeks to answer the **main research question is: “Are mortgages cheap or expensive nowadays?”**

### 3. Methodology

First, considered period are the years 2009-2019, respectively 01/2009-09/2019 due to quarterly data availability. The year 2009 was designated as an initial observation because it is also the year when the consequences of the Great Recession were fully reflected in the international environment, including the Czech Republic.

Further, in order to reach the above mentioned goal we had to define the property that was being bought (especially location and price). For this purpose, we got involved average price per square meter reported by the Czech Statistical Office (CZSO) and average interest rates on mortgage reported by Hypoindex.cz.

The data from which the input variable (property price) was derived are presented in Table 1 below.

**Table 1.** General parameters of the considered property in 2009

Region	Type of municipality	Type of a property	Size	Average price per m <sup>2</sup>
Hradec Králové	≥ 50,000 inhabitants	Flat	60 m <sup>2</sup>	CZK 27,204

<sup>1</sup> Compiled based on the data from the Czech Statistical Office (2019a)

It is clear from Table 1 that the property under consideration is a flat and its purchase price of the year 2009 is (after a small rounding) **CZK 1,635,000** (= 60 \* 27,204). During the year 2009 housing prices

rather stagnated (see house price index reported by CZSO (2019c)), so it is possible to work with the average price for 2019.

In order to assess mortgage prices during the analyzed period, there was set a set of assumptions:

- Considered property is still the same as defined in Table 1.
- Quarterly data are used.
- Price development is derived from the statistics of CZSO (2019c) – see house price index (2010 = 100).
- Interest rates are taken from Hypoindex.cz (3<sup>rd</sup>, 6<sup>th</sup>, 9<sup>th</sup> and 12<sup>th</sup> month of a year; www.hypoindex.cz).
- LTV = 100% (i.e. property price = the amount of the mortgage loan).
- Annuity repayment method.
- First installment and the absolute amount of interest within this first installment is considered.
- It is considered a 30-year maturity (360 installments).
- It is abstracted from the time value of money and further from, for example, wage growth.

Computations and result are presented in the following chapter.

#### 4. Results

From the computations conducted two groups of results occurred. First, a structure of individual installments are compared during the analyzed period. We focused on the initial and terminal periods as well as the periods with the minimum/maximum interest rate, purchase price and the total amount of installment. Second, a comparison within the whole period regarding the interest rates and interests as well as a comparison of annuity installments, interests and repayments of principal are presented with the help of graphical analysis.

##### 4.1. Initial and final periods, maximum and minimum interest rate, purchase price or installment

Based on the assumptions stated in the Methodology, property prices, mortgage installments and interests were computed. After the computations, we derived minimum and maximum in terms of interest rates, purchase prices, installments and interest (see Table 2).

**Table 2.** Initial, terminal and observations with the minimum/maximum interest rate, purchase price or installment

Special Feature	Month/Year	Property price (CZK)	Interest rate (% p.a.)	Installment (CZK)	Interest (CZK)
Initial obs., max IR	01/2009	1,635,000	<u>5.74</u>	9,531.03	<u>7,820.75</u>
Terminal obs., max PP	09/2019	<u>2,460,675</u>	2.47	9,684.30	5,064.89
Min IR	12/2016	1,937,475	<u>1.77</u>	6,940.51	<u>2,857.78</u>
Min PP	03/2013	<u>1,607,205</u>	3.17	6,924.28	4,245.70
Min INST	06/2015	1,706,940	2.05	<u>6,351.95</u>	2,916.02
Max INST	06/2019	2,413,260	2.76	<u>9,864.71</u>	5,550.50

Note: obs. = observation; PP = property price; IR = interest rate; INST = installment; I = interest.

Maximum and minimum values in columns are in italics and underlined.

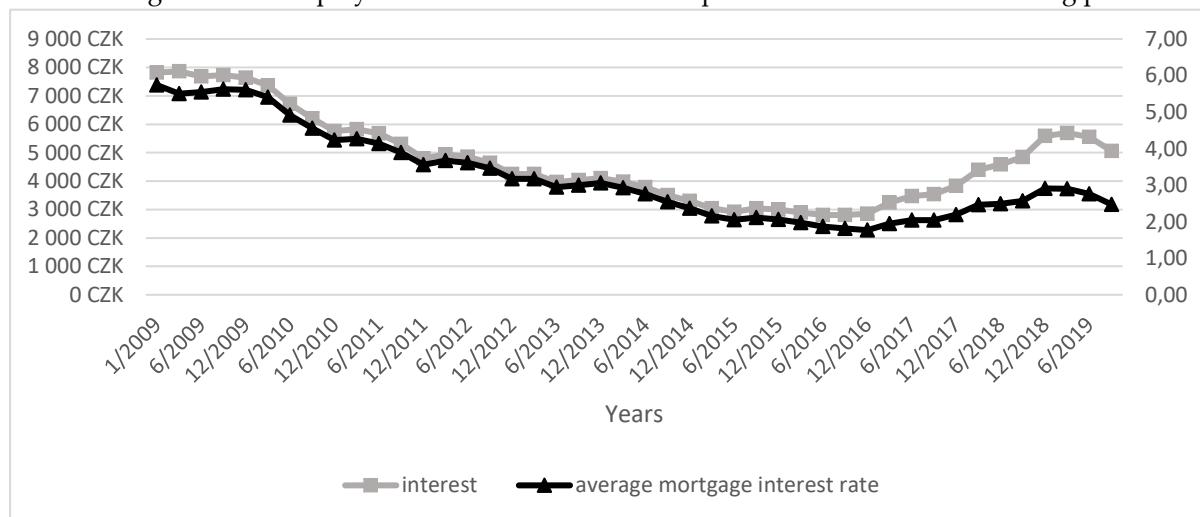
Table 2 shows that the mortgage market reached its minimum regarding the interest rate in 12/2016. This also corresponds to the lowest paid interest. From this point of view, in this period the mortgage was the cheapest although the price of the property was approx. 300 thousands of crowns higher than at the beginning of the monitored period (i.e. +18.5%). The explanation is the decline in interest rates in relation to the initial period (-3.97 p.p., i.e. -69.2%). From the point of view of the mortgage user's cash flow, however, this period is no longer the best (see 06/2015).

Today, or rather the recent state of the mortgage market (see 06/2019 a 09/2019 in Table 2) indicates that the demand on mortgage users is increasing. Total cash flow burden reached new maximum (06/2019). Compared to the 2016 minimum, the interest rate increased by around 40% as of 09/2019, and the interest paid increased by 77%.

From the above stated concludes that current mortgage prices – interests – are rather high in comparison to the past. However, as the 2W repo rate did not manage to transcribe more into commercial rates (cf. 2W repo<sub>2009</sub> = 2.25% vs. 2W repo<sub>2019</sub> = 2.00 while mortgage rate<sub>2009</sub> = 5.74 vs. mortgage rate<sub>2019</sub> = 2.47) it is rather possible to expect a further increase in mortgage interest rates. And since the amount of the total annuity installment has reached or exceeded the maximum at the beginning of the period under review, the risks of future refinancing are increasing. See next subchapter with the course of the variables in the graphs.

### 3.2. Graphical analysis of variables dDevelopment

Several interesting graphs were created when working with data. The two most interesting ones are presented below. See Figure 3 that displays the progress of interests and average mortgage interest rates and Figure 4 that displays installments and their compositions within the monitoring period.



**Figure 3.** The amount of interest on the first installment (left y-axis; in CZK) and the average mortgage interest rate (right y-axis; in %) in the years 2009-2019.

In Figure 3, there is captured one interesting point. Approximately since the end of 2016, the curves have been diverging. Until that time, it is possible to observe quite a tight bond. What is more, leading Czech socio-economist in this field Martin Lux states that according to the computations of his team, property prices have been rising too much since about the middle of the year 2017 (Kain 2020, p. 16). It is therefore likely that the divergence of the curves in Figure 3 can be explained by an overestimated property market.

Figure 4 below provides an overview of the entire reporting period in terms of annuity installment, repayment of the principal and interest. The figure shows the growing trend of the principal repayment curve which is naturally caused by increasing property prices. Moreover, there can be seen what was stated in relation to Table 2; despite consistently low or only slightly higher rates, the demands on mortgage users are increasing since the end of 2016. The amount of annuity installment, that burdens the personal cash flow, already exceeded the then maximum from 2009. On the other hand, while the share of interest on the installment is rising, it remains rather favorable compared to previous development. For current mortgages, therefore, the challenge is not the amount of interest as the amount of the total installment.

According to the maxima and minima of Table 2 (see above), it was stated that the best period for mortgage users was 2015 and 2016. Referring to Figure 4, it is apparent that this period is characterized in that the principal repayments exceed the interest paid.

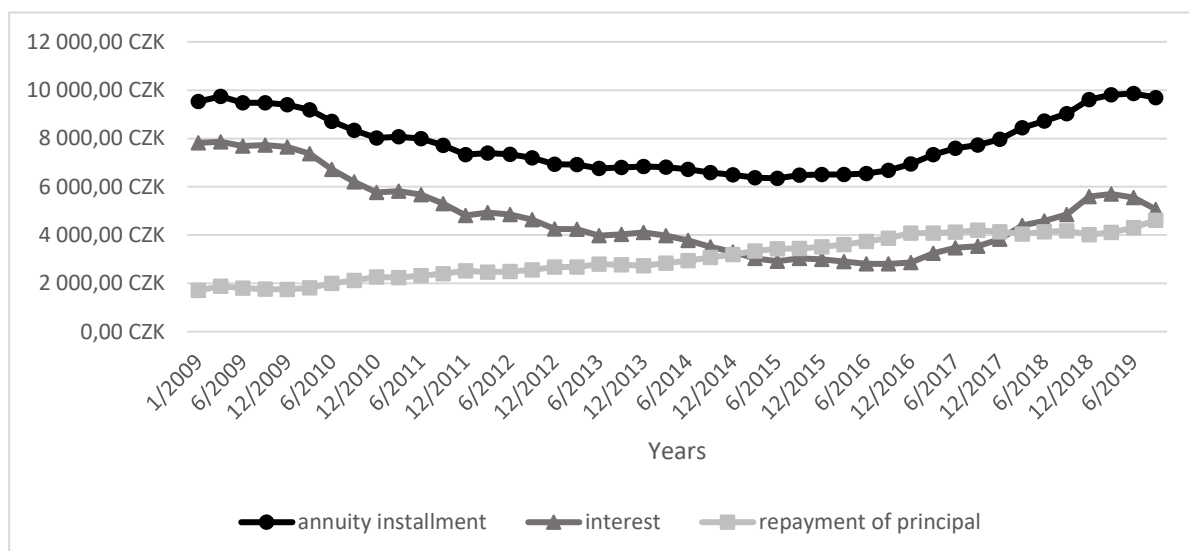


Figure 4. Mortgage annuity installments, repayments of principal and interests in the years 2009-2019.

## 5. Discussion

A mortgage is a financial tool that is used by individuals as well as corporations and municipalities. Each of these three entities uses the mortgage for a different purpose and in different volumes (see e.g. Svobodová and Hedvičáková 2017). This article was focused on the price (actually on the interests) of mortgages for individuals who finance their housing needs in the years 2009-2019 in the Czech environment. In a broader context, one may assess the situation on the mortgage market as a sign of house price affordability (see e.g. Squires and Webber 2019). From their study results that based on their data from New Zealand there is no significant correlation between house price affordability and mortgage rates. In our contribution, there can be seen that, in terms of annuity installments, house price affordability decreases. In fact, it returned to the 2009 level (see Fig. 4). While in 2009 interest rates decreased house price affordability, nowadays it is a property price.

Anyway, since 2017 there is a growing trend in both components of the installment – repayments of principal and interests – which makes mortgages more expensive. On the contrary, until approximately mid-2016, the effect of falling interest outweighed the rise in property prices.

Therefore, in relation to the main research question, it can be concluded that today's mortgages are more expensive in comparison to the recent past. In line with the conclusion of DeFusco and Paciorek (2017) who quantified how rising interest rates hinder demand for mortgages on the case of U.S. market, there can be expected further decline in mortgage demand in the Czech Republic (Unfortunately, we do not have accurate data on the strength of dependence in the Czech Republic. We conclude this also for the Czech Republic mainly thanks to the general knowledge of the relationship between the interest rate and the demand for loans). Moreover, this decline would be underpinned by prudential policy of the Czech National Bank through the setting of LTV, DTI, and DSTI limits. According to the analyzed indicators, it is obvious that the growing trend in mortgages reported by Hedvičáková and Svobodová (2016) will tend to reverse.

Obviously, our contribution has some limiting factors. These are mainly determined by the assumptions set out in the methodology (see chapter 3). For example, we work with average interest rate values, which are influenced by a number of real variables (i.e. length of interest rate fixation, the actual value of loan to value ratio, etc.).

## 6. Conclusions

From the perspective of the interest rates, mortgages remain quite cheap despite the Czech National Bank's rate hikes. In fact, final price of a mortgage is also influenced by the deductibility of interest paid from the tax base (on the possible impacts of the tax effect on mortgage demand see e.g. Slintáková and Klazar (2018)). However, a spread between interest rates and a share of interest on

mortgage installment increased (see Figure 3), which means a different than for this period otherwise standard development. This article signalizes that strongly rising property prices might be the main factor causing the spread difference. The correctness of this claim and potential issues resulting from this situation will be the future direction of our research interest.

Finally, thanks to the high principal, debtors are exposed to higher interest rate or refinance risks now. From the debtor's point of view, the most favorable periods were 2015 and 2016.

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# Gamification in the Focus of Innovative Education Methods

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**Abstract:** In the era of technological advancement, the modern approach in education have created the industry of e-learning. In connection to e-learning, a new phenomenon, gamification is also discussed. The current era requires creative individuals with quick decision-making skill and an ability to identify the correlations between information and different processes. Therefore, an increased focus is experienced by the education system that has to undergo significant changes in order to successfully develop these skills. Gamification or gaming is an increasingly used method in business and education as well. The essence of gamification is the use of game elements that might lack immediacy or relevance for users and incentivize them to achieve certain goals. The article deals with the role of gamification in education. Gamification is about using some of the elements of computer games to drive engagement and monitor progress in a less formal way. This new approach to learning is becoming more and more popular on international and domestic field as a tool to enhance the motivation of students in the education process.

**Keywords:** innovative method, gamification, generation Z, education

**JEL Classification:** I23

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## 1. Introduction

The increasing competition and changing requirements in education resulted in introduction of new teaching methods. The Internet generation of students cannot really break away from the world of games. It does not matter whether they are working, studying or having fun. They expect to see the transformation and establishment of game-based institutions, especially in the field of educational institutions. It is important to keep in mind that the generation socializing in digital culture is familiar with the toolkit of gamification that might determine their behavioural norms.

Gamification became popular around 2010, although the term itself has been in use since 2002. Gamification, serious game, edutainment (education and entertainment) are the concepts close in meaning; their English equivalent is also used by the Hungarian terminology, similarly to their Hungarian equivalents (Rab 2013). Gamification refers to applying game-like elements and games in a non-game environment to make the processes interesting, effective as well as achieve success. Gamification can be applied in various fields, including the education – the result can be a positive improvement (Frommann and Damsa 2016).

The introduction of game-like elements in business is not a novelty. It has been used in different areas of business e.g. many airline companies offer discount points to their passengers based on the miles flown with the company – passengers can achieve different grades by using the airline services and get discounts based on the grade they have achieved. Car manufacturers have also discovered the essence of gamification (Duřová et al. 2017). Business gamification is characterized by strong dominance in marketing, where the primary aim is to reach the customer and motivate them to buy products and use services, attracting new customers or increasing the activity of the existing clientele. The marketing focus eliminates the borders between the gamification project and the loyalty programme. The rapid development of information technology has widened the gap between the generations. This resulted in increased challenge for educational institutions and teachers as well. According of (Blřtáková and

Piwowar-Sulej 2019) it is worth emphasizing that gamification – just like any other solution in the area of HRM – has to be implemented with due caution. The game scenario has to be well thought-out, the technology must be adequately refined and the employees themselves cannot feel overloaded with excessive incentives.

The basic goal of the research is to map the relevance of the need to introduce alternative methods in education. Since the researched problem in Slovakia in the context of education, taking into account their benefits and possibilities, is not well analysed, we consider it crucial to address the issue in more detail.

## **2. The Importance of Games in the Education and the Life of the Individual**

Game-based teaching has long been a part of education process; games serving educational purpose were introduced early. Gamification is using game-like elements and techniques, but the purpose is not the game itself, it is aimed at increasing interest and effectiveness of the student (Rigóczyki 2016; Zichermann and Cunningham 2011). Gamification tools in education are used to raise awareness and interest. According to (Kenéz 2016), gamification is a tool to be applied in case of different subjects and courses with any number of students and technological condition applied. Gamification is a system-like application of the game that requires planning, even if we play only for an hour. According to (Werbach and Hunter 2012), the most important is to set the goals. The goals and the tools are functioning well if the players are provided experience and they feel motivated by the play.

The goals can focus on the lesson (higher participation ratio of the students, attention, students are engaged), homework and the continuity of the learning, which seems to be the most problematic aspect. It is a good idea to choose the goal and convert it to a measurable indicator (Kenéz 2016).

Gamification of the lesson and the pedagogical process does not mean that the activity is about enjoying the game. The student is involved in the education process by applying game-like elements and game mechanisms. Gamification tools include game mechanisms and game elements.

- The game is supported by the following game elements:
- Story (events and goals)
- Display
- Elements (phases, tasks and the related rewards e.g. scoring)
- Immediate and permanent feedback
- Missions to be completed (rewards also for partial achievements)
- Points, badges, rankings (performance indicators)
- Levels (progress, boundaries). (Rigóczyki 2016)

The tools can function effectively if the mechanisms of the game are determined: the game is properly planned, it is voluntary, promising, easy to understand, transparent, motivating and the time limits are properly set. One of the most important element in gamification process of the education is a breakdown into elements. The game should be designed to provide a possibility to join it later and achieve the level of those already playing. Scoring can be restarted by topic and rewards earned by chapters. These all can be motivating factors. Gamification is increasing equal opportunities also for students with special needs, as we provide choice of processing methods. The fundamental question regarding the rewards and the feedback is how they are connected to extra-curricular rewards, how material and immaterial reward is important e.g. the result, the success and the verbal praise (Kenéz 2016).

## **3. The Impact of Gamification, Benefits and Doubts**

Gamification has been used and tested in the education only for a few years, so only few studies have addressed the issue. Those who applied gamification made a conclusion regarding the extrinsic and intrinsic motivation of learning. The increase of motivation supported by gamification has increased the success and effectiveness of individual and group learning (Rab 2015). According to (Fromann 2012), the advantages of gamification can be summarized in three performance-enhancing factors: increasing

individual and group motivation, strengthening community cohesion and the result-oriented attitude based on playful processes.

Similarly to other methodological novelties, one of the difficulties faced when applying gamification is the resistance of experienced educators. It is supposed that teachers with lack of knowledge in the field of computer games find it difficult to understand the structure and mechanism of these games. Negative experience has also emerged regarding these games. The teacher may assess the extra work the introduction of the new method might bring, especially at the beginning of using the application. The resistance of teachers is not the only complicating factor when introducing gamification. According to (Szabó 2015) and the research based on effective use of technology in education, the students also find difficult to accept the introduction and the use of technology not only as an entertainment tool, but also as a part of the education process. Another argument among the opponents is the fact that the desire to learn is replaced by the desire to play. The consequence of this might be that the generation socializing on the Internet will be difficult to engage in any other way. (Huang and Soman 2013), in order to avoid misunderstandings and negative effect emphasize that not the result that needs to be gamified, but the process that leads to the result. The best results in gamification can be detected when the importance of obtained knowledge cannot be immediately perceived by the student, but continuous motivation and learning activity is required. Gamification can promote continuity throughout the learning process. There will be neither intensive nor learning avoiding periods; learning will become a continuous process (Barabasi 2018).

Gamification is an integration of game elements, experience and cultural roles in order to motivate the student behaviour. In cognitive terms, games can provide a complex system of rules that players have to discover through a process of experiment. Games help managing different tasks and keep students motivated while combating difficult tasks. An important technique during the game development process is to define specific challenges that perfectly fit the level of skills the players have and their level of difficulty increases as the skills of the player improve. Students are motivated by specific, moderately difficult and immediate goals (Fromann and Damsa 2016). The games played can exactly set these types of goals. If these techniques are applied in the education process, the attitude of students to learning will change. It provides students clear and accomplishable tasks and promising immediate rewards instead of unclear long-term benefits.

Emotional games evolve a wide spectrum of strong emotions from curiosity through frustration and up to joy (Lazzaro 2004) (Duřová et al. 2017). They allow to experience some positive emotions e.g. optimism or pride. These positive emotions can be sustained and students will benefit from during the periods experiencing negative emotions.

Gamification involves the promise of enhancing persistence in case of failure that is an essential part of the learning process. Gamification shortens the feedback cycle, offers students a low-risk opportunity to assess their own abilities and creates an environment in which effort and not only the perfect mastering of task is rewarded. It allows students to perceive failure as an opportunity instead of feeling helpless or being afraid of failure.

In social context, these games enable players to take on new identities and try new tasks in order to make decisions and act applying different perspectives (Lazzaro 2004). The players also take on roles that are less imaginary; they are discovering themselves from new perspectives in a secure game environment. The game can provide social recognition for school achievements that would otherwise remain invisible or even lead to feeling ridiculous among other students. Recognition may come from the teacher, but gamification allows students to give rewards to each other in form of feedback provided by the game.

A well-designed gamification system can help students to take on meaningful roles that initiate their learning. If creation of new identity is playful and rewarded, we can help students think differently about their potentials in school.

#### **4. Methodology and Research Methods**

In order to achieve the research objectives we applied primary data collection to obtain information about the researched issue. An anonymous questionnaire survey was conducted among the respondents in the winter semester of the academic year 2018/2019.

The questionnaire contained 25 questions, the vast majority of which were closed questions, but we used also open questions and Likert scale questions to assess the information in a detailed manner. The questions fall into the following groups:

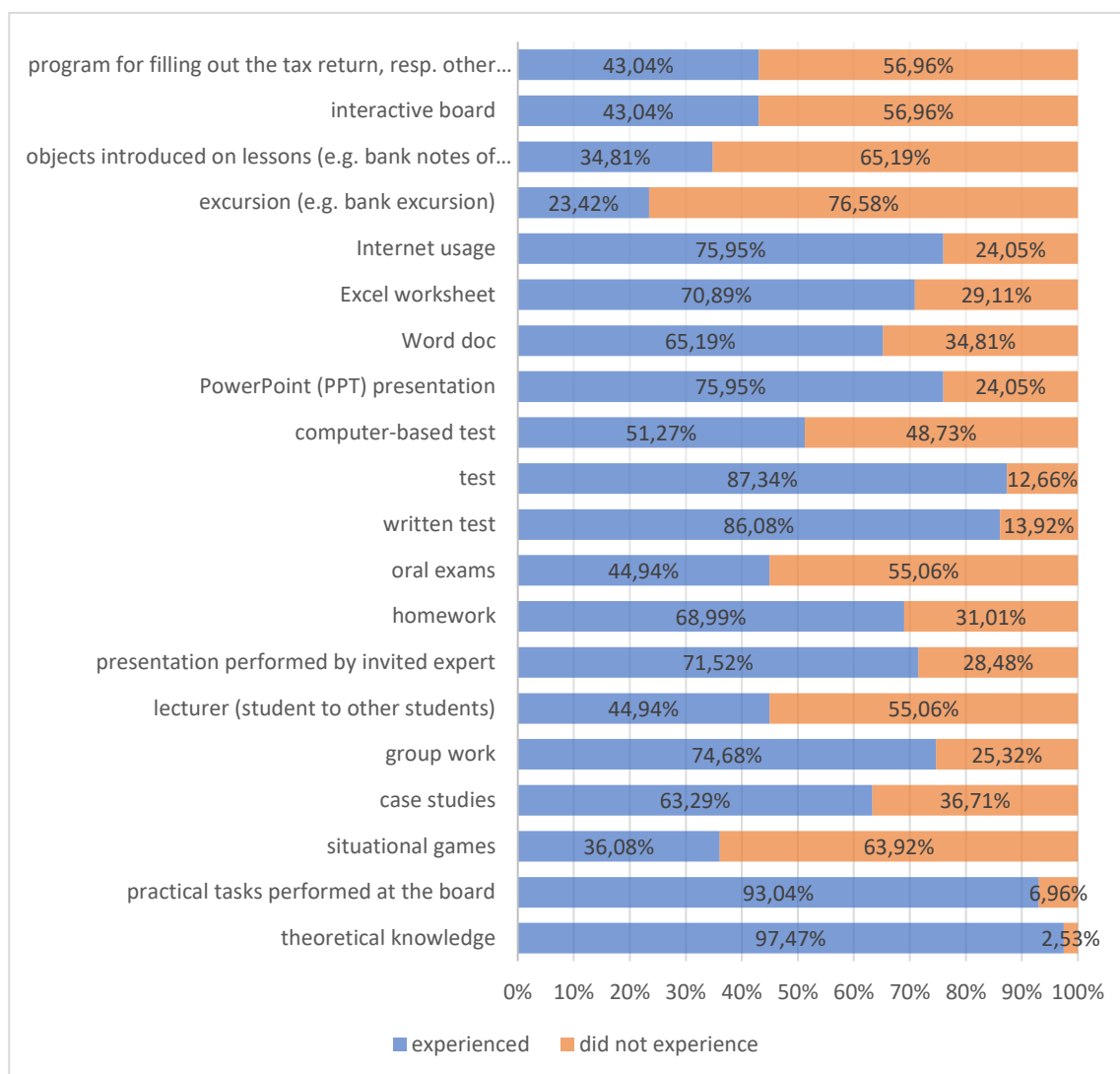
1. questions to explore financial education tools;
2. questions related to the learning of financial skills;
3. question exploring educational methods;
4. questions focusing on the basic demographic characteristics of the sample.

In order to analyze the collected data we applied statistical methods, crosstab and distribution also as st. deviation and mode.

In winter semester of the academic year 2018/2019, a research was conducted addressing the full-time students of the Faculty of Economics at J. Selye University. The research partially aimed at examining the relevance of the need to introduce alternative methods in education. 570 full-time students were addressed to participate in the primary research conducted in form of a questionnaire survey. The students represented different study programmes provided by the faculty and different levels of university education (bachelor, master, post-graduate).

#### **5. Empirical Analysis**

We managed to collect 204 completed questionnaires, which represents a return of 35,79%. Based on partial results of our primary research, it can be assumed that the most commonly used method in teaching process is sharing theoretical knowledge and performing practical tasks at the board. The respondents summarized that they often meet written tests, written exams or use the Internet to deepen their knowledge in the studied field.



**Figure 1.** The methods students experienced or did not experience in the education process

In addition to expressing the student's opinion whether they have encountered the alternative methods listed or not, we were also interested in their opinion about the efficiency of these methods in order to identify the requirements of the students and adapt the teaching methods and techniques to their requirements.

**Table 1.** The results of the survey on the effectiveness of alternative methods applied in the education process (1= not effective at all, 5= absolutely effective).

Style	Average	Mode	St.deviation
excursion (e.g. bank excursion)	4,12	5	1,09
practical tasks performed at the board	4,02	4	0,95
presentation performed by invited expert	3,96	5	1,04
Internet usage	3,86	4	0,97
objects introduced on lessons (e.g. banknotes of other countries)	3,65	5	1,23
theoretical knowledge	3,64	3	0,97
test	3,58	4	0,98

PowerPoint (PPT) presentation	3,5	4	1,05
group work	3,5	4	1,07
written test	3,5	4	1,06
case studies	3,49	4	1,08
interactive board	3,46	3	1,2
Word doc	3,38	3	1,06
Excel Worksheet	3,23	3	1,15
computer-based tests	3,2	3	1,15
homework	3,1	3	1,12
situational games	3,08	3	1,26
oral exams	2,85	3	1,11
lecturer (student to other students)	2,67	3	1,16

Mode is a way of expressing important information about the population. This statistical term is a set of data values in the value that appears most often. In normal distribution the numerical value of the mode is the same as that of the mean and media, but it may be very different in highly skewed distribution. (Pacáková et. al. 2009)

The results of the questionnaire survey (Tab. 1) clearly point to the fact that students consider the practical approach to teaching combined with the use of the Internet the most effective technique. This fact clearly supports the implementation of simulation software in the teaching process required by the students. Based on standard deviation data from the interval  $\langle 0.95; 1.05 \rangle$ , (we determined an interval  $\langle 0.95; 1.05 \rangle$  with respect to the characteristic values of the standard deviation), it is possible to state that respondents' opinions are consistent in assessing the effectiveness of the test, theoretical knowledge, the Internet usage, practical tasks performed at the board but also in the presentation performed by invited expert and PowerPoint presentations. Among these alternatives, the most practical, on average, are the practical tasks performed at the board, the presentation performed by invited expert and the Internet usage in the classroom. On the basis of the mode according to the respondents, the most effective method used in teaching is the presentation performed by invited expert, the use of the Internet and practical tasks performed at the board. The findings clearly show that students are encouraged to introduce alternative methods in teaching with intensive involvement of experts from practice and using the Internet. The other reason might be the competitive labour market environment in case of university graduates. Introduction of the simulation software is a key tool to prepare university graduates for the 21st century.

## 6. Conclusion

Gamified systems usually provide students more control over their results that is good for the individual and the institutions as well. Based on the results of our research the most preferred method was e-learning and the use of the Internet, which could be seen as a good ground for the future of gaming and that further research into the current situation of gaming implementation is needed. Today, the X, Y and Z generations are simultaneously present in the labor market, making it increasingly difficult for companies to find the right employee at the right place. Another problem is that if a company retrain from the Y and Z generations, it will invest time and money to properly carry out their job - but this generation will change jobs without thinking if they feel something is not being discussed. the responsibility is too great or too small. In such a situation, companies are trying to develop customized workplace loyalty for younger generations, one of the possible tools of which is gaming. With the application of various serious games in recent years, there have been many examples in the HR recruitment and selection field, clearly targeting the younger generation of employees. Gameplay is a method that affects the organization as a whole, supporting the achievement of organizational goals by

promoting employee satisfaction and motivation while using playful elements. (Kovács and Várallyai 2018)

Not only does gaming play a role in education and marketing, but it is increasingly used in some areas of human resources and organizational development. From creative recruitment through team building trainings to increasing workforce retention and loyalty. It also stimulates motivation, collaboration, and at the same time increases corporate performance.

The goal of the learning process is to acquire certain competencies and the teacher's duty is to support the student in achieving better results. The individual level of learning motivation determines how student can gain feedback and motivation. If we want to increase learning efficiency, we need to find a method and tool that has a positive value for the student (Szarka et. al. 2018). Employees face new challenges on the labour market nowadays. In order to find and retain a high-quality human potential, a company has to adjust to the needs and expectations of the potential and existing employees. The current labour market is dominated by two generations of the employees, Generation X and Generation Y (Blštáková and Piwovar-Sulej 2019). Gamification is not only a method, but a mindset with a focus on the student experience (Kenéz 2016). In our rapidly changing world, the teachers cannot survive using traditional methods if they want to succeed in the classroom. New directions are needed and new methodological tools. Since the representatives of generation today were born influenced by online environment, the education should remain open to using smart devices. Beside the methodology, introduction of gamification brought new perspectives in education. In our modern era, the whole society should be prepared for the Internet generation. This process has already started by the introduction of gamification in workplaces, business and education. The sustained interest in gaming techniques in theory and practice is determined by wide opportunities in the processes of research and solution of specific social and economic problems of the organisation. It results in increase of the student competitiveness, training and development.

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# Implementation of Active Labor Market Policy Instruments in the Context of University Graduates in Slovakia

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**Abstract:** Unemployment is often used to measure the health of the economy. Every single country has to struggle with the problem of unemployment, so various measures are being taken to minimize the unemployment rate. Unemployment affects not only the economy of the country, but also the social and physical well-being of the individual. We chose to discuss this issue, because we had been unemployed after completing our bachelor's degree and wanted to be familiar with the opportunities we have to successfully enter the labor market. The main reason why university graduates find it difficult to enter the labor market is lack of experience and skills required on the labor market. The operational programmes and the employment and social inclusion programmes support the field of human resources development. They are increasing employment, social inclusion and capacity building. The support is provided by the European Social Fund and the state budget. The operational programmes were created to help the young unemployed entering the labor market. The main objective is to promote employability, strengthen the integration of socially excluded people and promote the reconciliation of work and family life. These programmes are designed for those completing their secondary education and those with university degree, depending on how long they have been registered unemployed at the Labor Office.

**Keywords:** labor market; unemployment; active labor market policy; youth unemployment

**JEL Classification:** J08; J21; J64

## 1. Introduction

Several questions addressing labor market issues are present nowadays. The increasing competition created the demand for labor market flexibility. In order to analyze the labor market, accurate information is needed (Kanbur and Svejnar 2009)

- Employees become unemployed on voluntary basis (temporary or permanent leave)
- Recruitment of unemployed to new workplaces or recalling them to positions/workplaces they have been temporary laid off from.
- Employed or unemployed people leaving the labor market because of retirement or they have other reasons to quit their jobs.
- Individuals who have never tried to find a job or enter the labor market, as well as those leaving the labor market earlier can enter by finding a workplace (Smith and Ehrenberg 2003).

„The labor market is a place, where the formally equal players, employees and employers interact, refers to the supply and demand for labor in which employees provide the supply and employers the demand.” (Dabasi 2011)

Labor market is the most important production factor consisting of buyers and sellers. The labor market is formed by work as a complex, long-term task to be conducted (Amstrong 2007).

Unemployment was defined by Mankiw as the following: “unemployment is a macro-economic issue affecting the individual directly. Loss of workplace is a psychological burden that results in living standard decrease (Mankiw 2005).

Unemployment is a heavy burden for the young. Young unemployed are those between 15 and 25, but also those, actively looking for job, but cannot find for various reasons. Not only Slovakia can be characterized by youth unemployment. The ratio of youth unemployment is higher than the adult unemployment in many other countries as well. The main reason is the preference of adult workforce with adequate skills and experience. These factors are important for the employer since these employees directly contribute to profitability of the company. In order to find job easier, it is essential to have the appropriate skills. Lack of skills increases the chance to find a decent or inappropriate job, as well as it is increasing the possibility of long-term unemployment. Further reason might be the formal knowledge gained at universities, which does not meet the trends, skills and knowledge required on the labor market by Signorelli (2012).

Job matching (employee preferences and awareness) is essential on the labor market. The main objective is to match the employers maximizing their profit with the employees trying to maximize their efficiency and skills to meet this demand. It is not easy to meet this demand, since the employees have different preferences and qualifications. When the employees would like to maximize their usefulness, they express their demand for material and non-material needs. However, the performance-related wage offered does not always reflects the interest of the employee, not all of the workplaces offer the same wages and benefits. If all the workplaces provided the same offer and the same tasks, it would be easier for an employee to make decision about choosing a job. Since the market is not functioning smoothly, not all employers provide the same wage and offer the same workplace conditions. Some of the workplaces offer a freedom of decision in determining working hours, while other workplaces offer less flexibility. Some of the employers offer supplementary benefits to their employees (Ehrenberg and Smith 2003).

The following five models belong to Western-European models:

1. The German model is focusing on decreasing the worktime. The weekly working hours and the number of working days were decreased to four. The solution was applied by Volkswagen group in 1993.
2. The second German solution is the Relay System. It is focusing on efficient use of generation change. This idea was trying to help by increasing the worktime of new employees and decreasing the worktime of older employees in the company. This idea was also applied by Volkswagen.
3. In French model, the state offered to decrease the social insurance contribution paid after the employee. Several conditions had to be fulfilled to achieve this e.g. the number of employees is increasing by 10% parallel to 10% decrease of worktime. As a result of the introduced measure, the companies obtained allowance in the following six years of their existence from the state.
4. The Swiss model reduced the employee worktime by 25%, so they could apply for the unemployment benefit, which resulted in 10% decrease of the employee wage.
5. The Danish model used two variants of unemployment rotation system. According to the first solution, those working three years on their workplace are entitled for a year paid leave. During the paid leave, the employee has to participate on professional training. The second solution is to share the worktime of three employees with one unemployed person. The unemployment benefit and the wage of three employees are divided into four parts. According to this solution, these four employees will be unemployed for a week (Gulyás 2008)

The operational programmes, employment and social inclusion programmes support the field of human resources development, increase the employment, social inclusion and capacity building. The support is provided by the European Social Fund and the state budget. The operational programmes were created to help the young unemployed entering the labor market quickly. The main objective is to promote employability, strengthen the integration of socially excluded people and promote the reconciliation of work and family life. These programmes are designed for those completing their secondary education and those with university degree, depending on how long they have been registered unemployed at the Labor Office. New workplaces are created that provide appropriate practical base for the participants. 7 projects of this kind will be listed below.

National project – Opportunity for Young People (Šanca pre mladých) - operative programme of human resources. The amount of subsidy is 49,981,644.80 EUR. The project is implemented in the

following districts: Trenčín district, Trnava district, Nitra district, Banská Bystrica district, Žilina district, Prešov and Košice district. The project is focusing on integration of the young (those, who are not employed, do not continue their studies or do not participate in vocational training). The main objective of the project is to create workplaces for (until the age 29) those, who have been unemployed at least for 12 months before joining the project. The long-term unemployment is the most serious phenomenon of the Slovak labor market, detected in each region of Slovakia. Signing up for the programme provides significant and efficient support to enter the labor market. The employer might hire an instructor to assist the young employee in their effort to integrate easily. Supporting workplace creation targeting the young should be seen as an investment in terms of long-term employability of this generation on the labor market. Long-term unemployment has negative impact on the mental health as well as on the level of income. The employment experience is increasing the future employment chances. As an outcome of the project, 7,000 workplaces will be created for unemployed young people. Duration time of the project is 21 months. The subsidy lasted from April 2017 until December 2018 (Šanca pre mladých).

National project – Selected Active Measures for Young Unemployed (Vybrané aktívne opatrenia na trhu práce pre mladých uoz) - operative programme of human resources. The amount of subsidy is 11,999,988.00 EUR. The implementation of the project is restricted to the following districts: Trnava district, Prešov district, Trenčín district, Nitra district, Banská Bystrica district, Žilina district, Prešov and Košice district. This project provides funding to support employment growth and the activity of the Labor Office to support the employment opportunities of the young under the age of 29. In the framework of the national project, active measures will be implemented, in accordance with the Law 5/2004. The main objective of the project is to support the employment and training of job seekers under the age 29, improve their labor market position and increase the level of employment by supporting the development of local and regional employment. The project is implemented by the Ministry of Social and Family Affairs by 43 offices of western, central and eastern Slovakia. The assistance is available for 7700 unemployed people (Vybrané aktívne opatrenia na trhu práce pre mladých uoz)

National project – Training for Young Job Seekers (Vzdelávanie mladých uchádzačov o zamestnanie) - operational programme for human resources. The amount of subsidy is 30,983,991.45 EUR. The project is promoting the employability of young job seekers, offers trainings and strengthening the key competencies. The project activities are divided as the following: support the retraining of young job seekers, supporting the key competencies of young people and supporting the self-care of young job seekers. The objective of the project is to prepare these people to enter the labor market and benefit from the skills and knowledge gained on trainings. The retraining of young job seekers is ensured by cooperation between the specialized agencies and service providers. The institution providing training is eligible if it can demonstrate that the organization is accredited to provide the training programme in accordance with the Slovak legislation or has issued a consensual opinion about the professional body. It does not apply for communication, computer, managerial, social, and executive or language competencies. The retraining should be conducted in Slovakia (Vzdelávanie mladých uchádzačov o zamestnanie).

National project – Restart Programme for Young Job Seekers (Reštart pre mladých UoZ 2) - operational programme for human resources. The amount of subsidy provided is 29,942,400.00 EUR. The objective of the project is to improve the situation of young unemployed under the age of 29 in order to increase their employment by motivating them to tackle the problem of unemployment. The further aim is to target those regions in Slovakia that are less developed in terms of employment. This national project provides a motivational contribution for young job seekers by promoting stability and adaptability in the first 12 months of joining the programme. The contribution is provided for those active job seekers who find a job and can prove their presence at workplace. The financial contribution is provided on monthly basis after checking the duration time of the employment in the information system or in case of minimum 1 and maximum 12 months of employment, 126.14 EUR is provided monthly during the first six months and further 63.07 EUR can be claimed in the following six months. This system of subsidy is valid from September 2018 until June 2022 (Reštart pre mladých UoZ 2).

National project – Experience to Ensure Employment (Praxou k zamestnaniu) started in August 2015. The main objective is to improve or provide practical experience for those under the age of 49 with an assistance of a mentor. During the mentoring process, the office provides financial support for those employers creating a workplace serving this purpose. Financial support is provided if the workplace ensures a part-time job for at least nine months for an employee. The conditions of the programme changed in 2017. Following this change, the Ministry of Labor and Social Affairs made it possible for the employee to work full time at least 6 and maximum 9 months. The programme received a financial support of 10,070,080.00 EUR. There were 3,892 applications submitted in 2017, the number of approved applications reached 3628 (Vyhodnotenie AOTP 2017).

National project – Graduate Traineeship Programme (Absolventská prax štartuje zamestnanie) – the project was kicked off in August 2015. The main objective of the project is to increase the employment of young people until the age of 29. They provide opportunity for those, who do not have qualification or enough work experience after graduating by creating workplaces at an employer with university degree. These two programmes are implemented as active labor market steps in accordance with the Employment Services Act § 51 and 54. First is providing qualification for the employer, followed by a postgraduate support which is 56% of the living wage in accordance with § 51. The second is a financial contribution for those employers who employ fresh graduates, no later than 30 calendar days after completion of traineeship, in accordance with § 51 of the Employment Service Act. The employer has to ensure full time position for at least 9 months, while the position will be maintained by financial contribution for at least 6 months. Following this step, the employer is obliged to maintain this position for further three months (Vyhodnotenie AOTP 2017).

National project – Being Successful on the Labor Market – operational programme of human resources. The amount of subsidy provided is 50,000 000.00 EUR. The project “Being Successful on the Labor Market” started in 2015. The main objective of the project is to increase the employment of young people until the age of 29 in accordance with § 51 and § 54 of the Employment Act. The primary goal of the programme is to provide financial subsidy for creating and maintaining workplaces for young people. The programme provides possibility for those, who had not had paid job or regular income for at least six consecutive months before the start of the project. The second goal of the project is to support employers, who create jobs for young unemployed people. The project can be entered by participants until the age of 25, who have been registered as unemployed for at least three months. The second group is formed by participants up to the age of 29, who had been registered at Labor Office as unemployed for at least six months (Národný projekt Úspešne na trhu práce).

## 2. Methodology

The main objective of the research is to map the efficiency of active labor market instruments applied in Slovakia and to assess the knowledge of graduate jobseekers about employment services in the employment services sector and to assess the extent to which employment policy opportunities are being exploited in selected districts. Our research was conducted in 3 districts of Southern Slovakia, the students of J. Selye University (on Corporate Economics and Management second level study programme) are affected by. We were interested in what kind of subsidies and national projects are implemented in order to help the young unemployed in the districts of Komárno, Nové Zámky and Levice. In order to achieve our goal, the subsidies had to be determined. It is important for the state to keep the unemployment rate low since it is a high burden and extra expenditure for the state. Our sub-goal is to map the knowledge of job seekers about the employment services, as well as how they can utilize the opportunities offered by active employment policy.

## 3. Results

There are two institutions dealing with the registration of unemployed in Slovakia: Statistical Office of the Slovak Republic and the Central Office of Labor, Social Affairs and Family. The Labor Office shall perform the following tasks:

- implementing active labor market measures,
- registration of workplace vacancies,

- providing professional advice,
- registration of unemployed job seekers,
- labor exchange,
- preparing the projects set up by the European Social Fund,
- measures taken regarding the job opportunities (ÚPSVaR 2014).

Government agencies in the field of employment services

Act 453/2003 on social affairs, family and employment services and the amendment to certain law regulates the establishment of bodies and status in the field of public administration. The central state administration currently is the Ministry of Labor, Social Affairs and Family of the Slovak Republic. The ministry can either directly set up a unit offering employment services or establish a relatively independent national employment service (Hetteš 2013).

### *3.1. Employment policy tools to reduce unemployment*

The Slovak Republic is committed not only to the EU policy, but also to multidimensional development of its own country. It is seeking to influence the labor market in order to implement social functions. As it was mentioned above, it is contributing to decrease of unemployment in as the following: active workforce (labor market tools) and passive workforce (policy tools). Supporting trainings is an active tool that helps the candidate to find a job after completing the training. The new skills gained might increase the chance of the candidate on the labor market.

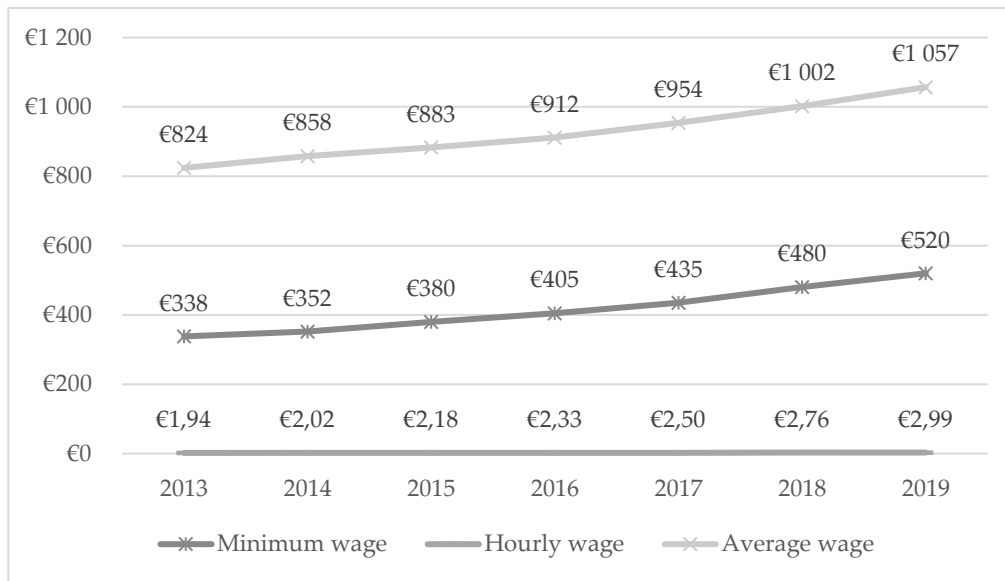
Active tools

Active tools are promoting employment. The main objective is the reintegration of those excluded from the labor market. It adjusts supply to demand. The following types of active tools are differentiated: employee retraining or an active tool dealing with the tension already present when the employee made redundant has to register in the Labor Office. Tasks: ensure the appropriate employment. The European Union is supporting the member states in reducing youth unemployment and increasing the employment ratio. The aim is to achieve 75% employment among the working-age population between the age of 20 and 64. Why is it important for the EU to incentivize the youth employment? Based on the data of the EU Commission, 6.3 million young people (15-24) in 2016 were not employed or participated in education in the EU. As a result, 4.2 million young people were unemployed in that particular year. The unemployment rate of young people fell to 19% in 2016 compared to 23% in 2013. This rate is still high in the member states of the EU (some member states exceeded 40%). This suggests that labor market disparities are present not due to inadequate skills, limited geographical mobility or dissatisfactory wage conditions.

The labor market conditions are largely determined by general problems arising from geographical location. The fresh graduates are attracted by nearby capitals of Budapest and Bratislava. As a result of braindrain, the districts are severely affected by high unemployment rate and low-income conditions. The lack of employment opportunities in particular districts result in the fact that many people are forced to accept job opportunities offering minimum wage. The wage level reflects the low qualification level of the employees. The lowest level of minimum wage is often offered by the largest employers in the district e.g. education, food industry or agriculture (Horváth, 2004).

The minimum wage is the lowest possible wage the employer has to ensure for a full-time employee. The low-wage work posed significant risk on pensions as well. It resulted in introduction of the minimum pension. Some workplaces apply higher coefficients and therefore offer higher wages. The amount of minimum wage is expressed in gross amount.

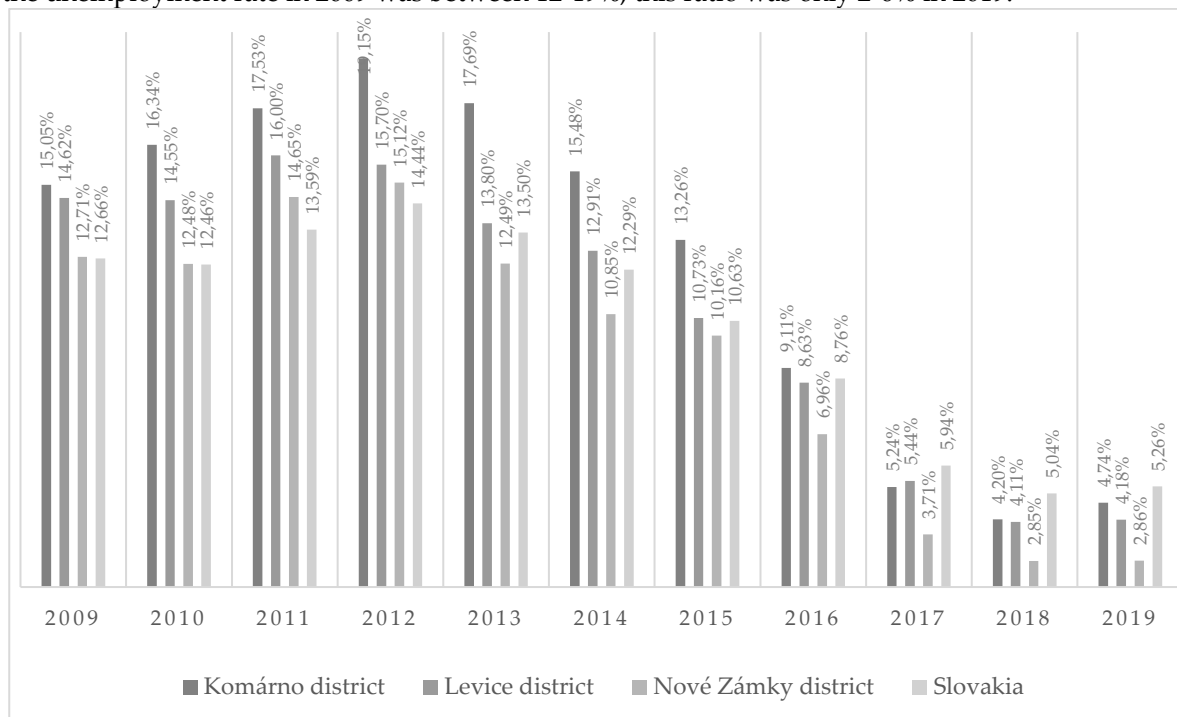
The Labor Code also introduces the hourly minimum wage. Natural persons employed by any company or employer are entitled to hourly minimum wage. All of those with permanent employment, work contract or conducting student job are entitled to hourly minimum wage. In Slovakia, the average wage is the arithmetic mean of wages. It can be concluded, that 70% of the employees in Slovakia earn less than the average national wage. The average wage increase is indicated by inflation. The inflation is determined by the decrease or increase of living standard (Minimálna mzda)



**Figure 1.** Minimum and average wage in Slovakia in the past 6 years (mimimalzda 2019).

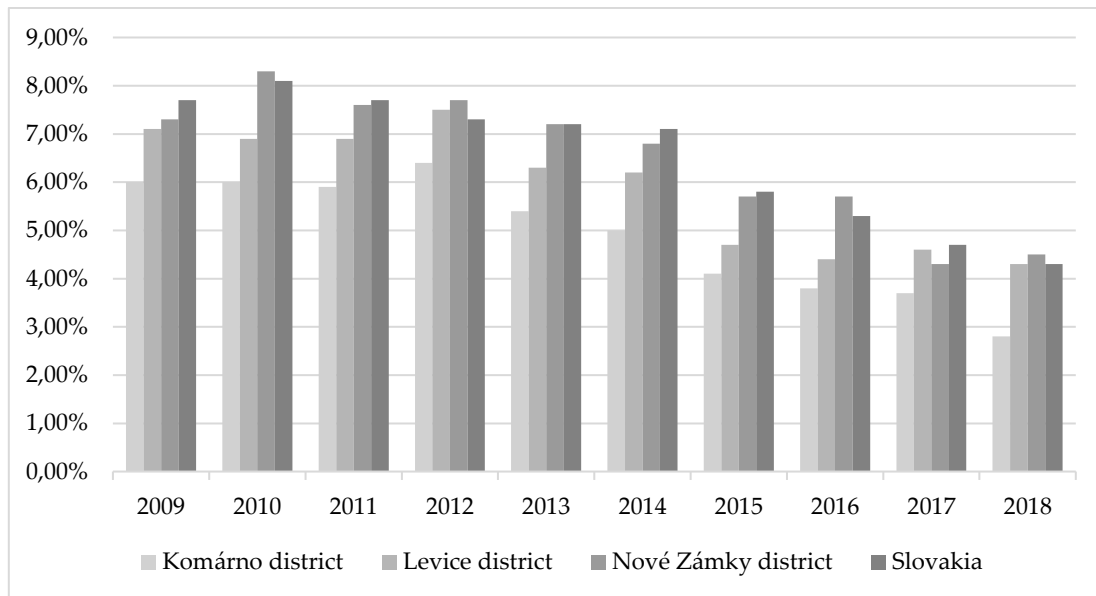
The minimum wage, hourly wage and the average wage has increased in Slovakia in the past few years. Figure 1 shows that the minimum monthly wage per capita was 338€ in 2013, while this amount increased to 520.00 € in 2019. The hourly wage per capita was 1,941 € in 2013, while it shows increase to 2,989.00 € in 2019. Similar positive result can be detected in case of average wage. The monthly average wage in 2013 was 824.00 €, while the estimated average wage in 2019 is 1057.00 € (Minimálna mzda 2019).

The next figure shows how the unemployment rate of Slovakia developed in the past 10 years, as well as the development of unemployment rate of three border districts (Komárno, Levice, Nové Zámky) is presented. We can detect a significantly decreasing tendency in the past ten years. While the unemployment rate in 2009 was between 12-19%, this ratio was only 2-6% in 2019.

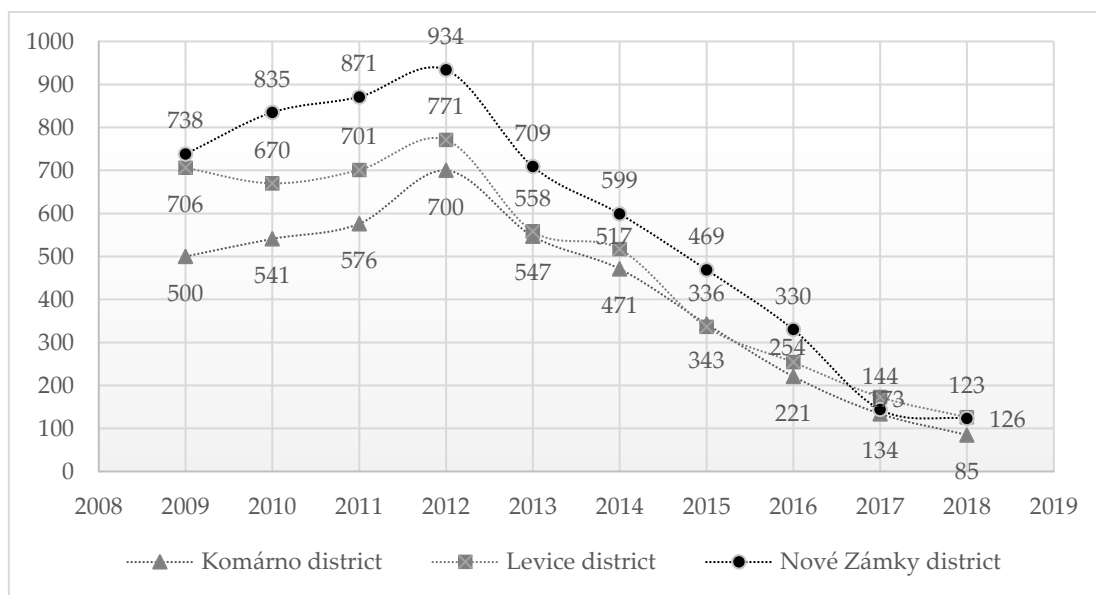


**Figure 2.** Unemployment rate in the past ten years (Statistical Office 2019).

The Figure 2 shows the rate of fresh university graduates in the past nine years. Our data was obtained by dividing the number of graduates with the number of unemployed job seekers. We examined the data of the above mentioned three districts and the national values. In 2009, the ratio of university graduates was between 6 and 8%. This value was between 2.8% - 4.5% in 2018. Steady decline has been detected since 2014, when the first national project for job seekers was introduced.



**Figure 3.** The rate of graduate job seekers in the past 9 years. (Statistical Office 2019).



**Figure 4.** The number of graduates between 2009 and 2018 (Statistical Office 2019).

The figure above presents the number of university graduates between 2009 and 2018. The figure presents national data and data of three districts: Komárno district, Nové Zámky district and Levice district. Between 2009 and 2011, Komárom district shows the lowest number of graduate job seekers. The highest number was detected in district of Nové Zámky. The highest number of graduate job seekers was detected in 2012, both in the selected districts of Slovakia and national level. The following years show a small then a greater decline. This change is largely due to the operational programmes being introduced. Compared to 2009, the ratio of graduate job seekers decreased in 2016. The number of graduate job seekers in Komárno district decreased by 83% in the period of 2009-2018. This ratio in

Levice district is 82,16% and 83,34% in Nové Zámky district. The overall results for Slovakia show 75,01% decrease in 2018. We can summarize that both in the districts and the country, a significant improvement can be detected during the surveyed years.

The table below presents the number of university graduate job seekers applying for the programmes and those completing the programmes in districts of Komárno, Levice and Nové Zámky in the years of 2015, 2016 and 2017.

**Table 1.** The number of those applying, participating and completing apprenticeship in different districts.

<b>Graduate Traineeship Programme</b>		<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>Total</b>
Komárno district	applicant	78	55	67	200
	participant	38	55	67	160
	finished	0	77	68	145
Levice district	applicant	14	80	66	160
	participant	8	71	62	141
	finished	1	26	72	99
Nové Zámky district,	applicant	103	248	200	551
	participant	98	247	200	545
	finished	12	185	278	475

Table 1 shows the number of those interested in the Graduate Traineeship Programme in 3 districts of Slovakia. There were 78 university graduates in Komárno district applying to participate in the programme in 2015. In the same year, 38 out of 78 participants could start the programme. In 2015 nobody finished the programme in Komárno district. The table also presents the number of applicants, participants and those finishing the programme from Levice and Nové Zámky districts. The table presents data from the years 2016 and 2017. The last column presents the total number of applicants, participants and those finishing the programme in 3 different districts. There were 55 participants in the programme from Komárno district in 2015. The number of those finishing the programme in 2015 was 77. This can be explained by the fact that there were participants who started the programme in 2015 but finished in 2016. A summary table was prepared to assess the questionnaire survey. The table contains the summary of answers provided by female and male respondents. Data is presented in percentages. The results were obtained by dividing the total number provided for a given response by the total number of male and female respondents.

**Table 2:** Answers provided for the questionnaire survey in terms of gender.

<b>Questions</b>	<b>The most frequently marked answer (%) in terms of gender</b>			
	<b>Female 65%</b>		<b>Male 35%</b>	
age	17.4%	24; 25	30.4%	24
qualification	53.2%	basic education	68%	basic education
district	36.2%	Levice	44%	Levice
year of obtaining qualification	29.8%	2017	40%	2018
time spent on job search	68.1%	3 months	68%	3 months
participation on career advice	57.4%	no	68%	no
utilization of opportunities	63.8%	no	72%	no
assessment of labour market	46.8%	less good	44%	less good
informed about the national programmes	44.7%	yes	48%	no
applied for national programmes	25.5%	yes	12%	yes
long-term unemployment is decreasing the chance of finding job	53.2%	yes	44%	no



assessment of the Labor Office	48.9%	less good	28%	less good
informed about financial support	66.0%	yes	52%	yes
the most important factor in finding job	55.3%	professional experience	40%	qualification
programme the candidate heard about	34.0%	Restart for Young Job Seekers	24%	Graduate Traineeship Programme

The figure above shows the most frequently marked age of the male and female respondents. 17.4% of the female respondents reported to be between the age of 24 and 25, while 30.40% of the male respondents reported to be 24. Both male and female respondents reported their highest qualification the basic education (female – 53.2%, male – 68%). Most of the respondents were from Levice district, 36.3% of the female and 44% of the male respondents. 29.8% of the female respondents gained university degree in 2017, while 40% of the male respondents achieved university qualification in 2018. The estimated duration of job search was 3 months both for male and female respondents. According to the statistics of Labor Office, the counseling services were not utilized by the majority of female (57.4%) and male (68%) respondents. Neither were utilized the further services offered by the office. Less satisfied the respondents were with the labor market conditions offered for university graduates (female – 46, 8%, male – 44%). Based on the results, 44% of the female respondents are informed about the national programmes, while majority (48%) of the male respondents were not informed about the issue. 25,5% of the female respondents, while only 12% of male respondents applied and have experience with these programmes. According to 53.2% of the female respondents, the long-term unemployment is decreasing the chance of labor market re-entry, while 44% of the male respondents do not feel like that. Both female (48.9%) and male (28%) respondents were less satisfied with the services of the Labor Office. 66% of the female and 52% of the male respondents are not informed about the financial subsidy provided for starting business. 55.3% of the female respondents find the appropriate professional experience essential to find a workplace, while 40% of the male respondents found qualification more important than the experience. While 34% of the female respondents are familiar with the Restart Programme for Young Job Seekers, Graduate Traineeship Programme is popular among the male respondents. 72.3% of the female respondents find it difficult to enter a job in their own district, while lack of professional experience seems to be a problem for the male respondents.

#### 4. Discussion

The efficiency of Slovakia's active labor market instruments proved to be successful, as the unemployment rate of graduates is showing a decreasing tendency year by year. It can be explained by the fact that the number of those participating and completing traineeship programmes is increasing, resulting in declining unemployment rate. The questionnaire research targeted those university graduates, who were registered as job seekers at the Labor Office. It was also important in what measure these graduates were informed about the opportunities and trainings offered by the office. The results seem to be disappointing, since 40%-40% of the respondents, less than half of them reported to be informed about the programme opportunities. 50% of the above-mentioned respondents participated on retrainings. The listed operational programmes were known by 24.95% of the respondents.

The results clearly show that both the unemployment rate and the rate of graduate unemployed is decreasing year by year, which indicates that our country has been successful in decreasing the unemployment rate. We propose not only for those to participate in operational programmes who have been unemployed at least for six months, but also those since the first month of their unemployment. Even the first month being unemployed has negative impact on the individual's physical and mental health as well as financial insecurity occurs. The results show that the long-term unemployment is decreasing the chance of the labor market re-entry and the individual is becoming isolated, losing skills and competencies to get a job. According to analyzed data, 68.10% of the survey

participants managed to find a workplace within 3 months. This seems to be a promising result in terms of decreasing the unemployment rate. The remaining 31.90% of the survey participants managed to find work as well, which resulted in falling rate of unemployment coupled with economic boom. We propose to put emphasis on developing practical skills of students in university education, since most of the graduates entering the labor market lack these skills. The analyzed districts offer limited number of workplaces. While decreasing the rate of unemployment, it should also be considered to create workplaces suitable for university graduates since they prefer to accept positions less accessible for low-skilled labor force. In order to achieve this objective, it is necessary to provide the appropriate financial compensation for their work, which has shown increasing tendency in the past few years.

## 5. Conclusions

The current knowledge and experience, in accordance with the amendments to the Act of the National Council of the Slovak Republic No. 5/2004 Coll. on employment services show the need to change the concept of active labor market policy. While intensifying and expanding active policy instruments, it is possible to expand the active policy tools, as well as the number of those individuals who are targeted by these instruments. The introduced effect is also supported by financing instruments of active labour market policy by the European Social Fund. However, this does not mean that the availability of these tools increased, because the more tools are accessible, more the administration associated with that will occur. The immediate effect of any active employment policy programme is that the unemployment rate is reduced, as part of the registered unemployed shifted from the category of open unemployment into the category of participants. However, the aim of active employment policy should not be to move the unemployed from the group of openly unemployed to the group of those participating in the programme. The main objective is to help those looking for a job. In the last programming period, it is the orientation towards graduates and job seekers over 50. This is the reason why it is necessary to increase the efficiency of active policy, provide adequate space for active measures to be applied and develop tools that might become effective. Despite the benefits offered by active labor market policy, it cannot be considered a perfect solution for the current situation on the labor market.

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# Open Business Model and Open Innovation: Bibliographic Analysis

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**Abstract:** At present, corporate governance has changed considerably. The company may have far more environmental and competitive influences of great intensity than it was in the past. In order to thrive and stabilize the competitive struggle, the company has to adapt, acquire and respond flexibly to consumers and capture the value of product and service delivery as effectively as possible. This can be achieved by a well-set business model that has to be constantly upgraded in relation to current trends, demand and other factors. The purpose of this paper is to discuss the current trend of open business models and of open innovation in relation to business models. To achieve this goal, a search using keywords in Web of Science database and a subsequent bibliometric mapping study with VOSviewer software is used. In final, the systematic review following the PRISMA guideline is included. Out of the 180 results, 28 papers were found suitable for qualitative synthesis. The results of the articles confirm the positive effect of open business models and open innovation based business models to value creation, effectivity and business performance. The growing trend of co-creation and collaboration in the field of business models is confirmed as well. Open business models and models based on open innovation are becoming more and more discussed over time. They are particularly useful in sectors characterized by high investment costs.

**Keywords:** business; business model; open innovation; open business model

**JEL Classification:** D04; O36

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## 1. Introduction

At present, corporate governance has changed considerably. The company may have far more environmental influences of great intensity than it was in the past. To change targets in the global economy, where communication and computing technologies and open global trading regimes make the environment highly competitive, and even more so in cases of low unemployment. (Hedvičáková and Král 2018)

In order to thrive and stabilize the competitive struggle, the company has to adapt, acquire and respond flexibly to consumers and capture the value of product and service delivery as effectively as possible. This can be achieved by a well-set business model that has to be constantly upgraded in relation to current trends, demand and other factors.

According to Osterwalder (2004), the very first theoretical reference to the business model appeared in 1960 in an academic article published by an accounting journal called *Accounting Review*.

The business model describes logic and expresses how company creates value and delivers it to final customers. Emphasis is being placed on the architecture of revenue and costs associated with business. (Teece 2010)

In the literature, business models are often used to describe the creation of business values and its conversion into financial gain. (Teece 2010) According to Zott et al. (2011), business models are understood as a tool to analyze business activities, to understand external and internal activities, and as a way to control and maintain business value.

Kopp (2019) states that the business model can be understood as a plan how to get profits in a particular market. The primary part of business model is the "value proposition". This phrase identifies goods and services, that the company offers, and it also tells why these goods and services are desirable

for customers. The message could ideally be said to distinguish the product or service from competitors.

The business model for the enterprise should also include projected start-up costs, funding sources, target consumer base for commerce, marketing strategy, competition research and revenue and cost estimates.

A common mistake in creating a business model is underestimating the cost of financing a business or product. The business model can also define opportunities for partnerships with further established companies. An example would be an advertising company that could benefit from an agreement with a printing company.

Chesbrough (2003) reports a total of six functions of the business model:

- To express the value proposition (value created for users by a technology-based offer)
- To classify a market segment (clients to whom is the technology suitable and the aim for which it can be used)
- To characterize the structure of the company's value chain, that is needed to generate and deliver the value, and to select the harmonizing benefits to boost the company's standpoint in the chain
- To define the income generation processes for the company, and predict the price structure and target margins of generating the offering, given the value proposal and value chain organization chosen
- To represent the rank of the company within the value group coupling customers and providers, including recognition of possible complementary competitors and companies
- To define the reasonable strategy by which the revolutionizing company will multiply and hold advantage over others

However, the topic of this work is not only focused on business models in a general context, but above all on open business models and on linking business models with open innovation. Weiblen (2013) defines an open business model as follows: „an open business model describes the design or architecture of the value creation and value capturing of a focal firm, in which collaborative relationships with the ecosystem are central to explaining the overall logic“. Weiblen (2013) also defines the differences and relationships between open innovation, business models and open business models. Open innovations represent targeted openness in the area of research and development activities of the company. Business models describe the continuous creation and capture of company values in an independent way of openness. OBMs are then a subclass of business models where collaboration in creating and capturing value is crucial.

The purpose of this paper is to discuss the current trend of open business models and of open innovation in relation to business models. To achieve this goal, a search using keywords in a specialized database and a subsequent bibliometric mapping study will be used. In final, the systematic review following the PRISMA guideline is included.

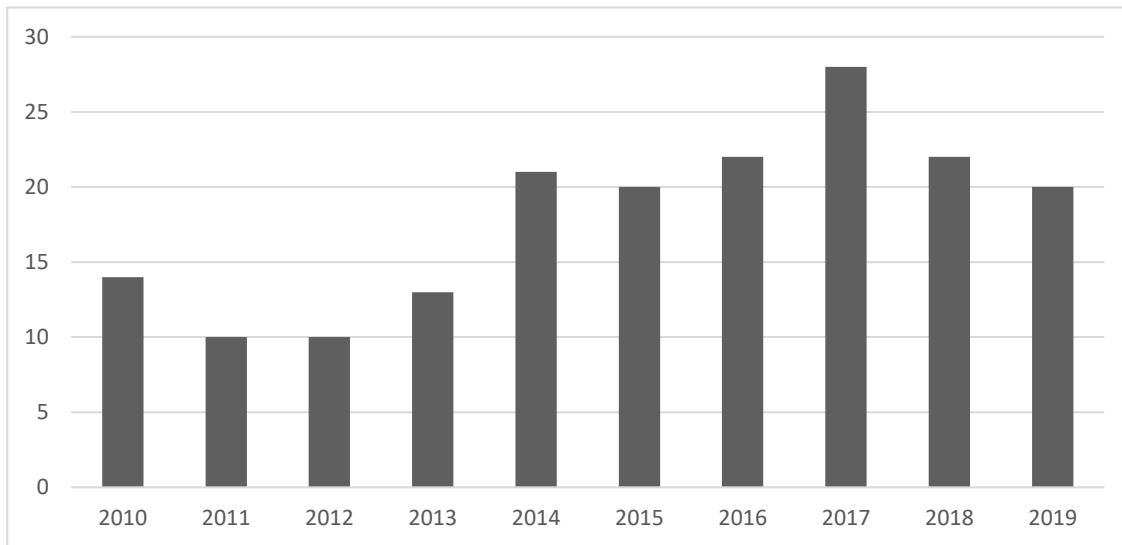
The paper is structured as follows. Section 2 defines the selection of the information mapping and information resources. The next section gives reports and discussion of the results in some fields, knowledge area, keywords, and authors. Finally, Section 4 provides conclusions and main research findings.

## 2. Methodology

To achieve the objective of the work we searched in a scientific database with the help of certain keywords. Specifically, the Web of Science database was chosen. The search was performed on 22. 12. 2019 with the following parameters:

- TOPIC: "business model" AND ("open business model" OR "open innovation")
- Timespan: 2010-2019 (22. 12. 2019)
- Indexes: SCI-EXPANDED, SSCI, A&HCI, CPCI-S, CPCI-SSH, BKCI-S, BKCI-SSH, ESCI, CCR-EXPANDED, IC

The search resulted in a total of 180 papers from the Web of Science Core Collection. The number of publications for each year is shown in Figure 1. The topic was the most published in 2017 (28 publications), and the least in 2011 (10 publications) and 2012 (10 publications).



**Figure 1.** Numbers of papers in WOS (Web of Science) database based on the query "business model" AND ("open business model" OR "open innovation").

In case of sorting papers by publication types, the largest part consists of articles (104), then proceedings papers (65), book chapters (6), reviews (6), editorial materials (4) and books (3).

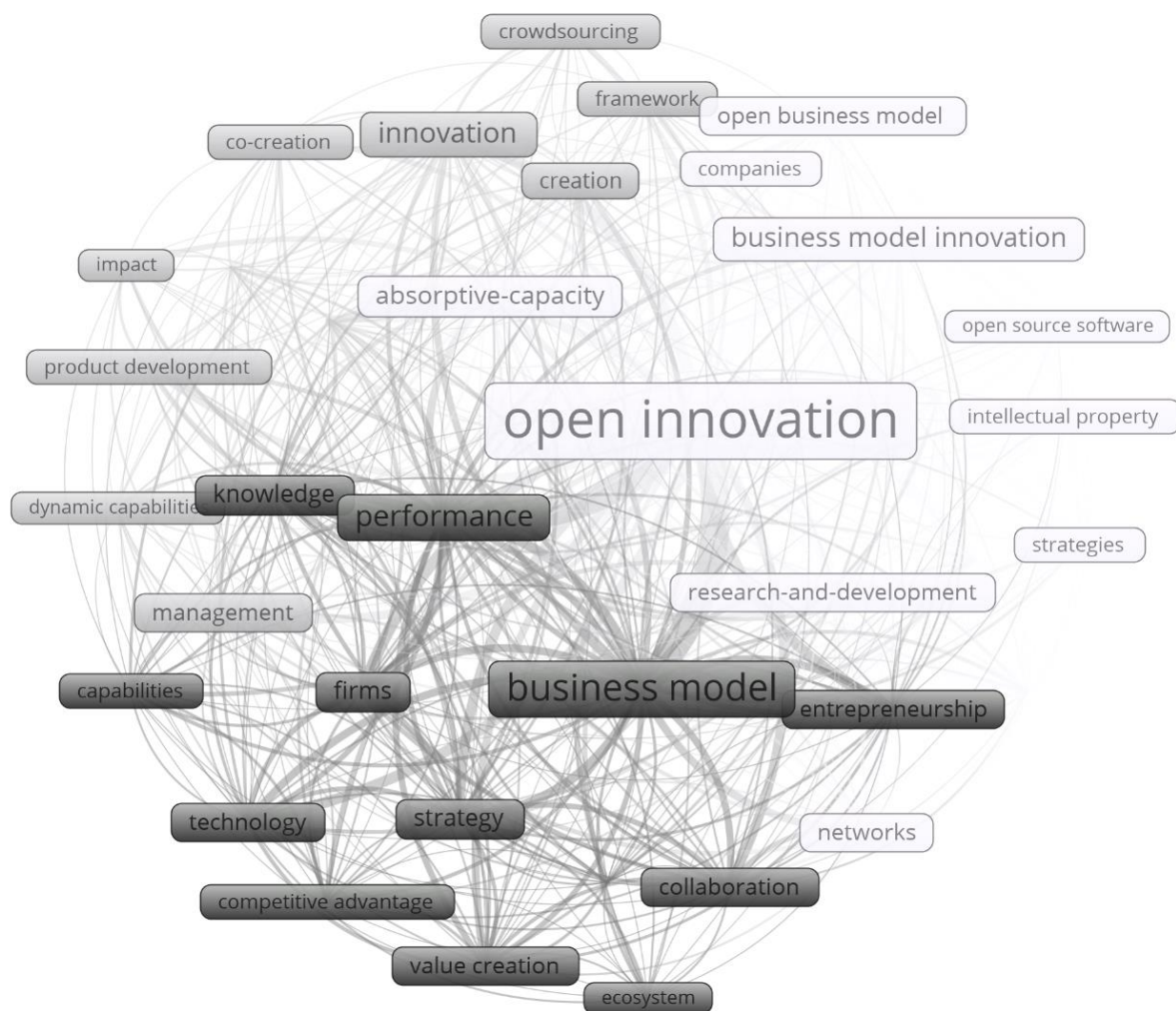
All the records based on the keywords "business model" AND ("open business model" OR "open innovation") in Web of Science (180) were added to marked list and then exported to Tab-delimited (Win, UTF-8) file format. This data file was afterwards imported to VOSviewer software, which is "a software tool for constructing and visualizing bibliometric networks. These networks may for instance include journals, researchers, or individual publications, and they can be constructed based on citation, bibliographic coupling, co-citation, or co-authorship relations". (Leiden University 2019) The results of co-occurrence analysis are in the next chapter.

In final, the systematic review following the PRISMA guideline is included. Keywords and abstract of publications were screened to reject papers that do not fulfill our inclusion criteria. Full-text papers were included in case they satisfied following requirements:

- Written in English
- Business model-related theme focused on openness of business models
- OR
- Open innovation-related theme focused on business models

### 3. Results

Figure 2 displays the co-occurrence analysis in VOSviewer software using data from Web of Science keyword search related to "business model" AND ("open business model" OR "open innovation"). "Co-occurrence" is the term which is used to represent proximity of the keywords in the title, abstract, or keyword list in paper. It is also used to find relations so that the research topic can be established. (Van Eck and Waltman 2014; Wang et al. 2018) The minimum number of keyword occurrence was set to 6. Out of the 810 keywords, 37 met the threshold and all of them were selected for the analysis.



**Figure 2.** The most frequently co-occurring keyword search related to "business model" AND ("open business model" OR "open innovation") in Web of Science, with 180 publications.

The bibliographic map divides the topic into a total number of three clusters. The first one, the largest cluster, is represented by white color on the map and among the most co-occurred keywords are primarily "open innovation", "business model innovation" and "absorptive-capacity". The second cluster is represented in black color, and its top 3 keywords include the terms "business model", "performance" and "firms". The third cluster (gray color) contains "innovation", "business models" and "management".

For all of the 37 keywords, the total strength of the co-occurrence connection with the other keywords was generated. The definition of "co-occurrence" was already mentioned. The "link" is the term used to describe co-occurrence relationship between two keywords. VOSviewer manual says that every link has its own strength which is symbolized by a certain numerical value. The stronger the link, the higher this value. "The total link strength" demonstrates the number of papers in which two keywords occur together.

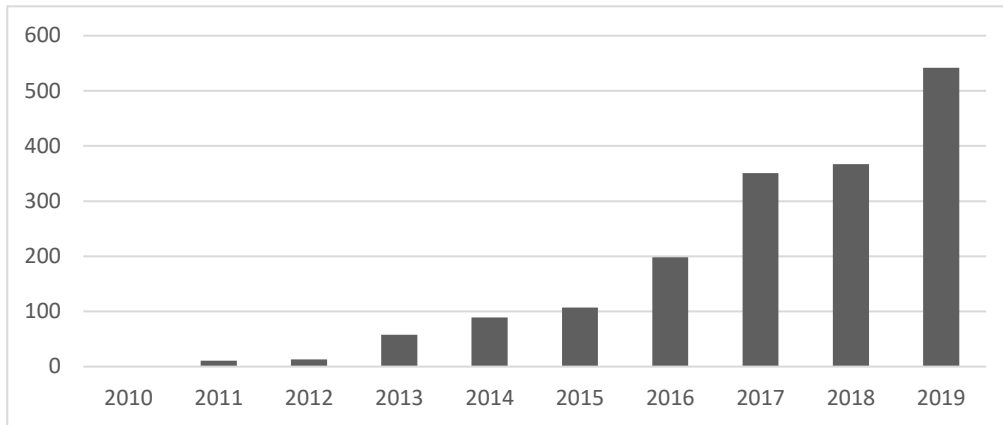
Table 1 shows occurrences, links and total link strength of the linked keywords to the keyword search. Data in the table are sorted primarily by cluster number and secondly by occurrences. The top 5 co-occurred keywords are: open innovation (110 occurrences), business model (56 occurrences), performance (31 occurrences), innovation (30 occurrences) and business model innovation (25 occurrences).

**Table 1.** Most common co-occurring keywords of "business model" AND ("open business model" OR "open innovation") in Web of Science.

Cluster	Keyword	Occurrences	Links	Total Link Strength
1	open innovation	110	36	339
1	business model innovation	25	32	80
1	absorptive-capacity	20	35	102
1	networks	15	28	76
1	research-and-development	14	25	68
1	open business model	13	21	41
1	industry	12	23	46
1	future	9	23	45
1	intellectual property	8	15	26
1	strategies	8	17	25
1	companies	7	18	26
1	dynamics	6	20	36
1	open source software	6	12	15
2	business model	56	36	210
2	performance	31	34	162
2	firms	19	30	101
2	knowledge	19	30	88
2	strategy	17	30	99
2	collaboration	16	30	82
2	technology	15	27	80
2	entrepreneurship	14	27	68
2	value creation	14	28	77
2	competitive advantage	9	25	51
2	capabilities	8	24	47
2	ecosystem	6	20	33
3	innovation	30	32	88
3	business models	13	26	59
3	management	13	30	65
3	creation	10	27	52
3	crowdsourcing	9	17	27
3	product development	9	18	45
3	co-creation	7	19	33
3	framework	7	20	32
3	dynamic capabilities	6	23	34
3	impact	6	16	30
3	innovation management	6	23	34

The quantity of citations of publications related to "business model" AND ("open business model" OR "open innovation") has been increasing linearly throughout the reporting period, suggesting an increase in interest and value of this research topic, see Figure 3.

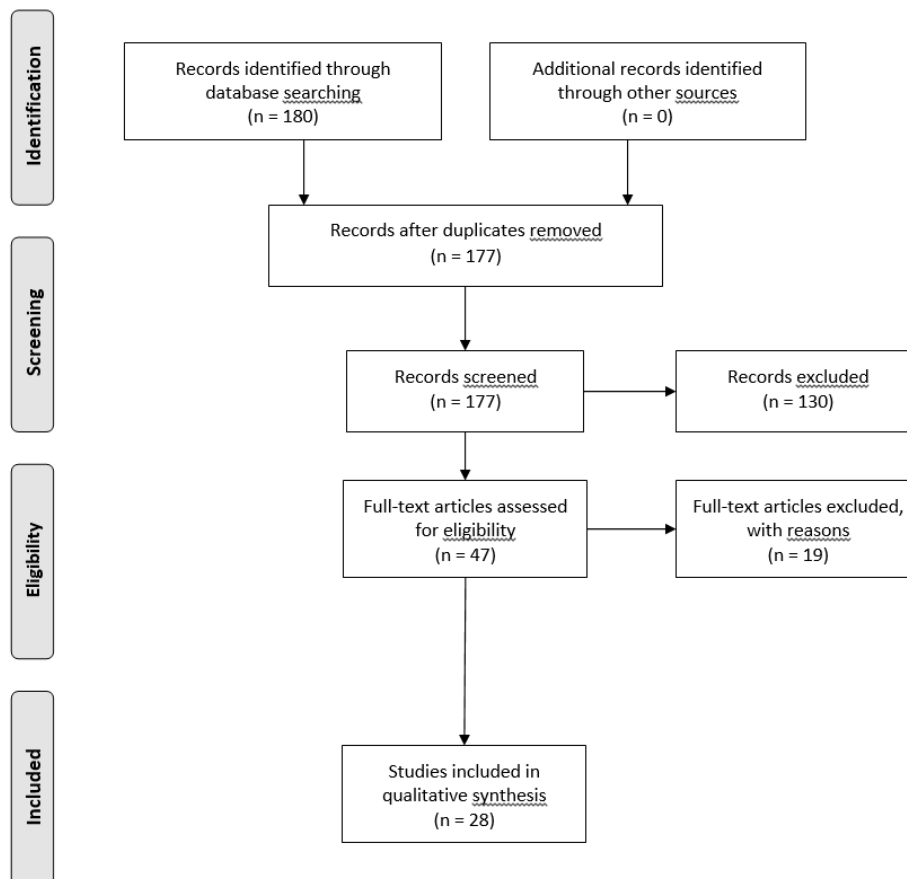




**Figure 3.** Sum of times cited per year of "business model" AND ("open business model" OR "open innovation") keyword from 2010 to 2019 in Web of Science.

Total sum of citations from 2010 to 2019 is 1,730 and 1,670 without self-citations. An average of 9.61 citations per publication. The topic has h-index 23.

For the final systematic review, the PRISMA guideline was followed, see Figure 4.



**Figure 4.** PRISMA flow diagram.

Out of the 180 results we removed 3 duplicates. Then 47 papers were passed to the step of full text assessment for eligibility (19 of them were rejected). Finally, 28 papers were found suitable for qualitative synthesis.

Selected studies are shown in Table 2 in descending order by the date of publication. 61 % of studies were published within the last five years (2015 - 2019), while 39 % were published in the range of 2010 – 2014.

**Table 2.** Studies selected.

<b>Author</b>	<b>Paper Title</b>	<b>Field</b>	<b>Environment</b>	<b>Main Finding / Value Added</b>
(Zhu et al. 2019)	The Fit between Firms' Open Innovation and Business Model for New Product Development Speed: A Contingent Perspective	BM, OI	265 Chinese firms from different sectors	Companies should adapt their BMs to different OI strategies to boost the innovation asdvantages
(Visnjic et al. 2018)	The Path to Outcome Delivery: Interplay of Service Market Strategy and Open Business Models	OBM	12 firms from 6 sectors	Paper shows how changes in the business strategy and the core changes in the BM jointly create value
(Pokojski 2018)	IN SEARCHING FOR BUSINESS MODEL OPEN FOR INNOVATIONS ON AGRICULTURAL MARKET – CONCEPTUAL APPROACH	BM, OI	Chemical companies, agricultural market	Paper analyses the possibility of creating an organizational and structure opened to innovation on agricultural market
(Harun and Zainol 2018)	Exploring Open Innovation as a Business Model for Enhancing Asean Economy	OIBM	Intellectual property laws in Malaysia	OIBM provides more effective and comprehensive business flow for ASEAN countries which contributes to enhancing of economic development
(Spieth and Meissner 2017)	Business Model Innovation Alliances: How to Open Business Models for Cooperation	BM, BMI, BMIA	General concept based on literature research	Authors developed framework which enables companies to open up their BM for exploiting the full potential of BMIA for BMI
(Khumalo and van der Lingen 2017)	The Open Business Model in a Dynamic Business Environment: A Literature Review	BM, OBM, OI, OIBM	Literature review	Article says that OBM is the integration of OI with a BM
(Vils et al. 2017)	Business Model Innovation: A Bibliometric Review	BM, BMI, OI	Literature review	there are many more innovation cases for Innovation in BMs than researchers capable of attending businesses demands
(Brasseur et al. 2017)	Open business model innovation: Literature review and agenda for future research	BMI, OBMI	Literature review	Study confirms growing trend of co-creation and collaboration in BMI supported by physical or digital tools, and reveals that OI has positive effect on BMI success
(Mosleh and Dehghan 2017)	Design a Model to Explain the Impact of the Open Business Model On Competitive Advantage in Knowledge-Based Companies of Bushehr Province	OBM	49 companies of Bushehr Province	Model design to explain the impact of the OBM on competitive advantage in knowledge-based companies
(Yun et al. 2016)	Open Innovation to Business Model: New Perspective to Connect between Technology and Market	BM, OI, OIBM	General concept based on literature research	Authors developed 4 types of BM toolkits, that can be used by individual firms on their present positions

(Kortmann and Piller 2016)	Open Business Models and Closed-Loop Value Chains: REDEFINING THE FIRM-CONSUMER RELATIONSHIP	BM, OBM	In general	Structure of OBM archetypes in the closed-loop value chain was developed
(Cesaroni et al. 2016)	Future Internet: Cloud-Based Open Business Models	BM, OBM	EU cloud platform	Paper discusses which BMs can be assumed by another participants involved in the usage and development of cloud-based platforms
(Ivascu et al. 2016)	Business Model for the University-Industry Collaboration in Open Innovation	BM, OI	Universities and industrial partners	Developed BM suggests a general framework for the creation of effective cooperation between universities and companies
(Asswad et al. 2016)	Overcoming the Barriers of Sustainable Business Model Innovations by Integrating Open Innovation	BM, BMI, OI	General concept based on literature research	This paper takes the novel balance of forces into account by showing the problems of a sustainable BMI and explaining how to get over them by using the toolset of an OI approach
(Ku 2015)	Recent Trends in Specialty Pharma Business Model	BM, OI	Pharmaceutical companies	OI provides opportunities for small pharma firms to gain the upper hand provided in case that specialty medicinal products or the technology platforms is what the big pharma wants
(Saebi and Foss 2015)	Business Models for Open Innovation: Matching Heterogeneous Open Innovation Strategies with Business Model Dimensions	BM, OI	General concept based on literature research	Paper contributes to the OI literature by specifying the conditions under which BMs are conducive to the success of OI strategies
(Davis et al. 2015)	Open Innovation at NASA A New Business Model for Advancing Human Health and Performance Innovations	BM, BMI, OI	NASA	Paper describes a new BM for advancing NASA human performance and health innovations and determines how OI solution sourcing services, formed its development
(Rojas and Azevedo 2014)	Pillars and Elements to Develop an Open Business Model for Innovation Networks	OBM, OI	In general	Article suggests key pillars and elements required to support the establishing of OBM for innovation networks
(Frankenberger et al. 2013)	Network Configuration, Customer Centricity, and Performance of Open Business Models: A Solution Provider Perspective	BM, OBM	3M Services, SAP, Geberit	Paper describes 3 ideal configurations of networks for OBM: the controlled, the supported, and the joint model
(Huan and Wen-song 2013)	Research on Coupling Intellectual Property and Open Business Model	BM, OBM	Intellectual property field, UTEK company	Paper explains the natures and necessities of BM and OBM in the field of intellectual property

(Berre et al. 2013)	Open Business Model, Process and Service Innovation with VDML and ServiceML	BMI, OI	In general, networked enterprises	Authors developed platform that provides a foundation for cloud-based OBMI, service innovation and process innovation for networked enterprises
(Holm et al. 2013)	Openness in Innovation and Business Models: Lessons from the Newspaper Industry	BM, OBM, OI	Newspaper industry	Paper examines the effect of opening BMs in the newspaper industry
(Huang et al. 2013)	Overcoming Organizational Inertia to Strengthen Business Model Innovation An Open Innovation Perspective	BMI, OI	141 small enterprises in Taiwan	OI has a major mediating effect on the relationship between organizational inertia and BMI, and the relationship between organizational inertia and company performance
(Rajala et al. 2012)	Strategic Flexibility in Open Innovation - Designing Business Models for Open Source Software	BM, OI	Open source software	A business model that embodies open innovation raises dilemmas between open and closed innovation paradigms
(Chu and Chen 2011)	Open Business Models: A Case Study of System-on-a-Chip (SoC) Design Foundry in the Integrated Circuit (IC) Industry	BM, OBM, OI	Integrated circuit industry	Paper analyzes a new OBM, called design foundry, in the integrated circuit industry
(Davey et al. 2011)	Innovation in the Medical Device Sector: An Open Business Model Approach for High-Tech Small Firms	BM, OI	Medical device sector	This paper using qualitative approach investigates the implicit and explicit BMs within HTSFs in the health care sector and provides a practical contribution to understand the tasks and identify solutions
(Gronlund et al. 2010)	Open Innovation and the Stage-Gate Process: A REVISED MODEL FOR NEW PRODUCT DEVELOPMENT	BM, OI	Oil and gas industry	The application of stage-gate model can assist companies in capturing value from both external and internal technology exploitation in increasingly OI processes
(Perr et al. 2010)	Open for Business: Emerging Business Models in Open Source Software	BM, OI	Open source software	Paper considers the dynamics of value creation fueling the production of OSS and examines the BM factors which enable capturing value

BM = Business Model, BMI = Business Model Innovation, BMIA = Business Model Innovation Alliances, OBM = Open Business Model, OBMI = Open Business Model Innovation, OI = Open Innovation, OIBM = Open Innovation based Business Model.

#### 4. Discussion and Conclusion

A total of 28 publications were briefly described in the table 2. It was found that the areas of the problem described could be divided into a total of seven groups, most of which do not focus only on one specific group, but there are interdependence groups (business model, business model innovation, open business model, open business model of innovation, open innovation, open business model innovation, and one paper also describes the so-called business model innovation alliances).

Some articles are a literature review (3), some create a general concept based on a literature research (4), some create general concepts using research in collaboration with real companies (7) and

the rest of papers (14) were focused on applying specific models for specific companies or fields of business, for example: chemical companies, agricultural market, intellectual property laws, EU cloud platform, universities and industrial partnership, pharmaceutical companies, NASA, 3M Services, SAP, Geberit, newspaper industry, open source software, integrated circuit industry, medical device sector and oil and gas industry.

The aim of chosen publications is usually either to determine the impact of open business model, open innovation, etc. on the company's results, or to create specific models for a specific area of application.

The results of the articles confirm the positive effect of open business models and open innovation based business models to value creation, effectivity and business performance. For example the study of Holm et al. (2013) confirms that the open business model is a useful analytical and conceptual device which can be used for studying the interrelations between business model adjustment and technological discontinuities. Zhu et al. (2019) say that companies should adapt their business model to different open innovation strategies to boost the benefits from innovation. According to Harun and Zainol (2018) open innovation based business models provide more effective and comprehensive business flow, which contributes to enhancing of economic development. Huang et al. (2013) in their study found out that business model innovation has positive effect on firm performance. It is necessary to add that high performance of the company in the period of prosperity is absolutely necessary - in all probability, this performance indicates the state that the company is stable and will achieve positive results even in the period of economic recession. On the other hand, the good performance of a company only in a certain area may mean great problems for the whole company in the future. (Hedvičáková and Král 2019)

We can confirm the growing trend of co-creation and collaboration in the field of business models. Open business models and models based on open innovation are becoming more and more discussed over time. They are particularly useful in sectors characterized by high investment costs. The purpose of this paper was fulfilled with the help of keyword search in Web of Science, bibliographic mapping, PRISMA guideline and literature review.

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# Development of Start-up Companies: Empirical Study of Key Determinants

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**Abstract:** Startup, or start-up, is a business entity, typically described as a newly established company, which is based on an innovative business concept using advanced technologies and is rapidly evolving. Start-up has large potential for economic growth. These firms are often funded by their business founders and venture capitalists. Due to high costs or limited revenues, a huge number of these small companies are not able to be maintained at a certain rate or level in the long term without additional funding by venture funds, business angel or private or public sector. Start-up companies cooperate in networks where they use access to supply of money, materials, staff, and other assets that can be drawn on by a person or organization in order to function effectively through different sort of stakeholders and key actors. It seems not clear to understand all particular issue and entities which these companies should concentrate their networking endeavour on, especially in correlation of variable of inputs is important to describe and see the connotation how the regional innovation strategy influences survival at their early stage. The article analyses a unique sample of 30 Czech start-up companies established between 2010 and 2020. The results show that the survival of a start-up company depends on three main part of network of actors: investors, external entrepreneurs, entrepreneur in residence and an influence of innovation centre (or science parks). In addition, start-ups that were raised in the region with a regional innovation strategy summarize the objectives, problem areas and priorities that will be required to deliver regional development policy, including business growth and innovation and have shown a greater likelihood of survival.

**Keywords:** start-up; survival of start-up; regional strategy; transfer technology; governmental support

**JEL Classification:** X03; X04

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## 1. Introduction

There is increasing share that star-ups entities are one of the strategical pillars of economic progression (Vincett 2010) with not only economic but also societal implications. Regional strategies to increase the effectiveness of the procedure of setting more start-up companies in a particular region (Fini et al. 2017; Lockett and Wright 2005; Miranda et al. 2018; Mustar 1997). These firms are often initially funded through business founders as they attempt to capitalize on developing the level of product or service where high demand is expected. Consequently, in the long term these entities are not sustainable without further support by the venture capitalist. In the last decades of last century, the most ordinary type of start-up was the internet online application. At this time, venture capital was very easily obtainable among start-ups that speculated about the creation of these new businesses. Unfortunately, most of these start-ups that were focused on the Internet application it disappeared only because of the high oversight of its basic business plans, such as the lack of sustainable income. There are therefore several Internet businesses that have not survived the burst of the Internet business bubble. Examples of companies include Amazon.com, an online retailer, and the eBay online auction portal. Other names of a successful businesses that came later are Facebook, Ant Financial, Airbnb, Uber. A start-up requires a clear business plan, an outlining mission statement, future visions, and a target as well as marketing and management strategies. Scientifically work have focused on describing the later stages of start-up, mostly post-start-up development (Iacobucci and Micozzi 2015; Visintin and Pittin, 2014). And the success was expected as potential sustainability. Other studies that



determine success as a progression through critical connection (Hayter 2016a) who are trying to get a chance to win successful businesses.

Other studies are focused on the industrial organization and the survival of the operational existence or persistence of a company at a time that it allows to understand the factors leading to its success and sustainability. Company survival is considered to be a complexion assessment of firm's performance efficiency (Jovanovic 1982) or larger productivity (Klepper and Simons 2000). However, in literature only a small group of start-ups has been described in terms of their development and few studies have been devoted to describing and generalizing key determinants so far. There are some factors which have been influencing the star-ups grow and that factors are mainly connecting with networks of stakeholders that support them in their early stage. (Hayter 2016b; Rasmussen et al. 2015). The literature on star-ups mostly describes 4 types playing crucial roles in their lifecycle: experienced entrepreneurs, investors, a business incubator in combination with innovation policy – governmental stakeholder. While much of the attention of these key players are mostly focused on to the first phase of a star-ups life time. Is very important as it makes it hard to set up policy tools, at different levels, there must be different tools set up on local, regional and national levels, which will be supporting start-ups and ensure to return public investment.

There are four key obstacles that can determinate company's success. These are the responsibility of newness, the responsibility of growing up the responsibility of senescence and the responsibility of development slowdown. The responsibility of innovation lead to that young companies have higher probabilities to fail, as they have not had enough time to develop their resources and external sources and legitimacy (Bower 2003). The factor can be observed in Borghesi's study (Borghesi et al. 2007) describing that " from studies on diversification strategies typically employed by older firms. In opposite site, the responsibility of adolescence affirm that firms experience a 'honeymoon effect' (Hudson 1987) in their first years of being on market, due to sunk costs, which leads to higher survival rates in the early years, and an increase in failure in the next years. Over time, firms develop their human resource, processes, product, technology and become unwilling to change when the state of affairs in the industry has change to competition-type challenges." This leads to a deprivation of the market or productivity disadvantage and could increase risk of failure. Jelfs (2016) and Lawton Smith et al. (2014) described the fact that UK start up experienced limited failure rates in their first three years only increasing afterwards, because start up wet through adolescence and responsibility. Star-ups benefit from management and the commercial skills (Wennberg et al. 2011) of their external entrepreneurs. Criaco (2014) claimed that star-ups whose headquarters had economical and business experience shown higher survival potential. Transitions in the business life cycle tend to affect many aspects of the business innovation system. A holistic and systemic analytical frame is provided with the "business innovation model". This model distinguishes between the business innovation value drivers and the critical resources related to them. A mutual understanding of star-ups and SMEs business innovation dynamics is a prerequisite for collaboration and sharing between stakeholders.

## **2. Methodology**

The aim of the research was to analyze the innovative start up ecosystem in one of the fastest high-tech and economical grow regions within the Czech Republic, including the socio-economic factors that influence it. In addition, an effort was made to describe the behavior of star-ups in the field of innovation implementation and transfer technology to follow factors such as the survive of company after three years, export rate, survival firm, increasing of turnover, venture capital, cooperation with innovation participate in innovation strategy of region, cooperation with entrepreneur in residence participating in accelerator program.

The aim of this paper is to give the answer to following research questions:

1. Who are the key stakeholder and network entities that determine the survival star-ups?
2. How are regional economic development conditions related to star-ups survival?

To answer these questions, a sample of star-ups companies formed between 2010 and 2020 is examined in terms of their survival.

- Hypothesis 1. There is positive relationship between the survival of start-up companies and the number of investors holding equity stakes in these startups.
- Hypothesis 2. Coherence between the involving of entrepreneurs in residence has positive impact on survival of startups.
- Hypothesis 3. There is relationship between access to business innovation parks and start-ups survival.
- Hypothesis 4. Innovation strategy of region supporting startups has positive impact on start-ups survival.

### *2.1. Description of data source*

In the work was applied a combination of qualitative and quantitative research method and the mutual penetration of these two approaches. In the simplified model of the three phases of such mixed research, the sample structure is as follows: determination of research questions, secondly data collection and thirdly data analysis. The basis of the research activity for the work was a structured background for interviews, not a questionnaire, but a sophisticated interview, which had to be properly prepared in advance, to study the documents for each company, for example from the annual reports of companies. There were involved 30 startups. An interview could only be carried out with the company owner. In both cases, the most important criterion was that the manager/owner is responsible of the company's innovation strategy and is holder of transfer technology strategy in company. For the selection of startups companies, three main criteria have been identified, which are described below. This was a multi-criteria selection. The first criterion was the company's age, interest in start-ups programs, interest in intellectual property issue.

### *2.2. Description of region*

The South Moravian region has a traditionally strong and expanding base in the research and development area of higher education students and scientists and industry. It is currently one of the most economically growing regions of the Czech Republic and one of the most dynamic regions in Central Europe. According to the extent of R&D capacity, the South Moravian Region has the most suitable conditions for the development of the knowledge economy. The Regional Innovation Strategy of the South Moravian Region is a long-term vision and implementation plan which enhance the competitiveness of the whole of South Moravia Region. Since 2001, Regional Innovation Strategy brings together scientists, universities and research centers, owners of technology companies, people from local government and the active public. The purpose of Regional Innovation Strategy is to create conditions for competitive knowledge-intensive business, setting start-ups particular by investing in improving the quality of education, research, improving the smart region image and directly supporting business activities where market failures occur (e.g. support for start-ups or support for knowledge intensive) activities in mature companies.

### *2.3. Software used*

There was selected IBM's software, named IBM SPSS Statistics. This software provides tools for the statistical analytical process, including reports and outputs important and useful not only for statistics but also for company management and their employees, and can also serve municipalities in decision-making on strategic regional development. The name of this software was derived from the Statistical Package for Social Sciences (SPSS) as a statistical package for social sciences.

### *2.4. Statistical methods*

Data was processed and analyzed using the following methods. A correlation analysis illustrates the statistical dependence of two quantitative variables and measures the mutual relationship of two variables. Variables are in correlating if particular values of one variable tend to appear together with particular values of the second variable. The aim of the correlation analysis is to determine the linear dependence between the variables. The first idea of the dependence of the characters X and Y can be

obtained by observing these characters in statistical units and showing the data with a point diagram. It is a diagram in which each pair of observations ( $x_i, y_i$ ) is represented as a point in a rectangular coordinate system where a scale of the x and a vertical scale of the y values are located on the horizontal axis. The points drawn are then a set from which to trace the characteristic features of both characters. The correlation shows the statistical dependence of two quantitative variables (it measures the mutual relationship of two variables). The original data source is .xls files and contains numeric variables. Which were imported into IBM SPSS Statistics software.

### 2.5. Data file variables

The following variables were tracked: factors such as the survive of company after three years, export rate, survival firm, increasing of turnover, venture capital, cooperation with innovation participate in innovation strategy of region, cooperation with entrepreneur in residence participating in accelerator program.

## 3. Results

The fact that the number of investors is positively related to start-up survival (Hypothesis 1) confirms a wide range of literature commend the position of venture capitals (Fini et al. 2017) but also public funds, business angels (Mosey and Wright 2007) and seed capital. Clearly, start-up challenging to survive without external capital to maintain and accelerate their development. Although the engagement of an external entrepreneur in a start-up has been widely discussed (Hayter 2013a), limited empirical experience links the role of external entrepreneurs to start-up performance (Visintin and Pittino 2014). It is obvious that these stakeholders are also very important for startup's survival (hypothesis 2). It offers "an important role for these experienced entrepreneurs' business and management skills and developed networks".

Moreover, entrepreneurs in residence could also play the role as a facilitator of investment-driven growth (Vohora et al. 2004). Literature describe the role played by investors, primarily in the form of the private venture capital, business angels, venture funding, public funds (Huggins 2008), or the role can play also industry of venture capital (Bonardo et al. 2011). These actors contribute vital resources that add to the development of a start-up company and ensure its growth. The receipt of investment not only influences a start-up s growth, but also signals its credibility (Vohora et al. 2004), quality (Fini et al. 2017) and entrepreneurial orientation.

Innovation parks are very important for start-up formation and widely discussed as one of important entities of governmental support the start-ups (M'Chirgui et al. 2018). Innovation parks offer a lot of support services as IPR consulting, law services, coaching, mentoring, administration, facilities, consulting and potential of investment, connecting to venture investor, and in some cases also management support. They offer accelerator programs where experienced mentors are involved, successful businessman and financial professionals help to support start-ups in their first stage of development. Innovation parks accelerate business development and reduce the probability of failing caused of isolation from immediate market. According the research there were occur significant correlation between the survival of company and the combination of venture capital and entrepreneur of residence, because more that investment itself is important the knowledge of market, knowledge of management processes and relevant business contacts, which brings entrepreneurs in residence. Also, there were significant correlation between the survive of company and their participating in some of activating carrying by innovation strategy. All hypothesis which were set in the research objective in the article were proven by empirical study and proven by statistical methods. The particular correlations are visible in table 1. There is significant correlation between the survival and entrepreneur in residence involvement in start-up in its early stage. It supports the hypothesis that not only venture capital but mostly the additional entrepreneur experience is important for start up to cross the "death valley".

**Table 1.** Correlation of individual variables.

		Survival firm	Increasing of turn over	Venture capital	Cooperation with innovation park	Participate in region with innovation strategy	Entrepreneur in residence	Participation on accelerator program
Survival firm	Pearson Correlation	1	,807**	,130	,326	,246	,603**	-,073
	Sig. (2-tailed)		,000	,486	,073	,183	,000	,698
	N	31	31	31	31	31	31	31
Increasing of turn over	Pearson Correlation	,807**	1	,080	,551**	,143	,659**	-,141
	Sig. (2-tailed)	,000		,670	,001	,444	,000	,450
	N	31	31	31	31	31	31	31
Venture capital	Pearson Correlation	,130	,080	1	-,036	-,015	-,139	,273
	Sig. (2-tailed)	,486	,670		,849	,938	,457	,138
	N	31	31	31	31	31	31	31
Cooperation with innovation park	Pearson Correlation	,326	,551**	-,036	1	,025	,599**	-,190
	Sig. (2-tailed)	,073	,001	,849		,894	,000	,307
	N	31	31	31	31	31	31	31
Participate in region with innovation strategy	Pearson Correlation	,246	,143	-,015	,025	1	-,053	,352
	Sig. (2-tailed)	,183	,444	,938	,894		,777	,052
	N	31	31	31	31	31	31	31
Entrepreneur in residence	Pearson Correlation	,603**	,659**	-,139	,599**	-,053	1	-,338
	Sig. (2-tailed)	,000	,000	,457	,000	,777		,063
	N	31	31	31	31	31	31	31
Participation on accelerator program	Pearson Correlation	-,073	-,141	,273	-,190	,352	-,338	1
	Sig. (2-tailed)	,698	,450	,138	,307	,052	,063	
	N	31	31	31	31	31	31	31

\*\* . Correlation is significant at the 0.01 level (2-tailed).

## 5. Conclusions

Factors influencing the degree of innovation and start-ups growing and thereby increasing their added value on the market are several and have a different character. The presented research shows that there are different linkages and correlations between the different factors. Precisely mapping and analyzing can be one of the guides to effectively set up innovation policy and to choose the appropriate instruments to support setting start-ups on regional base level and support innovation policy at regional and national level as well. As it has been already emerged from the research for the future innovation capacity of the Czech Republic, it is important that it significantly boosts the segment of companies that decide autonomously on their overall strategy and strategic innovation. This study was focused on venture networks and regional innovation strategy and the role of innovation parks in correlation to start-up survival. It shows that connections a multi-stakeholders-actor network have strategic key role for the start-up and also the paper describes main findings which are firstly that the number of investors is has positive impact on the probability of start-up survival. Secondly, the involving of an entrepreneur in residence who has the experience with running similar business with the similar business model is crucial to a start-up growth. Predicting. Thorough a set of business knowledge, business skills and networks than a technology orientation. Regional innovation strategy and industrial structure of particular region is important for understanding survival of start-up.

Survival in early stage of business entities cannot be isolated from the integrity of regional economic environment. It seems that higher survival potential is in regions following innovation strategy and that investors and entrepreneurs in residence who have the potentially positive external outsourcing may increase purchasing networks and improve network structure that build economic complex context for start-up support.

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# Project Management Trends and New Challenges 2020+

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**Abstract:** This study explores how the discipline of project management is currently approached within organizations and examines how the discipline will need to adapt to remain relevant in an era of constant change and the growth in project-based organizations. The data for this qualitative research study was collected from project management experts who participated in panel discussions at a conference held on 7th of November 2019 in Dublin, Ireland (The PMO Road Show – International Project Management Day). This study is also based on a literature review of project management trends presented in the last three years. Results suggested that in the technology driven world of the future, project managers will require a different set of skills. The study found there is also a significant increase in more successful project outcomes when project teams develop more bespoke hybrid mythologies tailored to unique project environments.

**Keywords:** project management; project management trends; sustainable project management; project teams; project management competences; project management maturity

**JEL Classification:** O32; M19

## 1. Introduction

Project management is continually evolving and will continue to gain momentum as a strategic competency and critical business discipline across all industry sectors. Organizations are increasingly adopting a project-based approach and there is no indication that this trajectory will waiver or lose momentum in the next decade. Project based work is now business as usual for many traditional business units. The world of work has changed and so to must the discipline of project management. In times of social, environmental, economic and increasing technological changes, project management must evolve and adapt to changing conditions if it is to remain relevant and meet the evolving demands of future focused organizations.

In technological development the changes are driven by the 4th industry revolution or Industry 4.0. Changes include automation, digitalization, integration, robotization, artificial intelligence and machine learning, cyber-physic systems, analysis of big data via business intelligence, wide range of internet usage – internet of things, internet of services, internet of people, augmented reality, virtual reality, 3D printing, blockchain, etc. (Marik et al. 2016). Society is changing and organizations are being forced to reinvent their business model to adapt to an hyperconnected global economic environment intertwined with a shared/collaborative economy.

Corporate Social Responsibility (CSR), Climate Change and Sustainability has taken center stage as customers seek to reduce their carbon footprint and become responsible environmental citizens. This has impacted on every aspect of social, economic and political life, including approaches to delivering projects. Project Management Offices (PMO's) therefore must consider energy needs and propose sustainable solutions across the business landscape from production to processes based activities.

In the approaching years and decades, it is likely that we will witness significant changes in the area of how and where people work, how task management is approached and the very essence of the discipline of work. Technology, artificial intelligence and robotics will undoubtedly result in a fundamental shift in the role of humans in organizations and project teams. We are in the midst of a transformation to globally dispersed diverse remote project teams and an increasing organizational focus

on knowledge, training, competency, flexibility and the adaptability of people. These collective changes will have a transformational impact on how organizations approach the art and science of project management, the role of the project manager and the methodologies and frameworks deployed.

The aim of the article is to analyse the current trends and approaches that are emerging in the discipline of project management methodologies, to focus on future project management skills and capabilities and the research will present guidance on how individuals and organisations can adapt to the future project management landscape that will develop over the next 5 years.

In secondary literature resources have been identified and trends presented based on observations over the last 3 years:

- Impact of technological developments on project management;
- Requirement to implement sustainable practices into the discipline of project management;
- Tailored hybrid approaches based on traditional waterfall methodologies blended with agile and adaptable project management approaches tailored to unique project environments;
- Increasing demand for Project Managers but also increasing demands on the role of the project manager;
- Diverse globally dispersed project teams who work remotely;
- New requirements on project manager and team member skills;
- Project Management Office (PMO) as a Centers of Excellence for executing strategy.

### *1.1. Technological development*

Technology is having an increasing impact on project management methods, tools and techniques and the very essence of project work. There are many aspects of project management that can benefit from new technological capabilities.

The first aspect is the digital transformation of project management approaches. This is not limited to just project documentation in electronic format but more about the digital transformation of the full project life cycle: initiation, planning, execution, monitoring and controlling and project closeout. Project focused technology tools also empower project teams in knowledge areas such as scheduling, risk, communications and cost management. Digitization also empowers project teams to innovate in approaches to project work. Digitisation also empowers organizations to harness data for data-driven strategic decision making. Based on digitized data it is possible to use other project management tools.

Project managers need to make accurate predictions and decisions regarding project status. Artificial Intelligence (AI) and Machine Learning will help in this area and provide project managers with relevant and timely information. Based on data analysis it is possible to analyze risks, predict problems before they arise which will empower project managers a competitive advantage. (Rastogi 2019)

Boogaard (2019) describes the areas of project management AI usage:

- Identifying potential risks through natural language search.
- Improving risk assessments.
- Testing risk response.
- Allocating resources and resource levelling.
- Intelligent scheduling.
- Automating mundane and repetitive tasks.
- Improving consistency in process and decision making.

Automation will be useful in project data collection but also in filtering and directing project communications by client, by stakeholder, by priority etc. Project payments, risk updates, daily or weekly check-in messages, reports, generating of alert in cases of variations in schedule, budget or risk assessment etc. (Aston 2019)

Middleton (2017) presented the results of research between JIRA project management software users. 39% of respondents confirmed to use some aspect of AI in their work, 87% of respondents expected changes in their work related to AI and 76% of respondents declare that some or half of their work could



be covered by AI, robots, algorithm, device etc. The development of AI usage is very dynamic and ever increasing.

Musienko (2019) presented as the most important benefit of AI in project management is the ability of task prioritizing and planning and optimal resource allocation based on the data analysis application to complex projects.

Mohan (2019) anticipates the extension of the application of AI and Internet of Things (IOT) especially in controlling projects remotely, benchmarking, setting realistic expectations and greater efficiency in fewer agile cycles. In a similar vein Dharmalingam (2018) identifies the Internet of Things (IOT) as a catalyst to the discipline of project management:

- It enables to provide a hyper speed reporting.
- It gives an overall process and monitoring control.
- It creates an explosion of highly valuable project data.
- Extremely deep data analytics is made easy by the use of internet of things.
- A comparatively stricter legal and ethical implications can be brought into the practice.

Kratky (2015) and Dharmalingam (2018) positively evaluated the usage of cloud-based project management systems in collecting of real-time data, in sharing of data, in communication, etc. Technological development extends the tools of remote communication (Kratky 2015).

As the use of technological tools increases, it is necessary to increase the level of cybersecurity. In this domain Dharmalingam (2018) anticipates the next steps lie in advancing the formal regulation to set a standard of detection, prevention, and response from technology.

### *1.2. Sustainability in project management*

There is an increasing swell from society demanding a more environmentally responsible approach in all project activities, there is increasing pressure to include a sustainable element in project management approaches (Silvius et al. 2012). A body of research has presented the different approaches on how to include the sustainability element in project management methodologies, processes, planning and implementation.

Silvius et al. (2012) present the contrast between the projects and concept of sustainable development. From their point of view projects are short term oriented, the sustainable attitude is long term oriented, the projects are results oriented, the sustainable development is oriented on the whole life cycle of some economic activity, the main partner of projects is their sponsor, for sustainable development the most important stakeholders are current and future generations.

Implementation of sustainability in project management is not limited to changes in project management methods and tools. The focus is more so on a holistic approach to sustainability in changing project-oriented organization's top management attitude (Misopoulos et al. 2018) and change of the project culture in organization (Zheng et al. 2017).

Silvius et al. (2012) recommend the implementation of six key sustainability principles into a project management methodology:

- Sustainability is about balancing or harmonizing social, environmental and economic interests in contrast to project management which is oriented on triple constraint balancing (time, cost, scope of project).
- Sustainability is about both long-term and short-term orientation in contrast to project management which has a temporary orientation limited to the life of the project.
- Sustainability is about local and global orientation, just as is project management with remote team members and worldwide suppliers. The evaluation of the most sustainable solution: the solution with the lowest impact on the environment (local or global) has to be incorporated into the project management approach.
- Sustainability is about the consumption of resources, not capital, what is interpreted in project management in the sophisticated way of resource selection and usage.

- Sustainability is about transparency and accountability, the governance rules which are applied in project management, the future trend is the increase of the transparency presentation towards the wider group of stakeholders.
- Sustainability is about personal values and ethics the rule which is an important part of international project management standards, in sustainable attitude it is strengthened and expanded.

Chofreh et al. (2019) analyzed the research areas of sustainable project management and present the anticipated areas of future sustainable project management research.

### *1.3. Tailored approaches based on available project management methodologies and based on the project specifics*

An important change associated with increasing demands in the ability to manage changes in project management was the introduction of agile project management and its implementation in practice. This trend of continually adapting to and managing constant change in project scope or success criteria and flexibility in the context of a rapidly changing and evolving world brings the trend of not adhering to strictly international project management standards or other methodologies, but to create a bespoke hybrid project management methodology that is tailored to the unique project environment. Project managers in this environment will also be required to be more flexible, deploying critical thinking skills and professional judgment more than ever before (Boogaard 2019).

Aston (2019) defined this trend as method melding, he recommends using traditional waterfall project management, agile project management and other project management methodologies as open project management umbrella and use them in accordance with specifics of the organization. Aston (2019) also mentioned trend to use agile project management in more and more areas not only in software development.

Musienko (2019) recommended the blending of different project management approaches, to use methods and tools from other management areas like Kanban. Brownlee (2019) summarizes this trend under a title Hybrid Project Management Approaches and Methodologies.

On the one hand, this approach expands the application of project management to wider organizational challenges, however on the other hand, this also increases the demand and requirements for more complex project management skills (see chapter 1.6.).

### *1.4. Increasing demand for project managers*

Surveys confirm the increasing trend in the number of project management roles and job opportunities. Project management Institute (2017) presented a dramatic increase in the number of jobs requiring project-oriented skills mainly in emerging economics like China and India and the extension of project management approaches in not typically project oriented sectors such as health care, finance and insurance and services. Their previous survey from the year 2012 estimate the number of project-oriented jobs by 2020 would be number 52.4 million. By early 2017, the number of project management jobs had reached 66 million. By 2027 the Project Management Institute (2017) estimate 87.7 million of project-oriented jobs.

With the trend of increasing project management roles, we are also witnessing another trend in the changing way project managers and project team members conduct project activities. This is intertwined with the trend of freelancing and the increase in the gig economy.

Gig economy indicates a limited area of collaborative economy or shared economy, where the shared subject is work. Gig economy favors the acquisition of work performance on the basis of temporary flexible contract delivery, where the work of the contractor, the freelancer, is preferred to the permanent employee (Schroeder 2019; Chappelow 2019). Gig economy is also characterized by performing work at any location thanks to a remote connection (Rose 2016). Deliveries of work within the shared economy are also referred to as freelance economy (Rinne 20017; Görög 2018).

Stats from the Bureau of Labor Statistics show that 1 in 3 workers earns income from non-traditional, non-9-to-5 employment. In fact, in a recent World Economic Forum's Report, almost half (44%) of

respondents rated “changing work environments and flexible working arrangements” as the top socio-economic driver of change (Aston 2019).

In 2015 Newman and Williams (2015) forecasted the increase of the number of project managers in the position of “mobile project managers” – working on a number of short-term contracts. It was the prediction of development of project teams till 2020. This change is closely connected also with the technological development in area of communication tools and creation of virtual/remote project teams (Mohan 2019). Project Management Institute (2019) confirm this trend, based on their worldwide survey with 5,402 project management professional respondents that analyzed 2018 situation, 68% of organization outsourced or contract project managers.

This change of organization of the work will bring many advantages like reduction of costs to project solvers, organization of jobs activities in the wellbeing mode for employees or more exactly freelancers. On the other hand, the project managers or team members employed on contract-based agreement will be more responsible to find new contracts.

### *1.5. Diversed project teams involving remote members*

Analysis in area of human resource management confirm that workplaces will continue to become more and more diverse in the coming years. Arguably, factors like changing parental roles, shifting policies and attitudes regarding sexual orientation/gender identity, increasing globalization, and an aging workforce will result in increasingly diverse project teams. Teams of tomorrow will have increasingly varied types of workers (including full time, part time, contractor/freelance, remote, etc.) potentially complicating administrative operations, day to day communications and team dynamics. (Brownlee 2019). Loehken (2014) confirms that heterogeneous teams are widely used in the work activities and projects. The team consists of men and women, representatives of older and younger generations (generation Z, millennials, generation X, generation Y, baby boomers), especially in international companies there are team members of different nationalities and cultures. Loehken (2014) positively evaluates mainly ability of diverse team to approach the solution creatively and evaluate more diverse designs increases as opposed to homogenous teams.

Thanks to technological development and virtual communication platforms the project team members from different locations in the world can be a member of project teams, Rastogi (2019) expects the explosion of remote project team members and project managers after 2019. It brings the reduction of administrative costs, travel and logistic costs etc.; on the other hand there is more complication organization of work because team members are not office based, they could work in remote form from home, from abroad in the same time zone or different time zones, or project team members could be work nomads (Musienko 2019). Mainly young generation (millennials and Z generation) is shifting from facetime hours to working in flexible regime and remotely (Mohan 2019).

For successful management of diverse teams, project managers have to increase their knowledge of diversity management so that all members will be involved in the project and can contribute to its implementation with maximum use of their capabilities. (Betchoo 2015; Sayers 2017).

### *1.6. New requirements on project manager and team member skills*

In addition to knowledge in diversity management there is systematic pressure on increase the project manager and project team member knowledge in all areas – hard project management skills, soft skills and skills in related areas like information and communication technologies (ICT) (Musienko 2019; Brownlee 2019). Brownlee (2019) expects the requirement of knowledge of ICT like AI, data analysis, design thinking, automation, robotics, machine learning, security of ICT etc.) On the other hand, the spectrum of project management knowledge will be more complex and interconnected with other scientific areas (psychology, sociology, pedagogy etc.) and based on creativity, emotional intelligence and organizational skills (Rastogi 2019; Aston 2019).

Newman and Nigel (2015) expect the increase of project management certification as tool to unify approaches in project management methodology and standardize the project management terminology in diverse/remote teams. Duncan (2019) presented that worldwide 50,000 individuals declare the level of their knowledge by competence-based certification and other 450,000 declare knowledge-based

credentials. There are available certifications of three the most important project management methodologies (Project Management Institute, International Project Management Association, and Project IN Controlled Environment - PRINCE2). Such certifications of project managers and project team members in different methodologies and other form of training (on-line courses, e-learning, webinars, gamification etc.) bring the improvement of project management maturity and could bring the opportunity to create the system of project management based on specific conditions on organizational level, and based on different type of project. (Musienko 2019; Dharmalingam 2018; Boogaard 2019).

Project Management Institute (2019) present the new role of project managers, based on their survey of 5,402 project management professional respondents:

- Strategic advisor – project managers help with planning, execution projects in portfolio in accordance to strategy of the company.
- Innovator – project managers act as product owners and developers.
- Communicator – project managers have the ability to lead people and communicate clearly, no matter the audience.
- Big thinker – project managers are flexible, adaptable and emotionally intelligent.
- Versatile manager – project managers have experience with different approaches – waterfall, agile, lean, design thinking, etc. and are able to apply it in hybrid approach.

### *1.7. Project management offices and Centres of Excellence*

Project management office (PMO) is a standard part of project management infrastructure in most organizations. Project Management Institute (2019) in their worldwide survey of 5,402 respondents, that analyzed year 2018 situation, presented 82% of organization has got PMO, and 72% of them indicate there is high alignment of the PMO to organizational strategy.

The role of PMO is changing from administrative support, creator of project management methodology rules and controller of project portfolio to Centre of Excellence. The Centre of Excellence is responsible for devising the strategic roadmap consisting of business models and processes that'll help the organization prosper in the future. It identifies strengths and weaknesses and develops competencies to mobilize and leverage true potential into the right opportunities. A Centre of Excellence also assesses firm's risk and channels their expertise into business activities, resources and capabilities needed to drive projects forward (Mohan 2019).

These have the innate ability to bridge the gap between the effective implementation of the project and the organization's high-level strategic prescience. And due to this robust reason, the PMOs and/or Centers of Excellence have been seen gaining more popularity in the recent future project management trends 2019 (Dharmalingam 2018). These ability of PMO is supported by top management level and also by improvement of project management information systems.

Boogaard (2019) highlights other role of PMO in time of insufficient project managers and team member skills. Less experienced project managers and project team members are going to be learning more heavily on PMO by their experienced colleagues, so mentoring, coaching and other way of knowledge transport are intensively used.

Project Management Institute (2019) and Musienko (2019) confirm another emerging trend in PMOs: intensive communication with project sponsors, to create more strategic relationships with sponsors. The sponsor must be involved into the project and should be interested not only in income and measurement of Return of Investment but must also be interested in the benefits of the project itself.

## **2. Methodology**

First the scientific questions were specified – what are the expected trends in area of project management for next 5 years; what are the emerging challenges in this discipline; what can impact in a positive or negative way on the future development of project management? Based on the primary and secondary resources the trends of project management for next years are summarized. As secondary resource the literary review of in scientific papers, published surveys, web discussions and opinions of project management experts and project management associations or consultancy agencies presented via public information resources was done. As primary resources were used the results of

panel discussion of project management experts on conference held on 7<sup>th</sup> of November 2019 in Dublin, Ireland (The PMO Road Show – International Project Management Day). Based on analysis of summarized information the results and recommendation were specified.

### 3. Results

Project management experts have confirmed the above trends from their practice or experience and agreed on the further direction of project management towards:

1. Globalization, Industry 4.0, Digital Transformation and hyper-competition has changed the world view for most project environments. Projects also no longer exist in a vacuum and projects are now the execution vehicle in the formulation of corporate strategy and lift an organisation in terms of their competitive positioning in the global marketplace.
2. High performing organizations acknowledge Project management has evolved from the solving of technical problems to the enablers of change and organizational transformation. Organizations can no longer approach project management with the approach applied in previous decades. Projects are the new normal and therefore project management can no longer be seen as merely about functional project management or interlinking systems and processes, but more about faster, empowered, focused execution of strategy.
3. Successful project execution requires project teams to develop a network of building block to construct more agile, responsive approaches to achieving successful project outcomes. Senior Leadership teams should aim to build bridges and mend gaps between strategic planning and execution. Traditional corporate structure result in a lack of autonomy for project teams to make key strategic decisions. Despite aspirations of organizational agility, project teams are suffocating in levels of bureaucracy making empowerment, focus and agility almost an impossibility.
4. There is a need for a more bespoke approach than the generic frameworks allow. The project management capabilities required will vary from organisation to organisation, across industry sectors and size and scale of project.
5. New technologies available enable project managers to effectively manage a project from anywhere on the planet without a single face to face meetings with the team. There is also a whole new dynamic complexity of megatrends added to the mix: Globalization, AI, Automation, Virtual Teams, Digital Transformation, Diversity of Workforce, Gig Economy and changing corporate culture.

### 4. Recommendation

In today's era successful project managers must have the ability to demonstrate the unbiased fairness of a judge, the skills of a diplomat, the authority of a general and the understanding of a parent (McNamara 2003). Becoming "project savvy" is no longer a luxury: it is rapidly becoming a necessity (Pinto 2007). This has driven an increased need for project management techniques and a more advanced set of project management capabilities. This has been supported by Rahman, Shafique, and Rashid (2018) who states that organizations are now entering the era of competitive pressures in globalized and international markets.

The ability to quickly react to change has become paramount to the success of an organisation. Projects have become the catalysts by which organizations achieve these strategies, and the ability to manage projects effectively has become a required competency.

Project management is experiencing a fundamental shift. The traditional skills of project management: delivering to schedule, budget and are no longer enough in the new world of constant change. Organizations are looking for a new skillset and competency: somebody who can drive organizational change and lead transform within the organisation.

Organizations should nurture a holistic approach to developing a collaborative environment of self-organizing teams, empowered decision-making and strong leadership rather than strict authority. Organizations should equally strive to develop competencies and capabilities which are more agile, empowered, adaptable within the organisation.

Project success contributes to organisation success and this has led to a fundamental shift in focus from tools, techniques and processes to consideration of skills such as creativity and innovation. While success of project management practices had commonly been attributed to the combination of tools, techniques and processes employed, more recent thinking has considered skills such as creativity, innovation as well as faster decision making by empowered teams to be the source of success.

To succeed in this new era, a high performing project team is required but this can't happen without project leadership. Project leaders must foster an environment where teams can achieve their full potential and overcome project challenges. Those challenges must create opportunities for the individual, the team and the organisation essentially a win-win for all.

## 5. Conclusions

On one hand, project management trends are driven by business trends, on the other hand the project management can bring a creative, innovative problem-solving approach to organizational challenges. Notwithstanding all organizational challenges are unique or at least different and therefore a broad-brush solution will simply not work. Success lies in a more bespoke project management methodology tailored in accordance with the project type, organisation culture and industry sector.

We are now in the era where all mature organizations recognize that all strategic change happens through projects and programmes. The next generation of project managers will need to develop a portfolio of skills to match not only the current but the future needs of the organisation.

To succeed in this new era, a high performing project team is required but this can't happen without project leadership. Project leaders must foster an environment where teams can achieve their full potential and overcome project challenges. Those challenges must create opportunities for the individual, the team and the organisation essentially a win-win for all.

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# The Impact of Anonymization on the Geosocial Network Metrics Used in Socio-economic Analysis

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**Abstract:** The expansion of mobile devices equipped with GPS (Global Positioning System) locators corresponds to the development of the highly customized location-based services including geosocial networks. The usage of customized location-based services positively effects many aspects of users' daily routines from travelling to choosing the best restaurant. On the other hand, providing customized services relates to collecting and storing large amount of users' information and gives rise to many privacy-preserving issues. In this paper, we discuss the privacy concerns connected with publishing geosocial network datasets and the impact of the anonymization on the utility of the geosocial network dataset. Considering the importance of the geosocial network for the socio-economic analysis, we put arguments for the importance of geosocial network anonymization before exploiting the dataset. We apply the clustering anonymization methods according to geographical coordinates and the values of location entropy on the real-world data to prevent the location privacy leakage. Afterwards, we compare the network metrics in the original and anonymized real-world datasets and measure the impact of the anonymization on the metric values.

**Keywords:** location privacy; geosocial network; anonymization; socio-economic analysis, location entropy

**JEL Classification:** C88; M31; O35

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## 1. Introduction

Privacy is a concept of preventing the sensitive data and information from an unapproved access. Due to the steady growth of the number of Internet users privacy preserving methods have become a deeply investigated field of study. The rapid development of mobile devices like smartphones or tablets enables the progress of various internet services. Enjoying the benefits offered by the service providers is usually connected with providing the service providers with personal information. Since the quality data have become a highly valued commodity, there has been a demand for sharing data among different subjects. However, publishing collected datasets give rise to many privacy issues like the problem of identity, attribute or inferential disclosure, as noted by Fung et al. (2010).

Location privacy is a special type of information privacy which considers the right of the individual to decide when, how and with what share the location information about themselves. The main aim of the location privacy is to control of location information about the user, as described by Duckham and Kulik (2006). Nowadays, a plenty of internet services, called location-based services, requires the user's location information to provide the user with the service. Gaining the weather forecast with the weather applications, finding the nearest restaurant or using the navigation application requires the user to share her or his location information with the service provider. The terms of services for the applications should contain the information how and for how long the location information will be stored, whether it will be shared with other subjects. However, the users are not able to check whether the providers keep the storage time limits and sometimes they are not even aware that their location information is stored at all, as pointed out by Keßler and McKenzie (2018).

Online social networks (SNs) are Internet services enabling users and organizations to communicate and share various information content with each other. Links between entities represents by the relationships between SN users. Geosocial networks (GSNs) are social networks enhanced with a location information. When user shares her or his current location with the GSN provider, then the location information can be distributed to other users and may lead to highly customized social



applications such as real-time discovering friends in the neighborhood, recommending services in the current location or highlighting nearby points of interests, as noted by Gambs et al. (2011). On the other hand, GSNs can be perceived as the special branch of location-based services, since sharing among friends is an additional feature to providing information based on user's current location.

GSNs has become a very important source of information with unlimited access and a simple communication tool for tourism participants. Instead of the traditional information centers, the information available on GSNs are up-to-date and come from all tourism participants including tourists themselves. Information from tourists that had visited a location and consume services in the neighborhood, have significant impact on the future visitors at the locations. Tourists can make quick and competent choices while deciding which service to buy. Furthermore, recommendations about travel-related services influence indirectly the future improvement of the services themselves.

Except the possibility of sharing information, GSNs provide connection between common users and registered businesses, called venues. Hence, GSNs play an important role in geomarketing strategies. Palos et al. (2018) presented that the geomarketing strategies, usually included in mobile marketing, were based on analyzing the behavior of consumers according to their location. The location information are later used to the business promotion. For instance, users are provided with different advertisements according to their location. Thus, GSN users usually benefit from checking-in at the venue location. They gain coupons, discounts and special offers for revealing their location to the provider, who transmitted it to the venues in a real-time, as mentioned in Palos et al. (2018). Indisputably, GSN contributes in higher profitability of participating businesses. On the other hand, applying geomarketing entails the companies to register their own locations in the network, loading a various content such as up-to-date photographs and videos and implement modern trends and technologies. Furthermore, providing location-based services relates to collecting and storing large amount of users' information, which has to be protected from the unauthorized access. Since data indicating customers' movements, shopping habits or behavior are very valuable for both academic and marketing researches, providers can also decide to share their datasets with another subject.

GSNs have a great potential to be used in various socio-economic analysis. Zhou et al. (2017) presented how geosocial network data could be used to quantify the impact of cultural investment on the urban regeneration process and predict attached socio-economic deprivation changes. They exploited 4 million transition records for 3 years in London from the popular GSN Foursquare and used the network metrics, average clustering coefficient and the centrality, to estimate the likelihood of local growth in response to cultural investment. Then, the findings were used in supervised learning models to deduce socio-economic deprivation changes in London. They proved that the geosocial network data become a powerful tool in social-economic analysis.

Zhou et al. (2017) exploited user mobility records and venue information shared from Foursquare (2020). As stated in the privacy policy of Foursquare, available at Foursquare Labs (2020), the company share only aggregated or anonymous data to other third parties. The anonymization was probably used before the dataset was shared, since the pure aggregation of visits may leak sensitive information about a single user from the data in the used representation of GSN.

Zhou et al. (2017) represented GSN dataset as a spatial network of locations where two locations were connected iff a GSN user passed from one location to the another one in a certain time period. It is a directed graph where nodes represent the locations and edges represents the users' transitions between the locations. The weight of the edge corresponds to the number of transitions made by all users between the two locations. Edges with the very small weights indicate that there are only a few users who passes between the corresponding pairs of locations. The weight equaling to 1 implies the transition of the only user. When this condition meets the background knowledge of the adversary about the visited location of the target user, then the connected location is revealed. Moreover, the user's trace can be compiled with the certain probability depending on the weight of the following edges.

Anonymization enables providers to publish their dataset or share it with the other subjects while preserving privacy of individuals being involved in the dataset. The aim of the anonymization is to modify the original data in the way to prevent the attacker from attaching the records in the dataset with the individual who is related to them. Obviously, the modification affects the data utility and the

range of the modification should be as small as possible. However, the anonymized data still has informative value for further data mining and analysis.

Narayanan and Shmatikov (2009) proved that the simplest anonymization method, removing the identifiers of individuals, is proved not to be sufficient for preserving the privacy. The combination of other record in the dataset may identify the target individual in the dataset even without his or her identifier. Methods for the anonymization of relational datasets differs from the anonymization methods addressing the problem in the SNs and the GSNs. While anonymizing relational datasets corresponds to modifying records, anonymizing SNs requires modifying the corresponding graph structure and node attributes, if included. Additionally, the presence of location information attribute in GSNs demand an even more specific approach for anonymizing GSN datasets.

When the further analysis of the anonymized GSN data requires preserving the location traces of users, then the anonymization approach should include the location privacy protection mechanism protecting the users' location privacy, which were studied by Shokri et al. (2011). The dataset is vulnerable even without the temporal information, since the background knowledge about the visited locations may lead to the successful re-identification attack and leaking the user's identity from the data, as proved by Masoumzadeh and Joshi (2011).

In this paper, we demonstrate how the anonymization effects the network metrics, average clustering coefficient and the ratio of the indegree and outdegree centrality, which was shown to have a meaningful value for socio-economic analysis by Zhou et al. (2017). We compare the relative difference of the metric values in the original and anonymized data. We use the same representation of GSN dataset as Zhou et al. (2017) and exploit the data from the real-world dataset Gowalla that was collected by Cho et al. (2011). We apply the hierarchical clustering method according to the geographical coordinates of locations to cluster the location from GSN into regions. Afterwards, the locations in one region are additionally clustered into subclusters using the hierarchical clustering according to the location entropy values. We examine the impact on both methods on the metric values and demonstrate that the usage of location entropy in the clustering method highly improve the relative difference between the original and anonymized values of the examined metrics and thus preserve the data utility in the anonymized data.

## 2. Methodology

In this section, we formalize the problem addressed in the paper, introduce the dataset and the network metrics investigated in our experiments and describe in detail the methods used for the anonymization.

The anonymization changes the structure of the graph representing the real data. Hence, it influences the network metrics as well. Clustering anonymization method is often used when the location-based data are anonymized, as in the research performed by Masoumzadeh and Joshi (2011). The locations can be clustered into large regions according to their geographical coordinates.

At first, we introduce our approach. The detailed descriptions are added in the following subsections. Using the exact locations from the sample of the Gowalla dataset, we made the graph  $G$ , where nodes represented the exact locations. For every location in the data sample, we computed the entropy location, the metric which would be later used in the anonymization method. Then, we applied the hierarchical clustering method on the same set of locations and obtained the clustered regions. Afterwards, we made the graph  $G_H$ , where nodes represented the regions, instead of locations. Then, we applied the additional entropy-based clustering on the regions. Hence, some regions are split into several subregions. After that, we made the graph  $G_E$ , where node represented the subregions. We measured the values of network metrics, average clustering coefficient and the ratio of indegree and outdegree centrality, in all three graphs and compute the relative difference between the metric values of  $G_H$  and  $G$  and the relative difference between the metric values of  $G_E$  and  $G$ . Our research goal is to answer the following research questions:

1. How does the clustering anonymization methods according to the geographical coordinates effect the values of the examined network metrics? What is the relative difference between the values of network metrics in  $G_H$  and  $G$ ?

2. How does the additional entropy-based clustering effect the metrics measurement? Does the entropy-based clustering reduce the relative difference between the values of network metrics in the original and anonymized graph?

### 2.1. Data representation

Gowalla was a geosocial network, where users shared their locations by checking-in. Cho et al. (2011) collected a total of 6 442 890 check-ins of 196 591 users over the period of February 2009 – October 2010. We examined the sample of Gowalla dataset related to 411 user which contained over 50 458 locations and 123 548 user transitions. The transition is defined as the successive pair of check-ins created by users. Formally, the Gowalla dataset was represented as a directed graph  $G=(V,E)$ , where the set of nodes  $V=\{v_1, \dots, v_n\}$  represented the locations and the set of edges  $E$  was composed of pairs of locations that had at least one transition between each other. The weight of the edge  $e(v_i,v_j)$  equaled to the number of transitions from the location  $v_i$  to the location  $v_j$ .

After the application of the hierarchical clustering, the anonymized data sample was represented as a directed graph  $G_H=(V_H,E_H)$ , where  $V_H$  represented the clustered regions and  $E_H$  represented the transition between the regions, instead of locations. Similarly, the weight of an edge equaled to the number of transitions between regions.

Similarly, we composed the graph  $G_E=(V_E,E_E)$  representing the data sample after the application of the entropy-based clustering method.

### 2.2. Network metrics

This research focused on the same network metrics as was addressed by Zhou et al. (2017), the average clustering coefficient of  $ACC$  and the ratio of indegree and outdegree centrality  $IOR_i$ . Indegree centrality  $IC_i$  represented the number of in-flow transitions that the node  $v_i$  received. It was computed as the sum of the weights of the incoming edges. Similarly, the outdegree centrality  $OC_i$  represented the number of out-flow transitions that the node  $v_i$  received. The ratio  $IOR_i$  was defined by Zhou et al. (2017) as follows:

$$IOR_i = \frac{IC_i}{OC_i}$$

For the purpose of the comparison, we also defined the average ratio of the indegree and outdegree centrality  $AIOR$  as the average of  $IOR_i$  for the entire graph:

$$AIOR = \frac{1}{n} * \sum_{i=1}^n IOR_i$$

, where  $n$  was the number of nodes in the graph. The local clustering coefficient of the node  $v_i$ , denoted by  $CC_i$ , described the connectivity of the nodes in its neighborhood of the node  $v_i$ . It was defined by Zhou et al. (2017) as follows:

$$CC_i = \frac{L_i}{k_i * (k_i - 1)}$$

, where  $L_i$  was the number of edges between the  $k_i$  neighbors of the node  $v_i$ . The average clustering coefficient was the mean of the  $CC_i$  over all nodes of the graph:

$$ACC = \frac{1}{n} * \sum_{i=1}^n CC_i$$

Since we measured the metrics in three graphs, the metric computed in the graph  $G$  were denoted by  $ACC(G)$  and  $AIOR(G)$ .

### 2.3. Clustering anonymization methods

We used the hierarchical clustering method with the average linkage, which was described in detail by James et al. (2013), to cluster the locations according to their geographical coefficients. Locations, which were geographically closed enough to each other, were grouped together and created a geographic region. The level of the anonymization depended on the height of the cut of the

corresponding dendrogram. For instance, if the height of the cut equaled to 10 kilometers, then the distance between all pairs of locations in one region was less than 10 kilometers. Hence, the locations within 10 kilometers were indistinguishable in the anonymized data. However, clustering based only on the geographic closeness may cause a significant information loss, since locations that are geographically close to each other might have very different location entropy.

Scellato et al. (2011) described the location entropy as a metric for measuring the popularity of locations in GSN. It expresses the possibility whether users who visited the particular location will have a social tie with each other in the future. Users who visited the location with low entropy are more likely to become friends in the GSN than user who visited the same locations with higher entropy. Furthermore, low entropy locations are usually places with significant importance for their visitors, for instance home places or work offices, as stated by Scellato et al. (2011). On the other hand, high entropy locations are likely to be public places, such as coffee shops or railway stations. We omit the formal definition of the location entropy metric with the reference to Cranshaw et al. (2010).

After the locations were clustered into regions according to their geographical coordinates, then all locations belonging to the same region were clustered into subclusters according to their location entropy. To do the entropy clustering we used the hierarchical clustering method with the complete linkage. The crucial parameter in the method was again the height of the cut of the corresponding dendrogram, which became the input parameter of the implemented algorithm. Hence, the final subclusters consisted of geographically closed locations with similar entropy values.

### 2.5. Relative difference measurement

The relative difference between the values  $m_1$  and  $m_2$ , where  $m_1$  is the controlled value, was defined by Kušnerová et al. (2013) as follows:

$$RD(m_1, m_2) = \frac{|m_1 - m_2|}{m_1} * 100 (\%).$$

## 3. Results

All experiments were performed on a PC running Windows 10 operating system with 16 GB RAM and 3.2 GHz processor. We compiled the procedures described in the previous section into an algorithm which was implemented in Matlab 9.6.0.1214997 (R2019a).

Since the experiments were executed on a single data sample and the various height of the cut in the hierarchical clustering method did not influence the runtime, the runtime of one run of the algorithm did not vary for the different values of parameters and was about 6 minutes for all parameter values.

**Table 1.** Number of clusters and subclusters corresponding to several  $C_H$  values. The number of nodes  $|V_H|$  in the graph  $G_H$  corresponds to the number of clusters. Similarly,  $|V_E|$  corresponds to the number of subclusters. The entropy cut-off  $C_E=0.5$ .

$C_H$ (km)	$ V_H $	$ V_E $
0.6	9 475	12 512
3.3	2 837	4 751
10	1 381	3 113
44.5	530	2 000

The input parameters evaluating during experiments were the height of the cut-off point for the clustering according to geographical coordinates  $C_H$  and the cut-off point for the clustering according to location entropy  $C_E$ . During each evaluation of the algorithm one parameter was fixed and another one took its value from its domain. The values of  $C_H$  varied from 0.6 to 55.6 kilometers, while the values of  $C_E$  varied from 0.25 to 1.75 (nats). The cut-off parameter values  $C_H$  and  $C_E$  had the impact on the

number of clusters and subclusters. The number of clusters and subclusters belonging to some of the  $C_H$  and  $C_E$  values are summarized in Table 1.

The output of the algorithm was the metric values  $ACC(G_H)$ ,  $AIOR(G_H)$ ,  $ACC(G_E)$ ,  $AIOR(G_E)$ . The values of the metric computed from the original graph  $ACC(G)$  and  $AIOR(G)$  did not vary and was computed during the first run of the algorithm. At first, we fixed  $C_E=0.5$  and examined the dependency of  $RD(ACC(G), ACC(G_H))$ ,  $RD(ACC(G), ACC(G_E))$ ,  $RD(AIOR(G), AIOR(G_H))$ ,  $RD(AIOR(G), AIOR(G_E))$  on the values of  $C_H$ , which is shown on Figure 1. Then, we fixed  $C_H=5.6$  km and focused on the dependence of the relative differences on the values of  $C_E$ , which is shown on Figure 2.

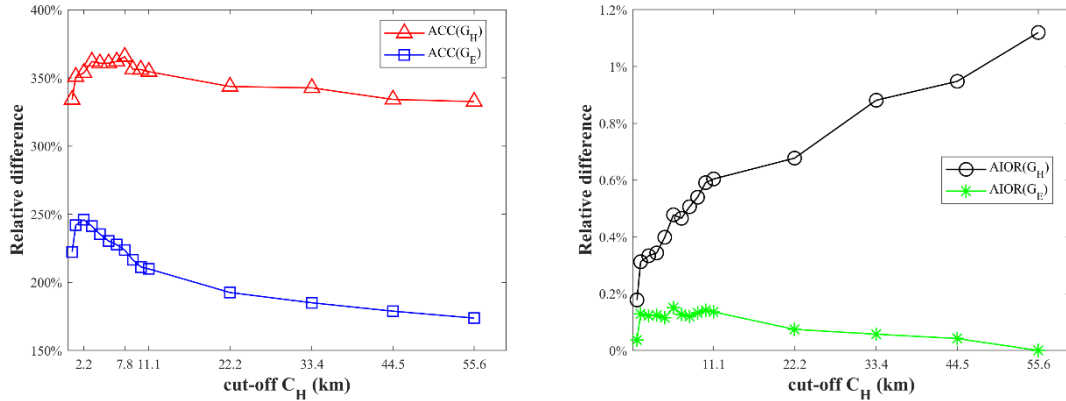


Figure 1. Dependence of the relative differences on the values of  $C_H$  with  $C_E=0.5$ .

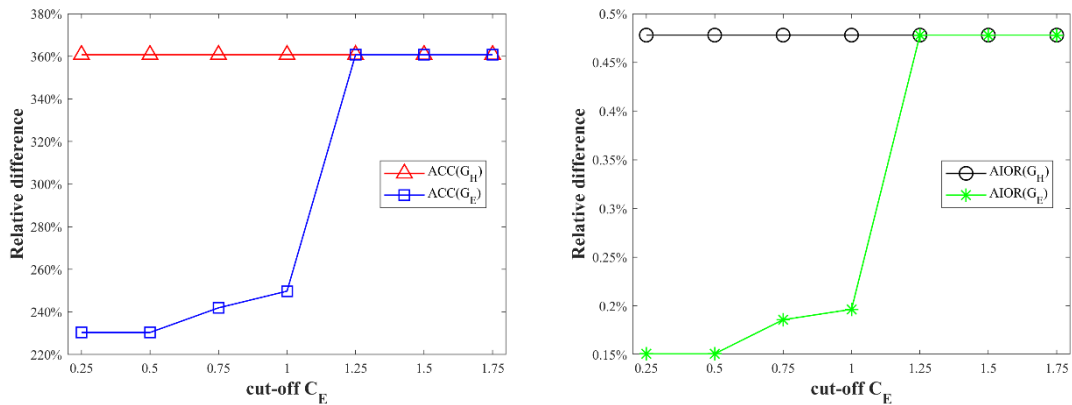


Figure 2. Dependence of the relative differences on the values of  $C_E$  with  $C_H=5.5$  km.

#### 4. Discussion

Since the relative difference values on the left-side graphs are significantly higher than the relative difference values on the right-side graphs on Figures 1 and 2, the used anonymization method is proved to have a larger impact on the values of the clustering coefficient than on the values of ratio of indegree and outdegree centrality.

In the first research question we focused on the impact of the clustering based on the geographical coordinates, which corresponding to the performance of the relative difference  $RD(ACC(G), ACC(G_H))$  and  $RD(AIOR(G), AIOR(G_H))$  on Figure 1. Table 1 illustrates that the higher cut-off  $C_H$ , meaning the higher anonymization level, corresponds to the smaller amount of clusters. The smaller amount of clusters causes naturally the larger utility loss in the data, which is also proved on the right-side graph on Figure 1, where the difference between  $AIOR(G)$  and  $AIOR(G_H)$  grows steadily with the increasing  $C_H$ . However,  $RD(AIOR(G), AIOR(G_H))$  is under 1.2% for all parameter values, hence we can deduce that the geographical-based clustering anonymization preserved the ratio of the indegree and outdegree centrality.

On the other hand,  $RD(ACC(G), ACC(G_H))$  values, which were between 202% and 366%, proved that the neighborhood of the clusters in  $G_H$  did not resemble the neighborhood of the locations in  $G$ .

The explanation is that most of the locations in the neighborhood of the location  $v_i$  in  $G$  were also near the location  $v_i$  geographically, thus they were clustered in the same cluster as  $v_i$  in  $G_H$ . Hence, the socio-economic researchers exploiting GSN datasets and examining the neighborhood of nodes should be careful about interpreting the clustering coefficient correctly and specify whether the clustering coefficient corresponds to the locations or some larger regions.

Our second research question addresses the entropy-based clustering method. The additional entropy-based clustering split the clusters into subclusters, thus it increases the amount of nodes in the anonymized graph  $G_E$ , as shown on Table 1. The comparisons of  $RD(ACC(G), ACC(G_H))$  and  $RD(ACC(G), ACC(G_E))$  on the left-side graph and  $RD(AIOR(G), AIOR(G_H))$  and  $RD(AIOR(G), AIOR(G_E))$  on the right-side graph on Figure 1 prove that the clustering according to the location entropy values reduces the impact of the anonymization on the examined metrics. On the right-side graph on Figure 1 there is visible a different trend in  $RD(AIOR(G), AIOR(G_H))$  and  $RD(AIOR(G), AIOR(G_E))$ . While  $RD(AIOR(G), AIOR(G_H))$  increases with the growing  $C_H$ ,  $RD(AIOR(G), AIOR(G_E))$  decreased. It indicates that using the location entropy values in the anonymization positively effects the preserving of data utility.

Figure 2 shows the dependence of the relative differences on the cut-off value  $C_E$ . If  $C_E$  is greater than 1, then  $RD(AIOR(G), AIOR(G_H))$  equals  $RD(AIOR(G), AIOR(G_E))$  and  $RD(ACC(G), ACC(G_H))$  equals  $RD(ACC(G), ACC(G_E))$ . Hence, nearly no subclusters were made, if  $C_E > 1$ . The value  $C_E = 0.5$  is proved to be the proper cut-off value for the hierarchical clustering according to the location entropy.

## 5. Conclusions

GSNs are valuable source of information for socio-economic researches. Since the privacy of users has to be preserved in the exploited GSN dataset, the dataset is usually anonymized before the further analysis. In this paper, we examined the impact of the hierarchical clustering anonymization method on the values of the network metric, average clustering coefficient and the ratio between the indegree and outdegree centrality, which was used in the socio-economic analysis performed by Zhou et al. (2017).

We applied the hierarchical clustering method according to the geographical coordinates on the data sample of the real-world dataset Gowalla. Moreover, we focused on the impact of the additional clustering according to the location entropy values on the clustered data. The geographical-based clustering anonymization preserved well the ratio of the indegree and outdegree centrality, while it had a huge impact on the values of the clustering coefficient. Applying the entropy-based clustering improved the metric values significantly and we recommend to use the values of location entropy in the anonymization of location-based data.

The future research can focus on the impact of anonymization on other network metrics as well as the further use of the location entropy in the other GSN anonymization methods.

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# Assessment of Employment Support Efficiency from EU Funds in the Selected Self-governing Region

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**Abstract:** The issue of human capital, or more specifically, employment, is one of the priority topics not only at the EU level, but also at individual national and regional levels. Given the significant increase in the impact of the EU Structural Funds, the paper is focused on the assessment of efficiency of employment support. Although the evaluation of the employment is perceived as basic, the evaluation is still underdeveloped at regional level. We firstly redistributed NUTS IV regions according to the extent of support needs in the selected self-governing region. We also applied one of the efficiency evaluation methods, deadweight effect, which was measured according to the selected characteristics of firms in NUTS IV regions. The main aim of our research is to analyze the efficiency of public support of employment from the EU Structural Funds through the deadweight effect for the monitored programming period in the selected self-governing region. Our results suggest that supported employment projects (according to the deadweight effect within the region) would be implemented to a limited extent if the EU Structural Funds were not used.

**Keywords:** employment; EU Structural funds; deadweight effect

**JEL Classification:** R58; E24; J68

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## 1. Introduction

The European Union's Cohesion Policy as well as employment support from EU funds is one of the main investment policies in the 2014 – 2020 programming period. Almost one third of the total EU budget is allocated to cover Cohesion Policy and address the various development needs in the EU regions. The evaluation of programs therefore plays an important role. An essential element in evaluation of the supported activity is the assessment of whether the activities were carried out as planned. Implementation of tailor-made support is difficult and virtually impossible. It is difficult to develop a policy by identifying problems, sorting them by importance, then preparing for politically acceptable action (Mendez et al. 2011). Thus, the evaluation of the EU support can be viewed from different perspectives.

Our paper aims to analyze the efficiency of public support of employment from the EU Structural Funds through the deadweight effect for the monitored programming period in the selected self-governing region. We assume that businesses in the selected self-governing region tend to receive employment support even if they do not really need this support. Moreover, we examine several characteristics of firms in NUTS IV regions and redistribute NUTS IV regions according to the extent of support needs. In the next section we describe the concept of the efficiency evaluation methods, deadweight effect. In further sections we describe the methodology of research and present the most essential results.

## 2. Deadweight effect

We can maximize the impact of support by allocating support to projects with minimal deadweight effect. Deadweight effect is a type of inefficiency that occurs while applying the principle of additionality (Šipikal, Pisár and Labudová 2013). The principle of additionality is one of the principles governing public support that can be used to examine the efficiency of the EU support. The whole process of the principle of additionality represents the course from the total (gross) result to the



net result of the support. Overall, there are 5 key support effects: deadweight effect, leak effect, reallocation, substitution effect and aid multiplier effect (BIS 2009).

“Deadweight effect is the proportion of total outputs/outcomes that would have been secured without the investment in question” (BIS 2009). The key is to differentiate between changes in the intervention (positive and negative changes or unforeseen and intended changes) from another potential changes. The rationale of deadweight effect is incorrect targeted support or market failure. In practice, we cannot eliminate the deadweight effect, as there is an asymmetry of information between the business and the support provider (Picard 2001). Obviously, businesses tend to receive public sector support even though they do not really need it.

There are several ways we can measure the deadweight effect. Our measurement according to Tokila and Haapanen (2012) is defined by a scale of 5 points:

1. The project would not be implemented at all (0%).
2. The project would be implemented to a limited extent (25%).
3. The project would be implemented at a lower quality level (50%).
4. The project would be fully implemented but later (75%).
5. The project would be implemented without change (100%).

This method of evaluation of the deadweight effect is investigated through the project group. On one hand, the projects are approved, and on the other they are the projects in which the funds were approved but were not supported for the limited resources of the call. There is a high similarity between the groups. Another way of evaluation is by comparing the results achieved by both supported and unsupported groups and creating a control group. It should be stated that selecting a group is very difficult and important. Depending on control group, the percentage of deadweight effect and total support efficiency is measured. The studies examined the effects in different areas (Wren, 2005; Lenihan and Hart 2004) and pointed out different proportions of projects that would have been carried out without support. There is no fixed proportion to be expected. Deadweight effect a highly variable effect and there is a need for clear conditions to support the private sector from EU support.

### 3. Methodology and Data

As stated in the introduction, the aim of our research is to analyze the efficiency of public support of employment from the EU Structural Funds through the deadweight effect for the monitored programming period in the selected self-governing region.

In our analysis we used data from ITMS2014+ website. The database consists of 43 projects focused primarily on employment and belonging to the Operational Program Human Resources in the programming period 2014-2020. The survey was carried out on two groups of applicants for a non-repayable financial contribution. The first group consisted of businesses that received funding and are implementing their projects. The second group of businesses were unapproved due to insufficient quality and limited resources of the call. So, we can say that we are researching a real and not a hypothetical state (as would be the case with control group). On the other hand, these projects were not initially selected, so there is a degree of distortion.

Tokila, Haapanen and Ritsilä (2008) believe that the likelihood of a minimum dead weight depends on the characteristics of the supported firms and location of the supported firms. If the deadweight effect reaches a high value, the changes that have occurred are irrelevant (changes would have occurred without subsidies too). Employment can be an example. Based on an evaluation of the deadweight effect by the authors, we used three characteristics in the analysis: size, age and location of the supported firms defined by according to European Commission Recommendation no. 2003/361/EC. The size of enterprises is divided into micro, small and medium sized enterprises according to the number of employees or the total annual balance sheet. The age of the enterprises is divided into less than 3 years (start-up) and longer-term existing enterprises. The analysis includes enterprises that have the registered office of the applicant as the location of project implementation in the selected self-governing region.

Firstly, we chose characteristics based on the data availability and based on the evaluation of the deadweight effect by authors Tokila, Haapanen and Ritsilä (2008). We analyzed data of the supported firms in the self-governing region of Banská Bystrica. Secondly, we divided the self-governing region of Banská Bystrica (NUTS IV) according to the extent of support needs, as we assume that enterprises in the selected self-governing region tend to receive employment support even if they do not really need this support. The distribution of the self-governing region according to the extent of support needs is shown in Table 1.

**Table 1.** Distribution of the self-governing region of Banská Bystrica according to support needs.

Percentage of support need	Districts of the self-governing region of Banská Bystrica
Districts capable of development without direct support (0% support)	Banská Bystrica and Zvolen
25% support	Žiar nad Hronom
50% support	Brezno, Žarnovica, Banská Štiavnica and Lučenec
75% support	Rimavská Sobota, Detva, Veľký Krtíš, Poltár and Krupina
Districts with the highest support needs (100% support)	Revúca

The distribution of districts allows us to compare the deadweight effect and the extent of the need for project support.

#### 4. Results

The assessment of the EU support can be viewed from different perspectives. We have analyzed three selected characteristics that correspond to the hypothesis that firms in the selected self-governing region tend to receive employment support, even if they do not really need it. All characteristics are related to the Operational Program Human Resources in the programming period 2014-2020 and are focused on descriptive of the approved and unapproved applications of the firms in the self-governing region of Banská Bystrica.

Unapproved applicants were represented by 29 firms (67.44%) and approved applicants were represented by 14 firms (32.56%). Eligible beneficiaries were businesses in the self-governing region of Banská Bystrica, more specifically joint-stock companies (2) and limited liability companies (41), while limited partnerships and public companies were not represented (they did not draw funds yet). Excluded from the analysis were enterprises that were not based in the self-governing region of Banská Bystrica or firms whose place of implementation was in several places in Slovakia (it is difficult to determine what proportion of this support was exactly in the self-governing region of Banská Bystrica).

While analyzing the deadweight effect, we considered the criterion of the volume of funds that would be spent in the absence of funds. Subsequently, the database shows the requested amount of the grant, the approved amount of the grant, the size of the enterprise, the existence of the enterprise and the type of call. The data are collected for the years 2016 – 2019, as by 2016 the data for all beneficiaries is zero (non-drawdown of the EU funds).

Companies in the self-governing region of Banská Bystrica received funding for the priority investment axes 1.4, 2.1, 3.1, 3.2 and 4.1. We examine the results of the approved and unapproved applicants depending on the size of the enterprise (Section 4.1.), the length of the existence of the enterprise (Section 4.2.) and the registered office of the applicant (Section 4.3.).

#### 4.1. Size of the supported firms

The section describes the size of the firms in the districts of the self-governing region of Banská Bystrica. The distribution by approved and unapproved applications is shown in Table 2 and their deadweight effect in Table 3. As we can see the district Banská Bystrica is the only district that covers all sizes of companies. The most common size of firm is a micro-enterprise, while this type of enterprise achieves the lowest deadweight value of 26.14 % (Table 3). According to the chosen scale, the projects would have been implemented to a limited extent. When comparing approved and unapproved applications in micro-enterprises, the ratio is 1:1.5 as opposed to other sizes that have a 1:1 ratio. The largest gap can be seen in the district of Rimavská Sobota, which also has the largest number of failed projects. Rimavská Sobota is one of the districts that needs a high level of support, but their ability to draw this support is the lowest.

**Table 2.** Distribution of the size of firms in the districts of the self-governing region of Banská Bystrica by the number of applications.

Size of firms in districts of the self-governing region of Banská Bystrica	Approved applications	Unapproved applications	Total number
Banská Bystrica	8	6	14
Micro-enterprises	5	4	9
Small enterprises	1	2	3
Medium-sized enterprises	2	0	2
Lučenec	1	2	3
Micro-enterprises	1	1	2
Medium-sized enterprises	0	1	1
Rimavská Sobota	3	18	21
Micro-enterprises	3	18	21
Detva	0	1	1
Micro-enterprises	0	1	1
Zvolen	1	2	3
Micro-enterprises	0	1	1
Small enterprises	1	1	2
Žiar nad Hronom	1	0	1
Micro-enterprises	1	0	1
Total number	14	29	43

As we can see in Table 3, the total deadweight effect in the monitored subjects is 30.58 % (percentage ranking the projects into a group of implemented projects at a lower quality level - 3 degree in scaling by Tokila and Haapanen, 2012). The most numerous groups are micro-enterprises. Despite the higher number of applications, only part of the funds is approved (for example, in the two applications only 70% of the funds was approved). The lowest deadweight effect is justified by the lower percentage of the funds of approved applications and the high number of unapproved applications. Small and medium-sized enterprises have fewer applications but 100% approved funding. Furthermore, we can say that as the size of the firms grows according to its number of employees, the deadweight effect also increases. This means that support is more efficient if the firm has more than 10 employees.

**Table 3.** Distribution of the size of firms in the districts of the self-governing region of Banská Bystrica by deadweight effect.

Size of firms in districts of the self-governing region of Banská Bystrica	Approved application	Unapproved application	Deadweight effect
Micro-enterprises	5 (100 %), 2 (70 %), 1 (95 %), 2 (90 %)	25	26.14 %
Small enterprises	2 (100 %)	3	40.00 %

Medium-sized enterprises	2 (100 %)	1	66.66 %
Total number	14	29	30.58 %

#### 4.2. Age of the supported firms

The section describes the age of firms in the districts of the self-governing region of Banská Bystrica. The distribution by approved and unapproved applications is shown in Table 4 and their deadweight effect in Table 5. As we can see, the most common length of existence of firms is a longer-term existing enterprise, with an average age of 11 years. Banská Bystrica is the only district that covers start-up, and the application was unsuccessful. This indicates that firms that have been on the market for less than 3 years pose a greater risk of receiving aid and their applications are not supported and therefore there is low interest in support from businesses. Start-ups achieve a 0 % deadweight effect, which means that projects could not be implemented. Enterprise that exist more than 3 years have a 31.31 % deadweight effect, which indicates low support efficiency and these projects would be implemented to a limited extent. Since the analysis does not allow us to take a closer look at the constraints (in the case of a questionnaire this would be possible), we can only guess what would happen. It is possible that the company would either apply for funding from another institution and thus ensure the smooth fulfilment of its objectives or the implementation of its project intent would not be met or it would only be met to a smaller scope and this shortcoming would have some consequences.

**Table 4.** Distribution of the age of firms in the districts of the self-governing region of Banská Bystrica by applications.

Age of firms in districts of the self-governing region of Banská Bystrica	Approved application	Unapproved application	Total number
Banská Bystrica	8	6	14
Start-up	0	1	1
Longer-term existing enterprise	8	5	13
Lučenec	1	2	3
Longer-term existing enterprise	1	2	3
Rimavská Sobota	3	18	21
Longer-term existing enterprise	3	18	21
Detva	0	1	1
Longer-term existing enterprise	0	1	1
Zvolen	1	2	3
Longer-term existing enterprise	1	2	3
Žiar nad Hronom	1	0	1
Longer-term existing enterprise	1	0	1
Total number	14	29	43

As we can see in Table 5, the total deadweight effect in the monitored subjects is 30.58 %. We can say that as the age of the firms grows, the deadweight effect also increases. Firms older than 3 years evoke greater confidence and stability in getting support from EU funds. This means that support is more efficient if the firm is more than 3 years old. Most projects are recorded in the call OPLZ-PO1/2016/DOP/1.4.1-01.

**Table 5.** Distribution of the age of firms in the districts of the self-governing region of Banská Bystrica by deadweight effect.

Age of firms in districts of the self-governing region of Banská Bystrica	Approved application	Unapproved application	Deadweight effect
Start-up	0	1	0.00 %
Longer-term existing enterprise	9 (100 %), 2 (70 %), 1 (95 %), 2 (90 %)	28	31.31 %

Total number	14	29	30.58 %
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#### 4.3. Location of the supported firms

The section describes the location of the firms in the self-governing region of Banská Bystrica. The distribution by approved and unapproved applications and their deadweight effect is shown in Table 6. As we can see support is captured in 6 out of 13 districts.

According to Table 1, the highest support is needed in the district of Revúca, which has not yet received funds from the Human Resources Operational Program and is not registered in the database. The lowest recorded deadweight effect is 0 % in the Detva district. Although this district requires a high level of support (75 % support), the project has not been implemented. The second district with the lowest deadweight effect (12.86 %) is also a district that requires a 75 % share of support. Despite the high need, 18 projects are rejected in the district. Results of the expert evaluation were not presented, and therefore we cannot tell for certain where the problems occurred. We ranked Lučenec among the districts that need 1/2 support. The deadweight effect in this district is 30 %. The district may have difficulty gaining additional resources to support projects as projects would be implemented to a limited extent and need to be supplemented. The district of Žiar nad Hronom is the only one that has not unapproved applications and approved 70 % of one project. The project will be implemented in full but later. Districts capable of development without direct support (Banská Bystrica and Zvolen Districts) account for approximately 40 % of the total number of projects. This is contradictory, since the districts should carry out projects even in the absence of the EU support (possible waste of funds). Nevertheless, districts implement projects at a lower quality level.

**Table 6.** Distribution of the location of firms in districts of the self-governing region of Banská Bystrica by the deadweight effect.

Location of firms in districts of the self-governing region of Banská Bystrica	Approved application	Unapproved application	Deadweight effect
Banská Bystrica	6 (100%), 1 (90%), 1 (95%)	6	56.07%
Lučenec	1 (90%)	2	30.00%
Rimavská Sobota	2 (100%), 1 (70%)	18	12.86%
Detva	0	1	0.00%
Zvolen	1 (100%)	2	33.33%
Žiar nad Hronom	1 (70%)	0	70.00%
Total number	14	29	30.58%

Globally, for the Human Resources Operational Program in the 2014-2020 programming period, we can assess that the deadweight effect reaches 30.58 %. This value indicates that all the projects examined will be implemented, but to a limited extent. This fact has a relatively negative character and confirms the established hypothesis. Not only for businesses that do not really need support, but the reverse is also true.

## 5. Conclusions

A more in-depth analysis and measurement of the EU spending could be an important step towards improving Slovakia's regional development. Based on theory and previous empirical research, we assume that businesses in the selected self-governing region tend to receive employment support, even if they do not really need it. In our research we have identified characteristics of such businesses with a potential impact on the efficiency of drawing funds based on ITMS2014 + data for businesses in the self-governing region of Banská Bystrica. Our results clearly indicate that support is more effective if the company has more than 10 employees and/or has been on the market for more than 3 years. The company's location and its need for support also play an important role.

Globally, for the Human Resources Operational Program in the 2014-2020 programming period, we can assess that the deadweight effect reaches 30.58 %. This value indicates that all the projects examined will be implemented, but to a limited extent. This fact has a relatively negative character and confirms the established hypothesis. Not only for businesses that do not really need support, but the reverse is also true. The highest number of approved applications is registered in the district of Banská Bystrica, which is capable of development without direct support. On the other hand, the Revúca district, which requires the most support, has no project in the period under review.

Our results could have several important implications for Slovakia's regional policy and public support for employment at national and transnational levels. Promoting employment at regional level seems important to further increase labor productivity and sustain regional economic growth. For this reason, measuring efficiency is one of the most important subjects. The potential for deeper analysis of aid efficiency to improve regional development is very high. This is one of the main challenges for regional development policy at national and EU level.

We consider these results to be beneficial, but we see some limitations, e.g. that the results cannot be applied to the whole country only to a self-governing region. Therefore, we do not consider the results to be representative, but merely indicative. The established method also has its pros and cons, and in the future, it would be more interesting to look at the EU support using counterfactual evaluation methods that are more accurate but also more difficult and time demanding. A further questionnaire survey could be added to answer supplementary questions, especially for unapproved applications. The survey could provide answers on satisfaction, awareness or lack of support. Furthermore, it would be interesting to examine which subjects fail on the market. Enterprises, aid approvers or aid providers?

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# Offline Networking Between Small and Medium-sized Enterprises as a Competitive Advantage – A Case Study from the Czech Republic

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**Abstract:** Despite the immense development of online technologies, offline networking still remains an integral part of the marketing activities of small and medium-sized companies. In business relationships, it is not yet fully possible to replace personal meetings. Personal meetings with business partners create trust, which is the cornerstone of business relationships and a launching pad for referrals. Each company creates and maintains its business network of contacts. The business network includes customer, supplier and business partner contacts, respectively. The facilitator of offline networking is most often the business owner or a senior manager with decision-making responsibilities. Developing and utilising offline contacts is typically an internal business matter and forms a part of the company's know-how. Authors researching this topic agree that data pertaining this area is so far insufficient and that the topic is worth further research to obtain more data. The article is based on a case study of small and medium-sized enterprises, whose owners are connected within the business community and routinely maintain and develop their strategic contact network in order to increase profits, obtain information and knowledge to innovate and grow their business and receive referrals for their future partners. The article focuses on the impact of offline networking activities on the competitiveness and competitive advantage of the company.

**Keywords:** offline networking, SME, business network, business contact

**JEL Classification:** D21, D22, D71, D85, D91

## 1. Introduction

Networking, business networking and interaction between market players are very often connected with social media and navigating the virtual world. The concept of network is also frequently used in computer science. With respect to the personal level of creating relationships, virtual tools have not yet succeeded in replacing all the five senses that the human being has available, so it is still not possible to fully replace personal contact. Personal face-to-face communication still plays an essential role when it comes to interactions between small and medium-sized enterprises on the market. "Despite the progress in virtual interactions in recent years, there still exists the need for personal contact when it comes to innovations" (Hardwick et al. 2012). In companies falling into the SME category, the main role in networking is played by the owner-manager, who creates local networks (Kubberød et al. 2019).

Offline networking as a discipline of management, marketing and enterprise economy is rarely mentioned in available literature. Many enterprises carry out networking as an internal company matter and consider this skill as their know-how. Czech law, for example, does not allow the provision of this data to third parties without appropriate consents. Available data are, according to the authors to date, very limited and insufficient. Russian and Finnish authors state that no enterprise is an island, therefore, the relationships of the enterprise are of utmost importance. Relationships affect success or failure of the enterprise. The relationships occur in dyads, which then form networks (Ivanova-Gongne et al. 2018).

Actors in the relationships naturally seek to develop the networks (develop the interaction process) or change their structures. "A successful networking between actors in any relationship depends on their effective networking in other relationships. Networks are diverse and unique. Each



actor follows his or her direction according to a unique and specific network image. The business network is not a market. The business network is an arena where mutually dependent actors connect in a unique manner, and the network adapts to diverse practices and structures within and among actors. All business actors will likely seek to control their interaction with others but none of them has the resources, knowledge or skills to manage it completely. The practice of creating business networks however remains a relatively unexplored area" (Ford et al. 2013). It is interesting that each enterprise (business) and its representatives are aware that contacts and activities aimed to maintain relationships which provide information, knowledge, skills and business opportunities are an important and integral part of competitiveness, profitability, performance and competitive advantage of the enterprise. "Managers and owners of newly established medium-sized enterprises must strengthen their ties with financial institutions, business partners and government officials in order to gain access to valuable resources and knowledge that lead to innovation, which in turn helps to increase the performance of the enterprise." Enterprises which are dissolved (50%) lack sufficient knowledge and resources, which is a problem that can be eliminated through creating a network of contacts.

Attending on globalisation, current companies are addressing entry into other markets. There is a proven dependence between expansion success and network relationships. Research shows that networking affects the decision as to which foreign markets the company enters. "Expansion into international markets is related to the entrepreneur's interconnected networks, and the subsequent internationalisation of the company is related to the development of its network." The entrepreneur is here described as an analytical unit. Business networks on the individual level often overlap with the networks of their enterprises on the organisational level. Partnership brings more opportunities for all the actors involved (Galkina, and Chetty 2015).

## **2. Methodology**

This study is based on the provision of data and consents to the processing of this data for the purposes of this research by a company which deals with offline networking events in the Czech Republic and is the largest community bringing together small and medium entrepreneurs. The available data comprise data collected in 2014, 2015, 2016, 2017 and two quarters of 2018 by this company. The data consists of a set of more than 10 thousand interactions between small and medium-sized entrepreneurs connected in the business community across the Czech Republic. To evaluate this data, the statistical method of correlation was used, which determined the relationships between individual interactions between subjects. The data was further compared and variously analysed.

This study also includes personal interviews with SME owners who are active in networking; these interviews helped to provide more detailed information concerning some of the results of mathematical statistical methods. The data collected by the company as part of the interactions are displayed in figure 1. This concerns data directly related to obtaining contacts, referrals and potential customers through events organised by the company for its clients. This data was sorted and adjusted and used for further research to find out about the competitive advantage of the SMEs which are active in pursuing offline networking activities as part of their marketing strategy.

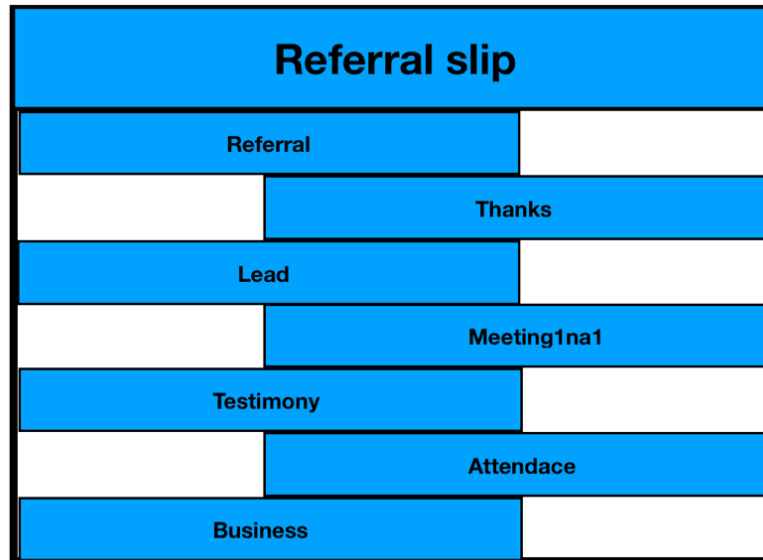


Figure 1. Specific networking interactions between SMEs performed in 2014–2018.

### 3. Results and Discussion

In the last decade, authors researching this topic agree that SMEs operate in a turbulent environment posing a number of threats, which (as confirmed by research) can be eliminated by creating a quality business network. Research further confirms that networking of the enterprise is directly related to its innovation and production. Networking becomes effective for the enterprise once networking activities lead to increasing the competitiveness and competitive advantage of the enterprise: increasing profits, reducing costs, multiple resources (Hamplová et al. 2019).

Networking activities bring much to the table when it comes to business. Competitiveness is linked to prosperity in the market. A specific example is a company that depends on a small number of suppliers or customers. A small number of suppliers may cause production problems and product or service delivery problems, even if at first glance it may seem that all the suppliers are prosperous and stable (Hedvičáková and Král 2019). A small number of primary customers (buyers) may cause major financial problems, should the company lose a few customers. The actors may ask why they should create and maintain a network of contacts when they have business enough, even too much to meet the demands. Creating and maintaining relationships (ties) is a preventative measure for a possible period of crisis.

Small and medium-sized enterprises can combine to form a power equal to that of a corporate business, as long as they operate in a network, whether informally or formally classified and categorised. By virtue of connections and networking, the SME owner is surrounded by various experts, much like a corporate company has dedicated departments to manage finances, marketing, logistics, communication, education and others.

Correlation and other comparative analyses yield the following results:

- Strong dependence with a correlation coefficient of 0.7 with a high level of significance was demonstrated between the 1on1 Meeting variable and the Thanks variable, which covers thanking for a business deal or a transfer of business information, knowledge and education which will contribute to closing a deal in the future or when the deal is not yet closed and its value cannot be established.
- A high correlation was also demonstrated in the 1on1 Meeting and the Participants variable; it is obvious that the more participants attend an event, the more opportunities for 1on1 Meetings arise.
- A higher correlation value also applies to the Testimony variable and the 1on1 Meeting variable, when the actors attest to the quality of services provided by other actors whom they meet in

person, which results in recommendations to other participants, thus increasing the likelihood of closing a contract, manifesting the power of the third party and the power of recommendation.

- When there are more than 12 participants at a single event, the value of a deal per regular participant doubles. In the monitored period between 2014 and 2019, groups of up to 12 members scored an average business value of approximately 200 thousand CZK of turnover, events of more than 12 participants scored an average business value of 390 thousand CZK in the same period.
- The results also include extreme values, for example, in the monitored period one group scored a record turnover from 1 participant to 9 regular participants amounting to hundreds of million CZK, which was owing to a major development project in the area

The more often small and medium-sized entrepreneurs attended 1on1 meetings to grow their business and find connections, the higher the thanks and the business gained from networking. A 1on1 meeting is a business meeting where each of the participants has the same space to communicate their goals and the partners then together look for ways of mutual assistance. The 1on1 meeting is significant because its participants already know each other, as they have met at least once in person at a standard meeting held regularly by the company which organises the meetings for this purpose.

Regular events taking place every two weeks serve as the point of first contact and opportunity to follow up at 1on1 meetings. Organising events is a demanding task, so it is most convenient for a third party to do the organising, so that the participants have time enough and space for networking rather than attending to organisational details. A big theme in offline networking is the connection to online networking; as today there are many industries where teams collaborate remotely. Social networks serve as a space where entrepreneurs build and maintain remote relationships. They meet some of these contacts offline as well, others not at all. An effective connection of offline and online networking and their mutual proportions or frequency of occurrence for SMEs is another area needing further research, as it significantly impacts the competitiveness and competitive advantage of this group, which is regarded as the backbone of the economy in the Czech Republic and elsewhere.

Within online networking, it is common to evaluate data; there are different tools that track various conversions of given parameters, such as measuring the interest of the audience in a given company communication (Hruška et. al. 2018). Within offline networking, such feedback is not readily available. So far it is necessary to take notes on the results of individual interactions between the participants in the old-fashioned way. Online tools are however very helpful for offline networking and can make it more effective. Connecting these two areas, face-to-face and virtual, makes companies more effective and increases their competitive advantage. However, it is proven that trust is established only after 5 to 8 meetings in person, hence face-to-face meetings cannot be entirely excluded from business interactions as yet. As long as the business transactions work as expected, online space is sufficient; but when there are any issues, everyone prefers to meet in person and communicate face-to-face in order to set up standards in order to continue the cooperation.

		Correlations										
		Meeting1na1	Thank	Business	Referral	ClubMeeting	Guest	Participant	TotalReferral	Lead	Testimony	Attendance
Meeting1na1	Pearson Correlation	1	,702**	-,050	,459**	,471**	,726**	,779**	,880**	,605**	,655**	-,117
	Sig. (2-tailed)		,000	,629	,000	,000	,000	,000	,000	,000	,000	,257
	N	96	96	96	96	96	96	96	81	96	96	96
Thank	Pearson Correlation	,702**	1	,013	,376**	,556**	,557**	,736**	,724**	,579**	,471**	-,054
	Sig. (2-tailed)	,000		,899	,000	,000	,000	,000	,000	,000	,000	,599
	N	96	97	97	97	97	97	97	81	97	97	97
Business	Pearson Correlation	-,050	,013	1	-,056	,091	,036	,024	-,055	-,056	-,010	-,023
	Sig. (2-tailed)	,629	,899		,586	,377	,726	,813	,627	,585	,923	,825
	N	96	97	97	97	97	97	97	81	97	97	97
Referral	Pearson Correlation	,459**	,376**	-,056	1	,457**	,231*	,501**	,733**	,522**	,552**	-,038
	Sig. (2-tailed)	,000	,000	,586		,000	,023	,000	,000	,000	,000	,709
	N	96	97	97	97	97	97	97	81	97	97	97
ClubMeeting	Pearson Correlation	,471**	,556**	,091	,457**	1	,478**	,747**	,644**	,504**	,366**	-,164
	Sig. (2-tailed)	,000	,000	,377	,000		,000	,000	,000	,000	,000	,109
	N	96	97	97	97	97	97	97	81	97	97	97
Guest	Pearson Correlation	,726**	,557**	,036	,231*	,478**	1	,683**	,711**	,490**	,497**	-,009
	Sig. (2-tailed)	,000	,000	,726	,023	,000		,000	,000	,000	,000	,931
	N	96	97	97	97	97	97	97	81	97	97	97
Participant	Pearson Correlation	,779**	,736**	,024	,501**	,747**	,683**	1	,797**	,701**	,640**	-,055
	Sig. (2-tailed)	,000	,000	,813	,000	,000	,000		,000	,000	,000	,595
	N	96	97	97	97	97	97	97	81	97	97	97
TotalReferral	Pearson Correlation	,880**	,724**	-,055	,733**	,644**	,711**	,797**	1	,762**	,812**	-,091
	Sig. (2-tailed)	,000	,000	,627	,000	,000	,000	,000		,000	,000	,421
	N	81	81	81	81	81	81	81	81	81	81	81
Lead	Pearson Correlation	,605**	,579**	-,056	,522**	,504**	,490**	,701**	,762**	1	,632**	-,065
	Sig. (2-tailed)	,000	,000	,585	,000	,000	,000	,000	,000		,000	,530
	N	96	97	97	97	97	97	97	81	97	97	97
Testimony	Pearson Correlation	,655**	,471**	-,010	,552**	,366**	,497**	,640**	,812**	,632**	1	,069
	Sig. (2-tailed)	,000	,000	,923	,000	,000	,000	,000	,000	,000		,504
	N	96	97	97	97	97	97	97	81	97	97	97
Attendance	Pearson Correlation	-,117	-,054	-,023	-,038	-,164	-,009	-,055	-,091	-,065	,069	1
	Sig. (2-tailed)	,257	,599	,825	,709	,109	,931	,595	,421	,530	,504	
	N	96	97	97	97	97	97	97	81	97	97	97

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

**Figure 1.** Correlation performed in the SPSS programme on SME interaction data collected from 2014 to mid-2018

#### 4. Conclusions

Offline networking activities have always been part of our lives. People meet for various purposes, connect in various groups, associations and trade chambers. Offline networking as a marketing strategy and marketing tool is a well-known concept among small and medium-sized entrepreneurs, however, only a small percentage of companies can use the networking tool effectively. These activities are closely related to the company's vision and goals. It transpired from the interviews that given the former lack of business and management education in the Czech Republic, many business owners learn these things on the go. Many companies are not clear about their direction, which means that they cannot clearly communicate their goals and use their contact network effectively. Networking activities are closely related to knowledge about how to set up a networking plan, how to communicate this plan and, last but not least, how to evaluate and plan further activities. Offline networking is a very important activity for each business because it is a part of competitive advantage and competitiveness on the market. Companies that create and maintain a quality network of contacts overcome periods of crisis because they have backup resources and more options to turn to.

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# Real Property Tax in Polish Communes of the Polish-Czech Border Region

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**Abstract:** Real property tax is one of the most important local taxes constituting the revenue of communes in Poland. At the same time, Polish communes have much greater freedom in shaping its rates, compared to Czech communes. This article analyzes the development of tax rates by Polish communes in the Polish-Czech border region throughout 2018. The purpose of this analysis is to examine whether local governments, located in the border region, differentiate their tax policy in terms of individual real property tax rates, and whether the specifics of the dominant type of economic activity in the commune can have an impact on rate formation. The study used data on the amount of tax rates adopted for 2018 by the councils of individual communes. Polish communes located in the Polish-Czech border region show a differentiated approach to shaping tax advantages in the area of real property tax rates, in particular in the regional system and in the scope of beneficiaries of advantages used. As can be seen, the tax policy of the analyzed communes is geared more to limiting the tax burden imposed on residential real property, and therefore it is pro-social, rather than pro-business.

**Keywords:** local government tax; real property tax; tax preferences; local development; borderline areas

**JEL Classification:** H41; H71; O23

## 1. Introduction

When Poland joined the European Union, border regions became an interesting place to live and do business. Communes in Poland do not have a wide range of instruments to attract new residents and investors, and the few that can be used include tax advantages under local taxes (Olejniczak 2012). At the same time, it should be noted that the most important taxes are those imposed on real property (Malkowska and Gluszak 2016). Therefore, the question arises whether and how communes use the possibility of establishing tax rates in real property taxes, and whether the choices made by communes are related to the specificity of the type of economic activity conducted in a given commune. It should also be noted that the areas along the border between Poland and the Czech Republic are characterized by significant diversity, i.e. due to the topography, dominant types of business activity, tourist attractiveness or the richness of natural resources. Thus, the analysis of the adopted tax policy of communes in the field of property taxes - on real property, agriculture and forestry, may lead to the discussion on the perception of the significance and role of tax advantages in revenue of communes.

Research on local taxes has been undertaken for many years both in Poland and worldwide. They may concern many dimensions of tax policy – from the issue of income independence of local governments (Kneller et al. 1999; Malkowska et al. 2018; Olejniczak 2015), through the impact on the situation of taxpayers (O'Brien 2017), the environmental issues (Dziuba 2015), the impact of the level of competitiveness of a given municipality (Bondonio and Greenbaum 2007; Malkowska and Gluszak 2016; Poliak 2017; Bimonte and Stabile 2020), the premises and consequences of tax policy including tax mimicking and tax competition (Lyytikäinen 2012; Sedmihradská and Bakos 2016; Swianiewicz and Lukomska 2016) and impact of democracy level on local taxation (Asatryan et al. 2017). In Poland,

such studies were usually conducted in limited areas covering a region, selected agglomerations or individual municipalities (including abovementioned papers and e.g. Felis and Rosłaniec 2019; Skica et al. 2013; Swianiewicz 2009). For the communes of the Polish-Czech borderland it is difficult to find similar research in the literature, so due to the advantages and specificity of this borderland the topic seems worth undertaking.

This article is part of a research project on the tax policy of communes in Poland and the Czech Republic, which is reflected in the focus on taxation problems of communes in the Polish-Czech border region.

## 2. State of Art

The tax system in Poland is characterized by the division of the tax authority between central authorities (government) and local government authorities (communes). This division is characteristic for unitary states where usually the most efficient and common taxes (consumption and income taxes) are state budget revenues, while less efficient property taxes remain the responsibility of local governments. In practice, there are various solutions modifying the aforementioned division that supplement the income of local government units (shares of local governments in central taxes), nevertheless, in relation to local taxes, local governments have tax authority which is understood as the possibility of using various types of tax advantages (within the limits permitted by law).

In the case of commune local governments in Poland, one of the most efficient local taxes, in respect of which communes have tax authority, is the real property tax, which is supplemented by agricultural and forestry taxes. As can be observed, these three taxes cover all real property, and thus conducting tax policy in this area (apart from a few statutory exceptions) falls within the competence of communes. Therefore, it should be assumed that communes can use the opportunity to shape tax advantages to increase the attractiveness of their region for residents, entrepreneurs and future investors.

As already mentioned, property tax is the most important source of income among local taxes. This tax was introduced by the provisions of the Act on local taxes and fees (*Act of 12 January 1991 on local taxes and fees*, 1991). The subjects of taxation are lands, buildings or parts thereof (generally irrespective of their destination) and structures or parts thereof related to conducting business activities. Real property tax is not subject to arable land or forests, with the exception of those used for running a business activity (subject to agricultural or forest tax, respectively). There is also a significant group of land exempt from taxation of land - including: land under flowing surface waters, land under public roads, real property used for the needs of local government units. It is important that determining the amount of property tax rates in force in a given commune falls within the competence of commune councils (legislative bodies). The Act and subsequent updating regulations specify only the height of the upper limits of tax rates: seven quota rates for land and buildings (calculated for the area in m<sup>2</sup> or ha), as well as one percentage rate on the value of the building. The upper limits of quota rates are subject to annual valorization using the consumer price index for goods and services announced by the President of the Central Statistical Office (GUS).

When adopting tax rates, commune councils may vary their amount for individual categories of taxable subjects using criteria specified in the Act (location, type of building, type of business, purpose, manner of land use, technical condition, age of the building) or other ones determined by the commune council.

Municipal councils also have the power, by means of resolutions, to introduce tax exemptions of an objective nature other than those specified in the Act, however, these exemptions are of a limited nature and are not the subject of this article.

Two other taxes – agricultural (*Act of 15 November 1984 on agriculture tax*, 1984) and forestry taxes (*Act of 30 October 2002 on forest tax*, 2002) relate to specific types of land - areas that are used for so-called agricultural or forestry production. Agricultural tax applies to land classified in the land and building register as arable land or as woodland and shrubland on arable land. This does not apply to land used for running a business activity other than agricultural activity. A farm is obliged to pay agricultural tax if its area exceeds 1ha or 1ha. It should be noted that the agricultural tax has two rates

– for the land of the above-mentioned farm it is the equivalent of the price of 2.5 quintals of rye – from 1 hectare (depending on the class/quality of land) and for other agricultural land that is subject to agricultural tax and does not constitute farm it is the equivalent of the price of 5 quintals of rye – from 1 hectare. As can be observed, the tax rates depend on the average rye purchase price. Commune councils may take the opportunity to lower the said basic price.

On the other hand, in the forest tax, forests are subject to taxation (forest land classified in the land and building register as forests). This does not apply, as in the case of agricultural land, to land used for running business activity other than forestry activity. The basis for taxing the forest is its area, expressed in hectares. Forest tax for 1 ha for the tax year is the monetary equivalent of 0.220 m<sup>3</sup> of wood, calculated at the average selling price of wood. The commune council may reduce the amount which is the average wood selling price. Table 1 shows the maximum rates used in 2018.

**Table 1.** Maximum local tax rates in 2018.

No. of the rate	Subject of taxation	Rate (PLN)
1.1	land related to running a business, regardless of the manner in which land and buildings are classified in the register (m <sup>2</sup> )	0.91
1.2	land understanding surface waters or flowing surface waters, lakes and artificial reservoirs (ha)	4.63
1.3	other lands, including those used for conducting a payable statutory activity of public benefit activities by public benefit organizations (m <sup>2</sup> )	0.48
1.4	undeveloped land, covered by the area of revitalization, referred to in the Act of 9 October 2015 on revitalization (Journal of Laws of 2017, item 1023) (m <sup>2</sup> )	3.04
1.5	residential buildings (m <sup>2</sup> )	0.77
1.6	buildings connected with running business activity and residential buildings or parts thereof used for running business activity (m <sup>2</sup> )	23.10
1.7	buildings used for conducting business activity in the field of trade in certified seed (m <sup>2</sup> )	10.80
1.8	buildings connected with the provision of health services within the meaning of the regulations on medical activity, occupied by entities providing these services (m <sup>2</sup> )	4.70
1.9	other buildings, including those used for conducting a payable statutory activity of public benefit activities by public benefit organizations (m <sup>2</sup> )	7.77
1.10	Structures (value)	2%
2.1	Farm land (ha) *2.5 or *5	52.49
3.1	Forests (ha)	197.06

### 3. Methodology

The analysis covered selected communes of the Lower Silesian, Opole and Silesian voivodeships included in the communes located in the Polish-Czech border region pursuant to the Regulation of the Minister of the Interior and Administration (*The Regulation on the list of communes and other units of the main territorial division of the state located in the border region and a table specifying the range of this region*, 2005). According to the content of art. 12 of the Act on the Protection of State Borders (*Act on the Protection of State Borders*, 2019), the border region covers the entire area of communes adjacent to the state border, and on the sea section – adjacent to the sea shore. If the width of the border region determined in this way does not amount to 15 km, the area of communes directly neighboring with the communes adjacent to the state border or the sea shore is also included in the border region. In addition, units of the main territorial division of the state, whose borders are located in the border region designated in the way described above, are part of this region. This means that 48 communes of the Lower Silesian voivodeship, 18 communes of the Opole voivodeship and 24 communes of the



Silesian voivodeship that meet these criteria were examined in this study. The study did not include cities with powiat rights due to significant differences in their functions and the scale of size (number of inhabitants).

The analysis included the development of tax rates on real property, agricultural and forestry taxes in border communes, the structure of business activity conducted in selected communes (percentage of business entities conducting agricultural and forestry activity, industrial and construction activity as well as others), percentage of agricultural land in individual communes and the amount accommodation places (reflecting tourist values). The sources of data included resolutions on the amount of tax rates in individual communes (based on SP-1 reports Part A) and the Central Statistical Office (GUS) database. Due to the limited availability of GUS data for 2019, the study used data from 2018. There is no aggregate data on the amount of taxes before 2018, which makes it impossible to make an analysis for previous years. Due to the above restrictions, this article can be mainly considered pilot.

#### 4. Results and Discussion

The analysis of the use of the possibility of applying reduced tax rates in the examined communes covered all items from Table 1. However, in some cases, due to their low significance for the financial situation of communes and the small number of taxpayers covered by them, they were not included in the discussion. The first of the most important issues was to determine whether communes use the possibility of reducing tax rates in the case of land and areas related to running a business activity (except agricultural and forestry activity). Data analysis (Table 2, rates 1.1, 1.6, 1.7) showed that communes actively apply differentiation of tax rates for this group of real property. Only from 25 to

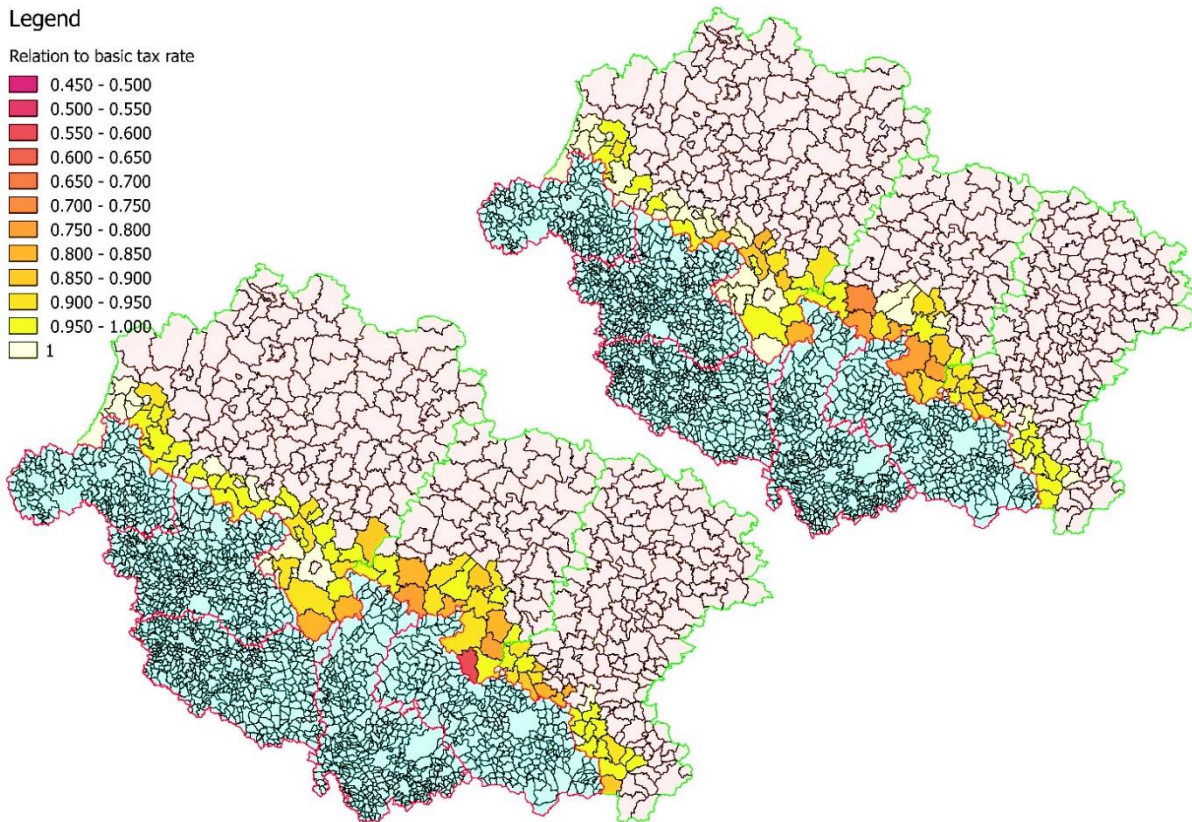
**Table 2.** Scale of reductions of individual real property tax rates (number of communes).

Range (%)	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9
100	36	50	23	46	31	21	46	49	27
<95,100)	26	30	8	30	26	37	33	29	26
<90,95)	15	5	9	1	22	16	3	7	4
<80,90)	9	5	11	1	8	13	6	2	14
<70,80)	4	-	21	-	3	2	1	1	12
<60,70)			8	2	-	-	1	-	3
<50,60)			8	-	-	1	-	2	3
(0,50)			2	10	-	-	-	-	1

50% of all communes maintained maximum rates, and the reduction in rates was mostly symbolic (around 5 p.p.) and resulted from the fact that the tax rate had not been changed compared to previous years. Nevertheless, it should be noted that in the case of about 20% of communes, the rate reduction exceeded 10 p.p. On the other hand, the analysis of the rates in relation to the region (Figure 1) indicates that lower tax rates are more common in the Opole and Silesian voivodeships.

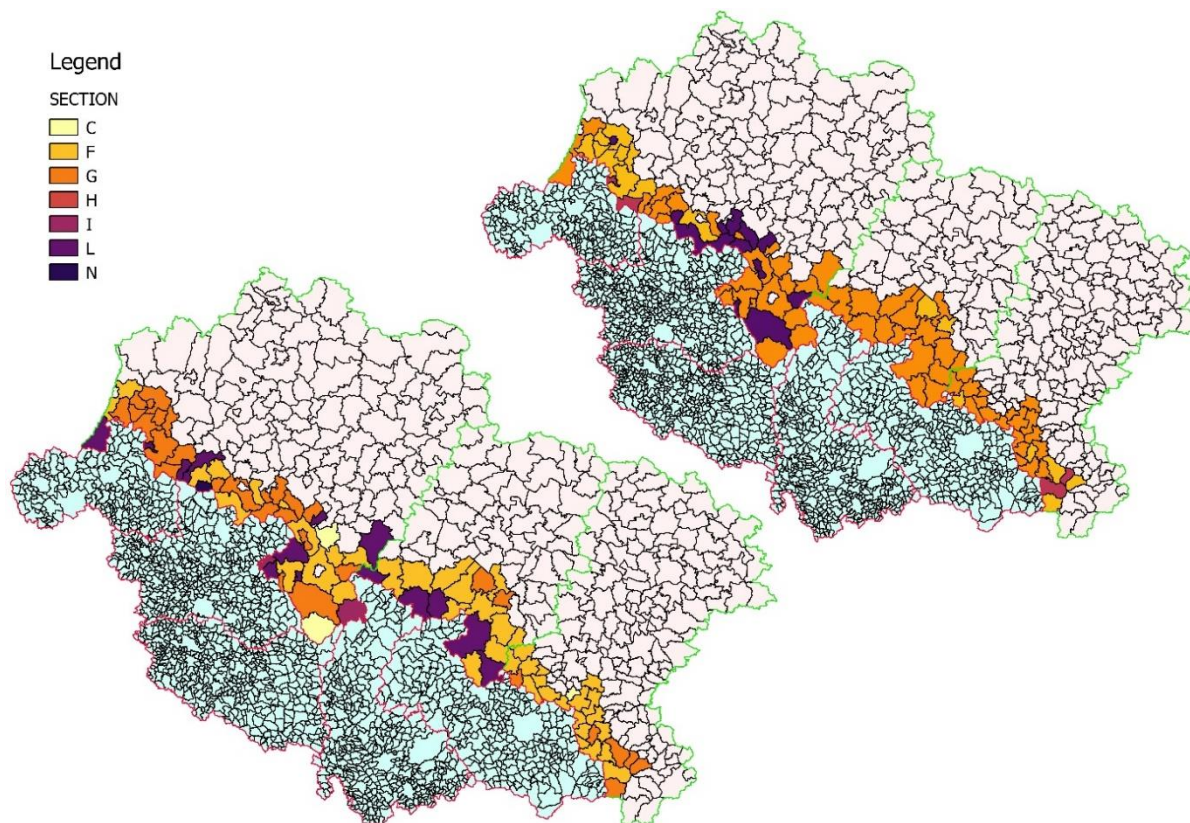
## Legend

Relation to basic tax rate



**Figure 1.** Relation of selected real property tax rates for land and buildings related to running business activity in communes to the basic rate (1.1 on the right, 1.6 on the left; description – see Table 1).

On the other hand, the communes of the western part of the Polish-Czech border are sporadically willing to apply reduced tax rates or they introduce slight reductions. On the other hand, it is difficult to assess the relationship between tax rate reductions and the dominant type of business activity in individual communes. For the purposes of analyzing this relationship, GUS data on the number of economic entities registered in individual sections of PKD (Polish Classification of Activities) in each of the communes was used. The most common sections have been identified for each commune (Figure 2). As can be seen, in most communes the section that is dominant is the section G - Wholesale and retail trade; repair of motor vehicles, including motorcycles. The second largest percentage of economic entities dominating in communes (Góry Sowie and Stołowe, Kotlina Kłodzka - that is the central part of the Polish-Czech border region in the Lower Silesian voivodeship) is section L - Real property market activities. As a consequence, in communes with a high number of accommodation places (Figure 4), there is the largest share of business entities in this section. In turn, in the western part of the Lower Silesian voivodeship, section F - construction dominates. These three sections usually take the leading positions in all communes, with the sections G and L taking the first two top positions in the communes with higher tourist values, and in other communes these are the sections G and F.

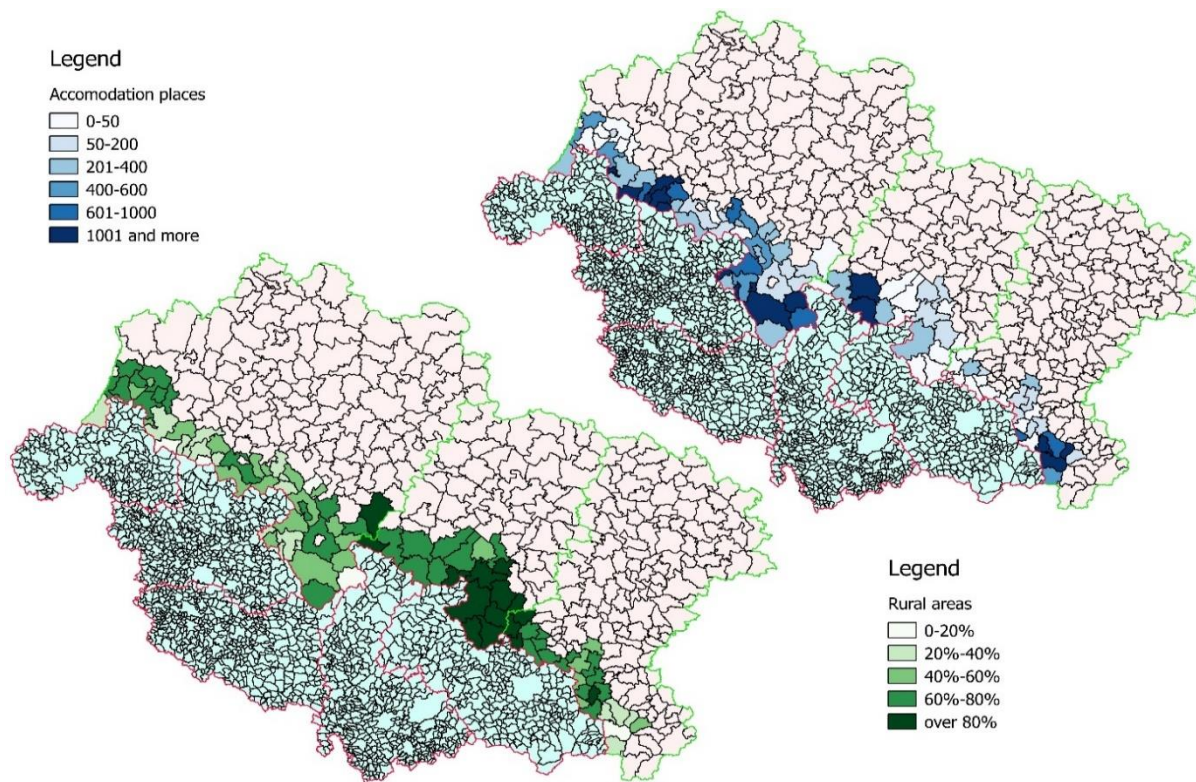


**Figure 2.** Main areas of activity of business entities by PKD section (the most common ones are on the right, the second most common ones are on the left).

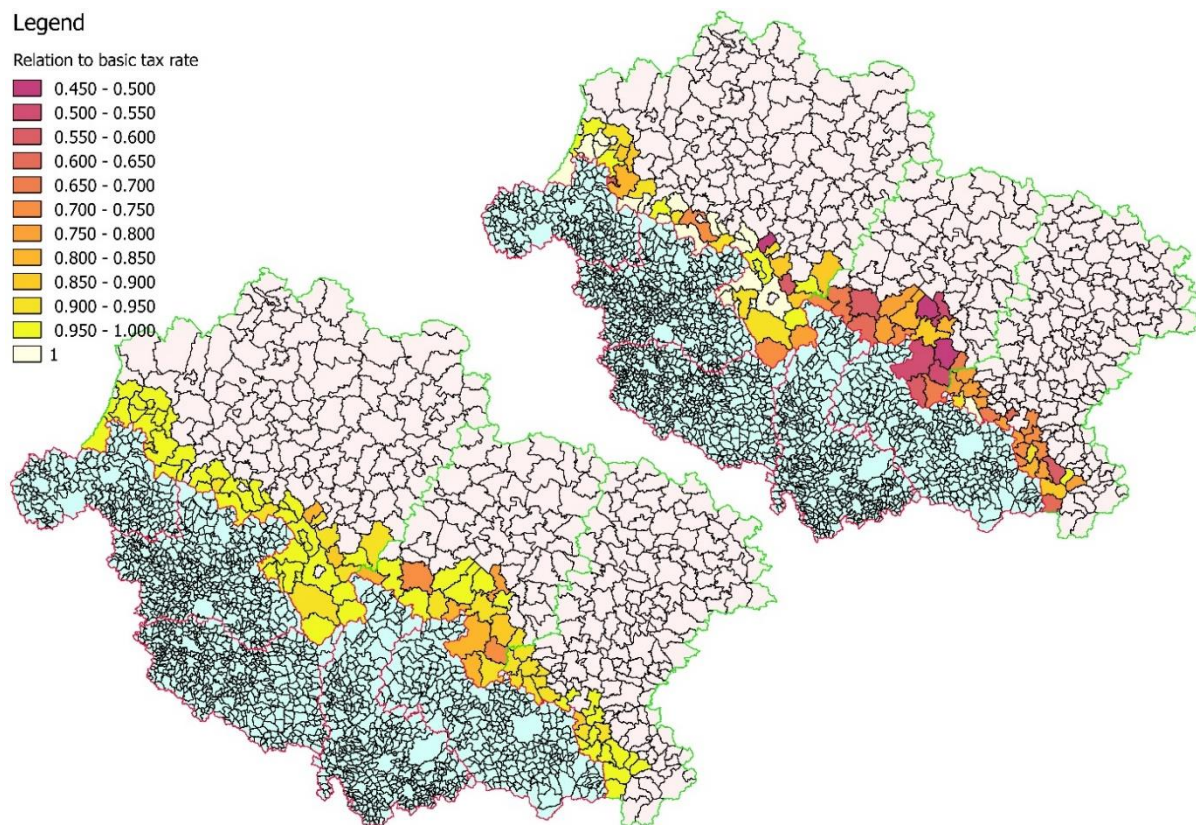
It can be observed that in those communes in which business entities conducting industrial and construction activities play a significant role, tax rates are reduced relatively less often. Also, when analyzing the scale of tourist traffic, it can be seen that the tax rates are higher in communes characterized by a high number of accommodation places (Figure 3).

On the other hand, the practice of communes looks different in relation to land and buildings not used for business activity purposes (rates 1.3, 1.4, 1.5, 1.9). In this group, there is a strong differentiation of tax rates with the smallest differentiation in the case of maximum rates for residential buildings where 80% of the communes introduced rates not lower than 90% of the ministerial rate (Figure 4). The spatial distribution depends here on the subject of taxation. In the case of "other lands", strong reductions in tax rates can be seen in the Opole voivodeship. It is followed by the Silesian voivodeship, and the smallest reductions have been observed in the Lower Silesian voivodeship. It should be noted that, as in the previous case, tourist and industrial communes were much less willing to reduce tax rates.

The situation is much different in the case of undeveloped lands covered by the revitalization area (rate 1.4) and other buildings (rate 1.9). While the reduction of rates by about 5 p.p. is common, the larger scale of reductions in these subjects of taxation occurs mainly in the communes of the Opole voivodeship. It should be noted that these communes are characterized by a high percentage of arable land (Figure 3), which may indicate a relatively lower wealth of residents and the use of tax advantages as a tool for redistributing public funds to citizens. However, in the case of the agricultural tax alone, only in two communes the tax rates were reduced, and in the case of forestry tax only one commune decided to reduce the tax rates.



**Figure 3.** Number of accommodation places in individual communes (on the right) and percentage of agricultural areas (on the left).



**Figure 4.** Relation of selected real property tax rates for land and buildings not related to running business activity in communes to the basic rate (1.3 on the right, 1.5 on the left).

## 5. Conclusions

To sum up, it can be pointed out that Polish communes located in the Polish-Czech border region show a differentiated approach to shaping tax advantages in the area of real property tax rates, in particular in the regional system and in the scope of beneficiaries of advantages used. In the field of taxes on real property used for business purposes, it is difficult to indicate to what extent the specificity of its dominant types influences the decisions taken by legislative bodies, but it can be stated that the conducted research provides premises for further analyses in this respect. One should also pay attention to increasing problems with the level of financial support for communes adequate to the needs, which to some extent will limit the activity of the communes in reducing tax rates. As can be seen, the tax policy of the analyzed communes is geared more to limiting the tax burden imposed on residential real property, and therefore it is pro-social, rather than creating significant tax advantages for entrepreneurs. It may also be of considerable importance here that 2018 was a year of elections in local governments. Due to the limited, or even pilot nature of the research, and the limited availability of data, the authors are aware that the above considerations are only a contribution to a wider discussion and further, in-depth analysis of the problem. The authors are also aware that a significant limitation of the conducted research is the inability to use statistical methods to answer the research questions.

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# Transmission of Prices Between Individual Links in the Production and Distribution Channel of Cereals and Cereal Products of Primary and Secondary Processing in Poland in the years 2004–2018

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**Abstract:** The study analyzed data on an exemplary primary wheat processing product - Poznanska flour and then a product of secondary processing (plain mixed bread). The collected data refer to the years 2004–2019. The differences between the prices of cereal production and prices as well as the primary processing level and the prices of the secondary processing product are systematically increasing. At the first two levels, prices fluctuated quite significantly. The producers and the sellers of bread, during periods of significant decreases in cereal procurement price and the producer's price for flour, usually kept their prices at a similar level, while periods of rising prices for cereals and flour were used for significant price increases. Bread producers had a dominant position at individual production stages in the analyzed years. Their share in the final price was always the largest and most stable, and the price growth achieved by them was the highest. The strongest relationships were found between the average procurement prices of wheat and the selling prices of flour producers.

**Keywords:** price transmission; wheat procurement price; flour producers' prices; producers' and retail bread prices

**JEL Classification:** P22; P42; Q13

## 1. Introduction

In most food industries, the purchase price of raw material constitutes the main cost. In this context, one can follow the price formation process from the supply side of the raw material and the finished product that goes to the market. In a well-functioning market, it can be assumed that the prices of processed products will be correlated with the purchase price of the basic raw material. Finished product prices are also influenced by many factors on the demand side. The price of the raw material and the product at various stages of its production is, therefore, the result of many elements and factors appearing on the market in each place and time. The final price of the product is very important as it determines the competitiveness of this product on the market. An attractive final price, especially for necessities, i.e. food, provides a competitive advantage during trade exchange with foreign partners. The importance of price in trade in products from the food and agricultural industries is discussed in detail in the publications by i.e. (Firlej et al. 2017; Kowalska et al. 2017; Kowalska et al. 2019).

The study analyses the data on an exemplary primary wheat processing product - Poznanska flour and then a product of secondary processing (plain mixed bread). The price margins of individual links (cereal producers, millers, bakers and traders) accommodate the volume of production and transaction costs, the profits achieved as well as the inefficiency of the market system [4]. The ability to shape sales prices of the products and the implementation of short- and long-term marketing strategies, including pricing, depends on the position of individual links in the production and distribution channel.

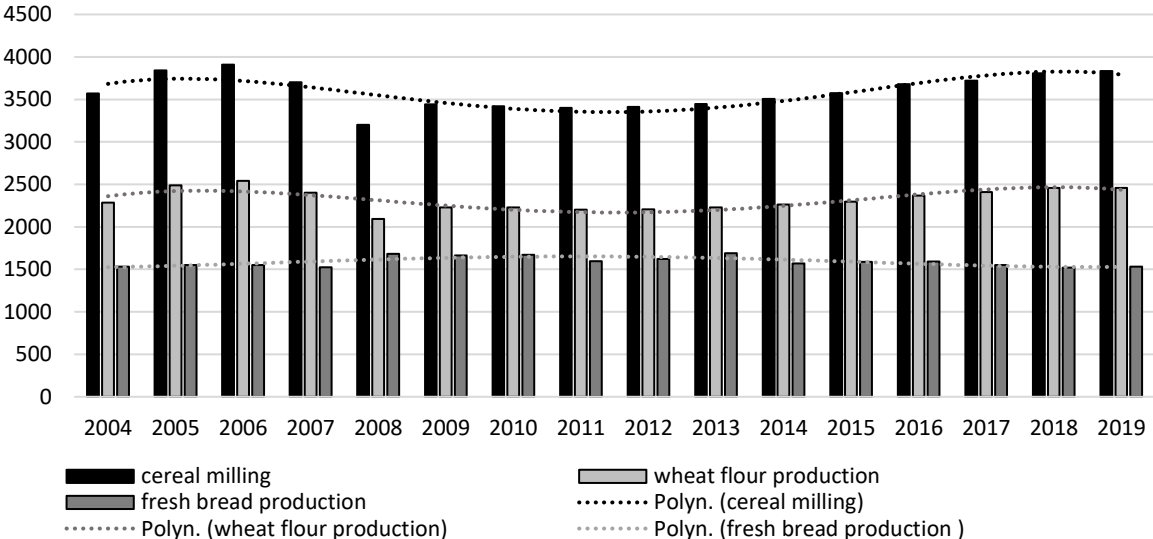
The purpose of the study is to analyze and evaluate price changes between individual links in the production and distribution channel of primary raw material (wheat), pre-processed product - wheat flour and secondary processing product - plain mixed bread.

**2. Methodology**

The data on the investigated products were taken from the studies of the Institute of Agricultural and Food Economics - PIB (Agricultural Market. Analyses, Trends, Assessment and Cereal Market (Status and Perspectives) as well as Agricultural Statistical Yearbooks published by the Central Statistical Office. The collection of data was conducted from the beginning of 2004 to August 2019. All the data used come from the reports prepared for the needs of the Central Statistical Office. Due to the changing level of inflation, the proportions between prices were mainly expressed in the form of price relations. The relationships were examined using basic methods of statistical analysis of data, including calculations of correlation coefficients between prices on individual links of the marketing chain.

**3. Results and Discussion**

In the analyzed years, domestic consumption of cereals and cereal products fluctuated significantly. The size of grain milling varied from 3200 thousand tons in 2008 to 3909 thousand tons in 2006 (Fig.1). After relatively significant fluctuations in the first five years of the period under review, a gradual and relatively steady increasing tendency in the volume of cereal milling for consumption was observed in subsequent years. In 2018, it reached the level of 3 835 thousand tons. The trends in the production of wheat flour were similar. Its share in the total flour production was relatively constant during this period. The minimum volume was recorded in 2008 and it amounted to 2093 thousand tons and the maximum in 2006 when it reached 2543 thousand tons. The coefficient of variation for grain milling volume was 5.61% and in the case of wheat flour production - 5.41%. Slightly different trends occurred in the production of fresh baked goods. In this case, the changes were smaller (3.74%) and they occurred regardless of the fluctuations of the two previously analyzed values. The minimum bread production volume was recorded in 2018 (1519 thousand tons) and the maximum in 2013 - 1689 thousand tons.

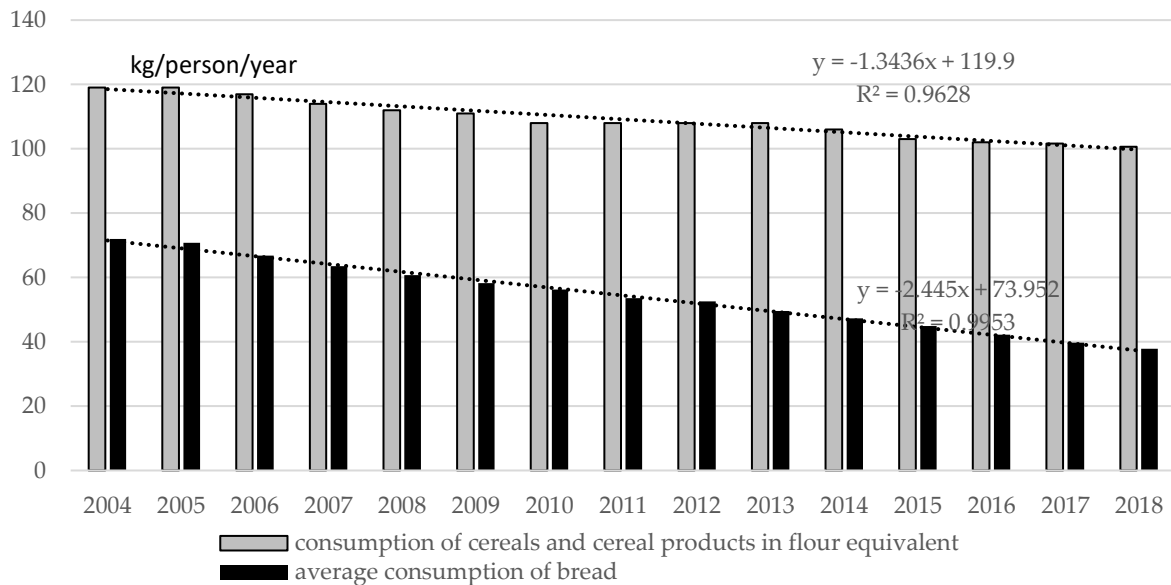


**Figure 1.** Cereal milling, wheat flour production and fresh bread production in Poland in 2004–2018 (thousand tons).

Demand for cereal processing products in Poland gradually decreased (Fig.2). Their total consumption in flour equivalent decreased at an average rate of about 1.3 kg/person/year, from 119 kg

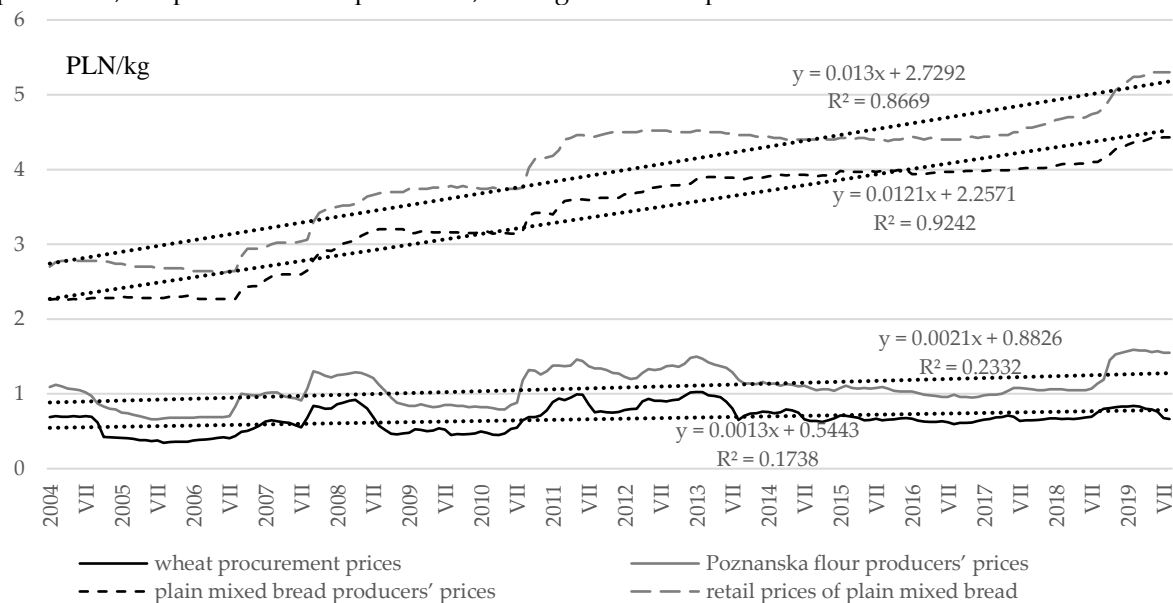


in 2004 and 2005 to 100.6 kg in the last year of the analysis. This means a decrease of about 15 pp. The average consumption of bread dropped much faster, at a rate of about 2.4 kg/person/year. In the analyzed period, this consumption decreased by as much as 47 pp. In both cases, very high trend line fits were obtained, which indicates that also in the coming years these values shall be largely predictable. This is a serious challenge for the baking industry. How, in the case of such decreasing demand, to stay in the market and what marketing strategy to use to get relevant revenues from the sales of products.



**Figure 2.** Average annual consumption of cereals and cereal products in flour equivalent as well as average consumption of bread in Poland in 2004–2018 (kg/person/year).

The next drawing (Fig.3) presents how the average prices changed at individual stages related to the production of plain mixed bread, starting from wheat procurement prices, through the prices of flour producers, the prices of bread producers, ending with retail prices of bread.



**Figure 3.** Average wheat procurement prices, flour producers' prices, bread producers' prices and retail prices of plain mixed bread in Poland in 2004–2019 (PLN/kg).

Even preliminary analyses show significant differences in the average price formation in the first two links of the marketing chain of bread production, covering wheat production and flour

production, compared to the prices of bread producers' and the retail prices of bread. First, it is visible that the differences between the prices of cereal production together with the prices of the primary processing level and the prices of the secondary processing product tend to increase rather systematically.

Procurement prices of wheat fluctuated to the greatest extent over the period considered (coefficient of variation: 25.17%). These prices changed quite significantly around the marked trend line with a minimal growth tendency. The average prices of flour producers were less variable (21.95%). Trend line analyses indicate that these values have gradually increased over the years, to a greater extent than in the case of the wheat procurement prices. It should also be noted that in both cases the level of trend line fit was very low. The data initially indicate that these two links were strongly interrelated.

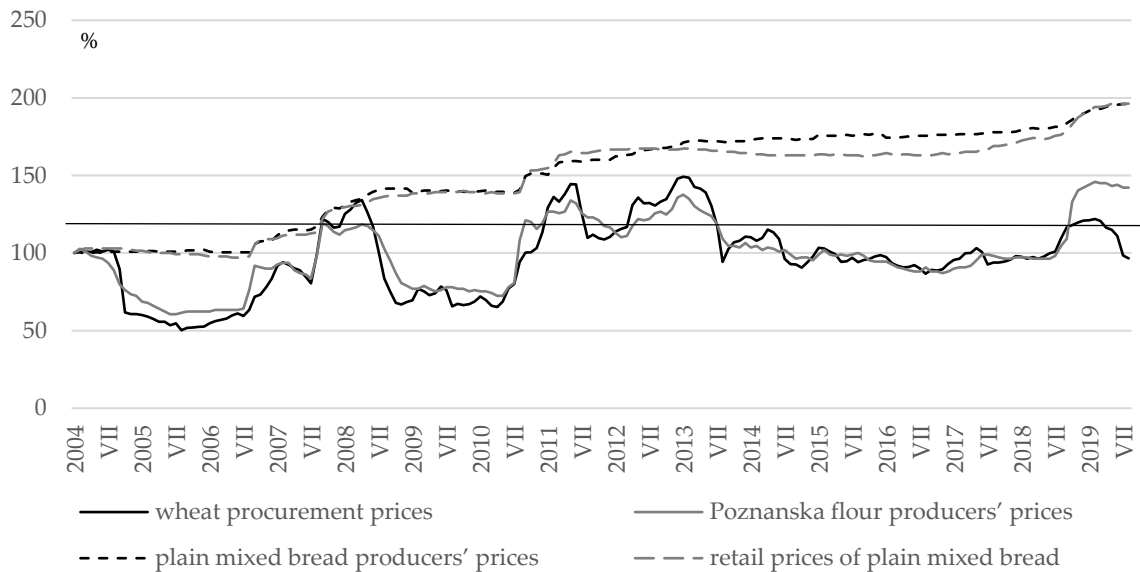
The average prices of bread producers also fluctuated significantly (20.19%). However, they grew at a much faster rate compared to the previously analyzed prices. The retail prices of mixed bread increased even faster. The level of variation for these prices was the lowest and amounted to 19.3%. The level of trend line fit was high in both cases. In both links, price fluctuations were not as sharp as in the case of cereal producers and milling industry. They were more extended in time and the given direction of price changes continued for a longer time.

These conclusions can be confirmed by the analysis of the dynamics of changes in the examined prices. The analysis comprised the calculation of dynamics with a fixed basis, for which January 2004 was adopted (Fig. 4). The procurement prices of wheat in numerous months were lower than those of January 2004. In September 2005 they reached the minimum level of approximately 52% of the average January 2004 price. Prices lower than the initial price were kept for three marketing years. In the 2008/2009 marketing year, they were more favorable in several months, but the next two made another period of low prices on this market. In subsequent marketing years until the 2018 harvest, prices fluctuated, but usually at a level like those from the beginning of 2004. Sales prices of the analyzed milling product changed in a similar rhythm, while in periods of low prices on the cereal market, the dynamics of flour sales prices were usually slightly more favorable. At a time when wheat procurement prices grew to a greater extent, the dynamics of the milling product sales price was slightly lower. After a long period of stabilization of wheat procurement prices and flour producers' prices, a significant change in the milling industry took place after the 2018 harvest. Flour selling prices increased in the following months to a much greater extent than wheat procurement prices and the market reacted only slightly to the rapid reduction in cereal prices in 2019.

The prices of bread producers' and the retail prices of this product were structured in a quite different manner. The average prices at these stages were quite stable until the 2006 harvest, and it was a period of a significant drop in prices in the first two links. Until August 2008, these prices used to rise steadily. In the final months, price increases in these links compared to January 2004 reached a similar level. When cereal and flour prices reached very low levels again (harvest season 2011), prices at these two successive levels stabilized again. Increases in the prices of cereals and flour in subsequent years were associated with further growth in prices at the bread production stage. Another long period of relative price stabilization at the stage of wheat procurement and flour production was again associated with price stabilization on the bread retail market and only a slight reduction in margins at the production stage. Such a strategy of conducting price policy in the bakery sector and in the retail trade of plain mixed bread led to the situation in July 2019 when the average purchase prices of wheat amounted to 98.4% of prices from January 2004, the selling prices of Poznanska wheat flour were at the level of 142.2% and selling prices of plain mixed bread and its retail prices -196.3% of the prices from the beginning of 2004.

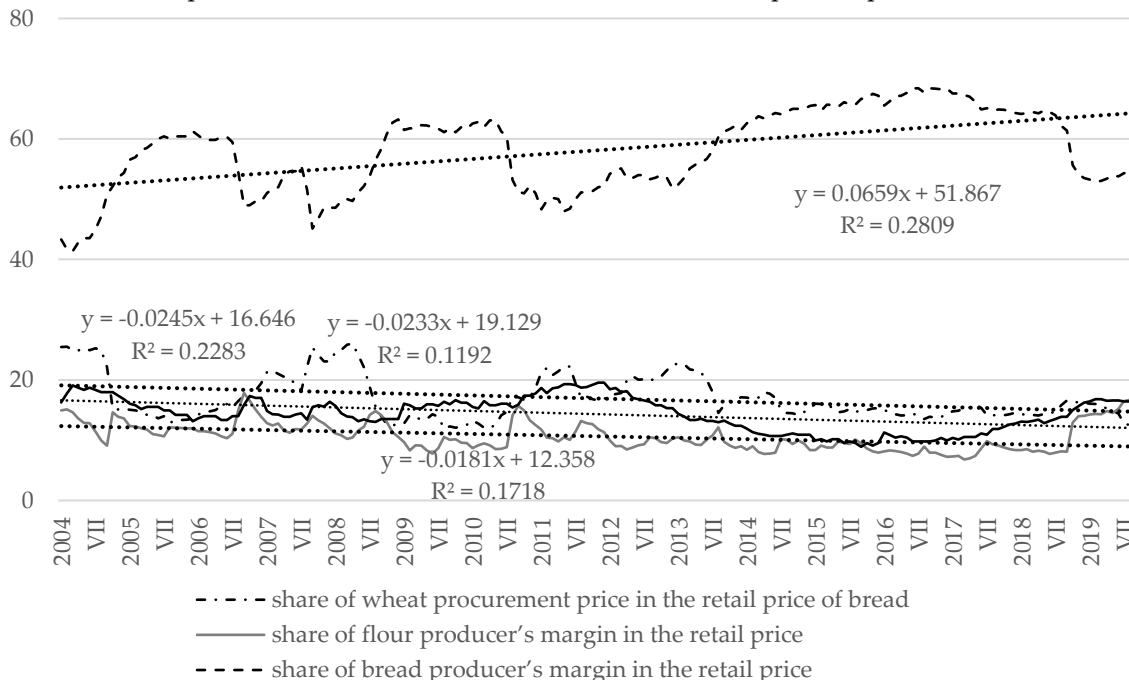
Observing these data, it can be said that millers, at least until the harvest in 2008, responded to changes in the purchase prices of wheat by increasing and decreasing the selling prices of their product. Producers and traders of bread also closely monitored price changes at earlier stages of production of the raw material for their production, but they reacted in an entirely different way. In the periods of the price fall observed at the earlier stages, they stabilized their prices, and at the time of rising prices at earlier stages, they responded by a rapid increase in the prices of their products. As a result, despite growing inflation, farmers obtained for their product, in some periods, prices lower

than at the beginning of 2004. A similar situation remained also until the 2018 harvest at the milling level, while the average selling and retail prices of plain mixed bread increased in the analyzed fifteen years almost twofold.



**Figure 4.** Dynamics of average wheat procurement prices, the producers' prices of Poznanska flour as well as the producers' and the retail prices of plain mixed bread in Poland in 2004-2019 (January 2004 = 100%).

Further observations on the functioning of these markets are possible thanks to the analysis of figure 5 and 6 that present the shares of individual links in the retail price of plain mixed bread.

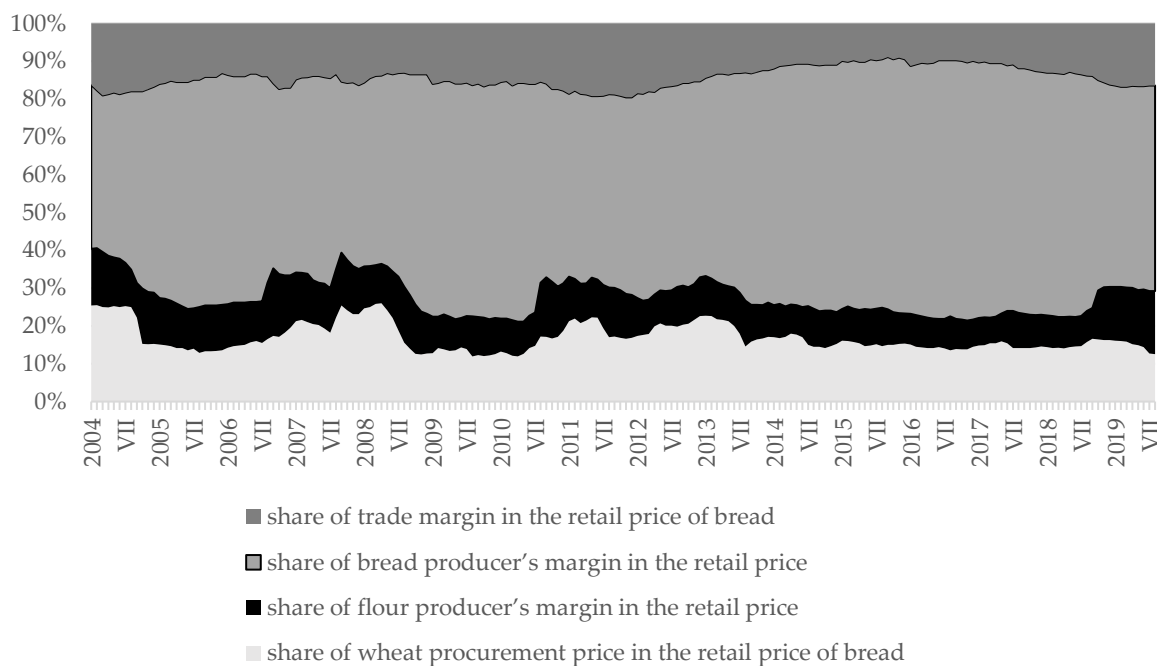


**Figure 5.** Shares of average wheat procurement prices, the producers' prices of Poznanska flour and the producer's price in the retail prices of plain mixed bread in Poland in 2004–2019 (%).

The largest share in the retail price of plain mixed bread in the whole analyzed period had the bakery margin, the share of which ranged from 41.37% (such share occurred at the beginning of the analyzed period) to 68.41% (which was recorded in 2016). Shares below 50% were registered in the first three quarters of 2004 and the last quarter of 2007 and 2008. These were the periods of rising

procurement prices for wheat. In the subsequent period, when these prices used to rise (2011 harvest), the margin was about 50%. In the following similar periods, no impact of the growth of wheat price on the bakery margin level was noted. Margins above 60% occurred in the 2005/2006 marketing year, from the fourth quarter of 2008 to harvest in 2010, and from harvest in 2013 to the end of the third quarter of 2018. In total, in 98 out of the 188 months analyzed (52.8 %), bakery margins were higher than 60%. Margins below 50% occurred in 23 months (12.2%). The presented data indicate that in 88% of the surveyed months the share of bakery margin in the price of plain mixed bread was at least 50%. The variation of these shares was the lowest among the analyzed ones and amounted to 11.6%. Hence, it can be concluded that the bakery margins were the highest and the most stable. The margins at the previous three stages were lower.

Procurement prices of wheat had the second-largest share. Their share in the retail price of the finished product ranged from 11.94 (after the harvest in 2009) to 26.03% (April 2008). In 23.4% of the analyzed months, wheat procurement prices had over 20% share in the price of bread, while in 40% of the months, those shares were lower than 15%. The variation of the share of wheat procurement prices in the retail price of bread was 21.7%. The margin of Poznanska wheat flour producers and the trade margins had comparable shares at the price of the analyzed final product. In the first case, the share of these margins ranged from 6.8 to 17.82% and the variation of these values was minimal although the highest among the three margins discussed in this part (22.3%). The shares of the trade margin in the retail price of bread ranged from 8.9 to 19.6% and the variation in the values of these margins was 19.5%.



**Figure 6.** Structure of wheat producers', milling, bakery and trade margins in the retail price of bread in Poland in 2004–2019 (%).

Table 1 presents the values of correlation coefficients between all analyzed prices at each of the analyzed levels of final product price formation. Correlation values were calculated for monthly data on a scale of each year for which full data was available. It was assumed that strong relationships between the values under review occur in the case of correlation coefficients greater than +/- 0.7. No correlation between the discussed values was assumed for the values in the range +/- 0.3.

The strongest relationships were found between the average procurement prices of wheat and the selling prices of flour producers. In eleven years, there were observed very strong positive correlations between these values. In the following year, a weaker positive correlation occurred. And only in three years, according to the adopted assumptions, no correlation was found between these values.

**Table 1.** Correlation coefficients between prices on individual links in the production and distribution chain of plain mixed bread in Poland in 2004–2018.

Years	Wheat procurement prices; flour producer's prices	Wheat procurement prices; bread producer's prices	Wheat procurement prices; retail price of bread	Flour producer's prices; bread producer's prices	Flour producer's prices; retail prices of bread	Bread producer's prices; retail prices of bread
2004	0.91	-0.63	<b>0.15</b>	<b>-0.80</b>	<b>-0.01</b>	<b>0.07</b>
2005	0.85	<b>-0.08</b>	0.86	<b>0.25</b>	0.79	<b>-0.21</b>
2006	0.93	0.95	0.94	0.94	0.94	1.00
2007	1.00	0.90	0.90	0.89	0.89	1.00
2008	0.94	<b>-0.85</b>	<b>-0.92</b>	<b>-0.71</b>	<b>-0.80</b>	0.98
2009	<b>0.11</b>	0.43	-0.54	0.43	<b>-0.14</b>	<b>-0.07</b>
2010	0.97	0.89	0.88	0.91	0.89	0.99
2011	0.90	-0.35	-0.37	<b>-0.27</b>	<b>-0.30</b>	0.98
2012	0.94	0.89	<b>0.16</b>	0.94	<b>0.02</b>	<b>0.06</b>
2013	0.95	<b>0.28</b>	0.91	<b>0.15</b>	0.96	<b>0.07</b>
2014	0.81	<b>0.28</b>	0.43	<b>0.26</b>	0.54	-0.32
2015	<b>0.21</b>	<b>-0.14</b>	0.49	<b>-0.76</b>	<b>0.13</b>	<b>-0.25</b>
2016	0.60	-0.59	0.46	<b>-0.84</b>	<b>0.25</b>	<b>-0.09</b>
2017	<b>-0.25</b>	-0.50	-0.40	0.75	0.67	0.97
2018	0.91	0.92	0.92	0.98	0.98	1.00

In the case of procurement prices of wheat and the prices of bread producers, significant positive correlations were found only in the five researched years. Similarly, strong relationships occurred in four of the analyzed years between all investigated price levels. These were the years 2006, 2007, 2010 and 2018. In the fifth of these years, strong relationships reached the level of bread producers. There was no correlation between 2008 and 2013-2015.

The procurement prices of wheat and the retail prices of bread were closely intertwined in six years. In 2005 and 2013, bread producers broke out of the chain of close links. In the remaining four years, these close relationships concerned all the links.

Bread producers and their sellers were strongly connected in terms of pricing in seven of the years analyzed. Apart from the years when price incentives were transmitted between all links in two years, in 2008 and 2011 there were strong connections only between procurement and flour producers and between bread producers and its sellers. In 2017, the prices at further stages were largely independent of wheat procurement prices. In price relations between bread producers and the trade, seven years were recorded when such relationships did not exist.

It should also be noted that the year 2008 was outstanding in terms of shaping mutual relations between prices at the analyzed levels. Close relationships occurred between the procurement prices of wheat and the prices of flour producers, and on the other hand between bread producers and retailers, but analyzing the remaining correlations, it can be concluded that there are high negative correlations. The prices at the first two levels fluctuated significantly while on the other two, they used to rise systematically.

## 5. Conclusions

In the years 2004-2019, the differences between the prices of cereal and flour production and the prices of secondary processing products systematically increased. At the first two levels, the prices fluctuated quite significantly and were often lower than at the beginning of the analyzed period. The producers and the sellers of bread, during periods of significant decreases in cereal procurement price

and the producer's price for flour, usually kept their prices at a similar level, while periods of rising prices for cereals and flour were used for significant price increases.

The bakery margin had the largest share in the retail price of plain mixed bread in the entire reviewed period. The analyses show that in 88% of the examined months the share of bakery margin in the price of plain mixed bread was at least 50% and in nearly 53% of the total number of examined months its share was higher than 60%. The variation of these shares was the lowest among the analyzed ones and amounted to 11.6%. Bakery margins were, therefore, the highest and the most stable. This demonstrates the high consistency and freedom in price formation at this stage of bread production. The margins at the previous three stages were lower. It is also the answer to the question of how bread producers have been dealing with the problem of falling demand for their products that have been going on for many years.

The strongest relationships were found between the average procurement prices of wheat and the selling prices of flour producers. In eleven years, there were very strong positive correlations and only in three years, by the adopted assumptions, there were no correlations between these values. Bread producers and its sellers were strongly price-related in seven of the fifteen years analyzed. Only in four years (2006, 2007 2010 and 2018), there was a strong positive correlation between prices at all investigated stages. In two years (2008 and 2011) there were strong relationships only between procurement and flour producers as well as between bread producers and its sellers. In 2017, the prices at further stages were largely independent of wheat procurement prices. Analyzing the prices of bread producers and the prices in retail trade it was found up to seven years when they developed independently of each other.

Summing up the previous considerations, it can be said that the bread producers had a dominant position in the reviewed stages of bread production in the analyzed years. Their share in the final price was always the largest and most stable, and the price growth achieved by them was the highest.

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# New Trends in Product Placement Strategies - Case of Instagram

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**Abstract:** The paper focuses on product placement strategies used on Instagram platform. 1,000 posts in total from 100 most influential instagrammers were analyzed. For each post numerous data were collected: URL, Number of Followers, Age Average, Likes, Comments, Publication format, The caption of the publication, Date of publication, Staging of the publication, The name of the brands placed, The category of the product placed (16 categories were taken into consideration). We found women are slightly more influential than men and make much more product placements in the "Beauty & Fashion" and "Clothes, Shoes" categories, but otherwise the category of the product is not much differentiated by the gender of the influencer. A category determines a popularity in terms of likes, while sport categories correlates positively with paid partnership captions. The video format has a lower popularity in terms of likes and the posts with products and influencers in the same photo are more appreciated than other staging.

**Keywords:** product placement; influencers; Instagram

**JEL Classification:** M2; O3

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## 1. Introduction

It is one of people's desires to socialize and communicate with each other. Digital social networking was born in 1971, when the first email was sent. In 1978 the first social media called BBS – (Bulletin Board System) was born. It was the first system that lets users interact with one another over the internet. By the 1980s, home computers were becoming more common and social media was becoming more sophisticated. Social media exploded in popularity after people came to the platforms and started to create and spread content. Today, there is an enormous variety of social networking sites and Instagram is in the top 5 of the favorite ones. The number of social media users worldwide in 2019 was 3.484 billion. (Chaffey 2019; Vondra 2015)

There is a real change between the media of the past and the media now. Although the majority of the past media is still used, most are not used as much or used in a different way. For example, newspaper sales have fallen down but at the same time the audience of the online version grew up due to the technological transition. Therefore, online advertisement also became more frequent. Nowadays, most of us get our news from social media, while newspapers are less utilized.

Every month, 1 billion people use Instagram. This platform was launched only seven years ago (October 2010 for iOS and a year and a half later for Android) and already has about 500 million active users daily. (Newberry 2019) The social networks allow users to upload photos and videos from smartphones, adding various filters, hashtags, caption and location information. The service also includes a messaging and sharing content features. An account's posts can be shared publicly or with pre-approved followers. The photo and video sharing social networking service is owned by Facebook. It was found that Instagram creates big social pressure therefore a big change on Instagram might be coming as Instagram is now testing disallowing of likes. The goal is to avoid the mental pressure because of an informal competition that some users experience. Many researches show that social networks cause damage to mental health partly because users are addicted to likes. For example, Nottingham Trent University study show that "it may be plausible to speak specifically of 'Facebook Addiction Disorder'...because addiction criteria, such as neglect of personal life, mental preoccupation, escapism, mood modifying experiences, tolerance and concealing the addictive

behavior, appear to be present in some people who use [social networks] excessively.” (Nottingham Trent University 2011)

Influencer marketing wasn't even an industry 5 years ago (Potancok 2013). It was the royal family who began the trend for "influencer marketing". Their influence was spread across the globe by the "British Empire".) Influencer marketing has been one of the most rapidly evolving types of marketing and it continues to grow. A lot of influencers have a considerable audience (= a high number of subscribers) on their accounts or channels. As of November 2019, the most followed person on Instagram is Cristiano Ronaldo, a Portuguese footballer with over 190 million followers. The most-followed woman is Ariana Grande, a singer with over 167 million followers. Nowadays, an influencer is a profession because it brings a high income, unlike before. More and more brands invest a big part of their marketing budgets into the hands of influencers. (Patel 2017)

Instagram has 4.200 billion daily likes and 95 million photos and videos uploaded daily (Newberry 2019). On Instagram, most of the content is photo although videos are becoming more and more popular. The 5 most famous hashtag on Instagram are: #love, #instagood, #photooftheday, #fashion and #beautiful according to Instagram. Hashtags are creating more traffic on posts and deliver engagement if they are used correctly. With at least one hashtag a post gain 12.6% more engagement. Including a location in a post is also a solution to have more engagement: about 79% more engagement. (Influencer Marketing Hub 2018)

In our research we were interested in what content is the most popular within people and who is creating this content. Some research has already been made in this area.

There is the case for the study "Happiness on Instagram - Content Analysis and Engagement Based on Attention Theory" (Li 2019) which is about Instagram and happiness. This study of Qiuwen Li and Young Ae Kim try to explain the concept of happiness on Instagram. To do that, the study downloaded the 200 most recent posts from individual accounts between January 9 and 20 2019 with the hashtag #happy or #happiness. The point here was to find the reality behind posts on Instagram concerning honesty. Are people being honest on Instagram? Are they being sincere with their comments? Are they truly happy when they put the hashtag #happy or #happiness?

The main results of Quiwuen's study show that the kind of post the more link to the idea of happiness is "physical appearance" with 36 %. It is 15 % more than happiness from the relationship and 27 % more than happiness from the achievement. This study then provides a better understanding of the behavior of Instagram users and what attracts them to this social network. In addition, this study shows that users' behaviors can be different according to the gender. Indeed, women like and comment on the content of others more than men (+2.3 times more comments and +1.7 times more likes). Finally, regarding sincerity, this study tries to show through the study of many accounts that Instagram often deviates from reality and that users are not always honest on this social network. To do this, they also observed the comments under the posts. Here, the results show that the majority of comments are not sincere and that only 13.1% of the comments are.

Another study to look for in a similar way to study the behaviors of Instagram users. The analysis criteria are different, but the idea is always to understand the behavior on this social network. According to Nils Herrmann in this study "Instagram Study: We analyzed 9 million posts and here's what we've learned" (Herrman 2018), images are more shared but less efficient than videos or carousels, short posts generate more interactions and the majority of accounts observed use hashtags but no emojis. This is a study conducted by Quintly on 9 million posts and 44,000 Instagram Business profiles to identify and better understand publication performance criteria. The profiles analyzed are diverse and categorized according to the number of followers. Concerning the results, the study highlights that images represent 72.6% of posts but that they are less efficient than carousels or videos. Indeed, videos involve 21.2% more interaction than images. A type of post that also involves a lot of interaction is the short post, with little character. However, on the posts studied, the majority of content is long content of more than 300 characters. But it is the shortest posts that bring interaction. Finally, the study aims to understand the role of hashtags and emojis in posts. The results show that 54.9 of the Instagram profiles do not use emojis. However, hashtags are widely used and 36.2% of publications contain 1 to 3 hashtags.



There is another study by Yuheng Hu Lydia Manikonda and Subbarao Kambhampati (2014) who determined 5 main types of Instagram users. The University of Arizona's Computer Science Department conducted this study on Instagram photo content and user types. For this study, the analysis is based on a sample of 50 users among friends and followers from the 37 most popular Instagram users. In addition to the 5 types of Instagram users, this study established 8 main categories of popular photos: Selfies, Friends, Food, Gadgets, Images with embedded text, Animals, Activities and Fashion. Concerning the 5 types of users, the study distinguishes between the "Foodies", a common user who mainly posts images of food, the "thinker" who posts images with integrated text, the "active" who posts images of his activities, the "selfies-lovers" who posts images of himself and finally the "My friends and me" who post images of their friends and themselves.

## 2. Methodology

From auditing server hypeauditor.com were selected 50 most followed female and 50 most followed male Instagram influencers in the world. We then chose to analyze 10 posts per personality, so, 1000 posts in total. For each post following data were collected: URL, Number of Followers, Age Average, Likes, Comments, Publication format, The caption of the publication, Date of publication, Staging of the publication, The name of the brands placed, The category of the product placed (16 categories were taken into consideration: Beauty & Fashion, Cars & motorbikes, Children & Family, Clothes, Shoes, Handbags & Accessories, Education, Entertainment, Fitness & yoga, Home & garden, How to & Style, Movies & TV, Music, Photography, Restaurant, Food & Grocery, Sports, Travel & Tourism, Video games).

While collecting the data, we added some variables to make the data more relevant.

First, the **Engagement Rate** of each influencer is the sum of comments and likes divided by the number of followers they have, it is a metric that measures the level of engagement that a piece of created content is receiving from an audience. It shows how much people interact with the content. Because the engagement rate is calculated relative to the number of followers an influencer has on Instagram, the rate for both small and large influencer's audience can be compared equally. It is very important to keep an eye on this metric because a higher engagement rate means higher potential consumers for the product placed.

The **Ratio of likes to followers** is the number of likes divided by the number of followers. Likes are a real indicator for great content and likes matter because the more likes, the more the influencer knows what their followers prefer. This metric is important as Instagram algorithms will expose posts with a higher amount of likes to other users. This means, the more likes, the faster their account will grow, the faster their posts could attract more potential customers. The average rate of likes on Instagram is 37 likes per 1000 followers for photos (3.7 %) and 24 likes per 1000 followers for videos (2.4 %), which means above this amount for a post, the content is more appreciated than the average.

The **Ratio of comments to followers** is the number of comments divided by the number of followers. There is a major difference between likes and comments when it comes to evaluating Instagram performance metrics. Likes are basically easy to give and oftentimes the influencer can't be certain a post was truly seen by their followers, but with comments, it is clearer. Whether positive or negative, comments left on their posts are an indication that the content had some kind of impact, or at least enough for the individual to take the extra step to leave feedback. This type of engagement, especially when positive, is a strong factor in community building and establishing a loyal fan base. Anyone can double tap with ease but those who go out of their way to comment are the ones to keep an eye on.

The **Likes/Comments ratio** is the likes divided by the number of comments. It shows how many likes the influencer has for one comment. It is an important metric, because as explained before, the more comments they have, the more they could be sure they have a real fan base and a real engagement from their followers. To be clearer, the lower is the **Likes/Comments ratio** result, the better is the engagement. For example, in the first line of the table, the likes/comments result of Selena Gomez is 205.72859, which means that she got 205 likes per comment.

On the other hand, we also calculated the **Comments/Likes**, which is the same metric but reversed. It shows how many are the comments for one like. The higher the result, the higher the engagement is.

The staging of the product can be very diverse according to the posts and it is very important to classify them in order to be able to compare the differences in posts' engagement. We have 6 categories for the staging:

- **Photo of influencer without the product:** The influencer can only promote the product by themselves if it's immaterial or just without it.
- **Photo of product with influencer:** The product is clearly highlighted with the influencer on the picture (they are wearing or holding it, or by their side).
- **Photo of product without influencer:** The product is highlighted in the picture taken by the influencer.
- **Promotion video with influencer:** The influencer is directly promoting the product in their video (demonstration of use, denouncing the benefits...)
- **Promotion video without influencer:** Commercial of the product without the influencer (demonstration of use of design), most commonly advertisements.
- **Trailer:** Trailer of a movie or TV shows that the influencer has realized or in which they are playing.

Then, we have 4 different captions:

- **Formal / Paid partnership:** The influencer is very clear and says above their post that it is a paid partnership or an official advertisement.
- **Formal / Tag:** the influencer is clear and tag the Instagram account on their post (caption or on the picture / video).
- **Formal / Thank you note:** The influencer is clear and thanks the brand under their post.
- **Informal:** The influencer is ambiguous on the promotion, but the logo of the brand appears clearly.

### 3. Results

#### 3.1. Descriptive statistics

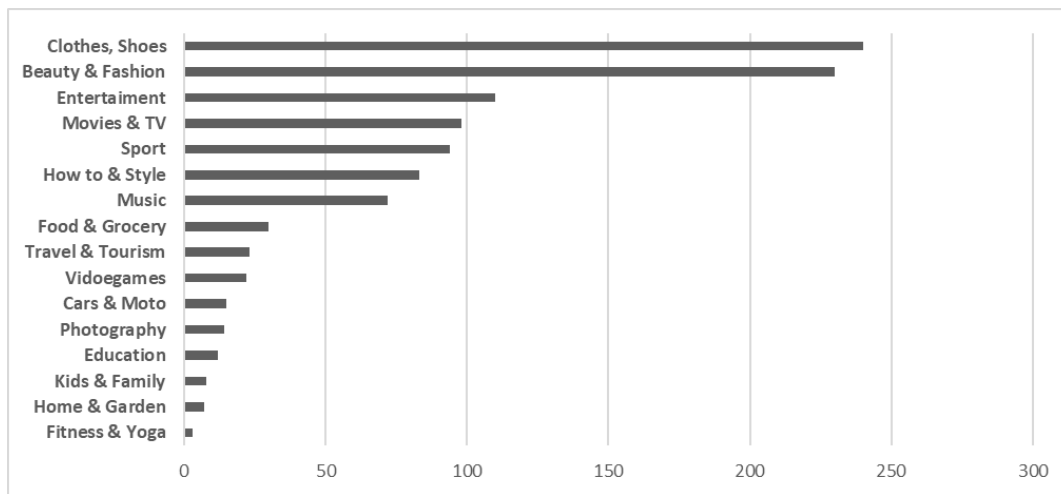
The average amount of followers amongst the 100 influencers studied is equivalent to 48,826,858. This category has a relatively high variation in the range between the maximum number of followers and the minimum which is equal to over 179 million followers. This is explained as the Hype auditor database did not classify its top influencer ranking solely on the number of followers. Although all our studied influencers have several million followers, there are high disparities between them. The standard deviation of this variable is also extremely high. Assuming that the number of followers follow a normal distribution, we can conclude that approximately 68% of the influencers have a number of followers that lies between one standard deviation away from the mean which is between 9,235,115 and 88,418,601 followers.

**Table 1.** Descriptive statistics results.

	<b>Average</b>	<b>Median</b>	<b>Minimum</b>	<b>Maximum</b>	<b>Range</b>	<b>Std. dev.</b>
Followers	48,826,858	34,700,000	7,470,000	186,800,000	179,330,000	39,591,743
Engagement	0.05	0.03	0	0.64	0.64	0.05
Likes	1,518,508	1,120,427	71,760,00	38,823,881	38,752,121	1,754,936
Comments	10,979	5,595	0	490,000	490,000	21,669
Likes per comment	2,129	195	0	244,326	224,326	14,634

The engagement rate has a relatively low standard deviation which shows that most of the data concerning this variable are clustered around the mean. Again, assuming a normal distribution, around 68% of the engagement rate lies between one standard deviation away from the mean which is between 0.00 and 0.1 (0% and 10%) while 95% of the engagement rate lies between two standard deviations from the mean which would be between 0% and 15%. The number 0 is the minimum value of the engagement rate, Comments, and Likes per comment section can be explained due to the fact that certain influencers have a special privacy setting in which they disable the possibility to write any comments. It can be clearly seen that the number of likes is much higher than that of comments. Most followers do not put in the extra effort and time to type a comment on posts they see on their feed. This explains the very high number of average likes per each comment which is equivalent to 2,129.

The following three charts put into perspective the categorical qualitative variables that could not be inserted in the descriptive statistics above.



**Figure 1.** Product placement category.

The histogram above clearly shows the distribution of the main categories in which the product placements are being done. The Category Clothes, Shoes, Handbags and accessories leads with Instagram 240 posts followed closely by Beauty and Fashion with 230 posts. The next main categories are more or less evenly distributed between Movies & TV, Entertainment, Sports, How to & style with just under 100 posts. The other Categories were very slightly represented with less than 15 posts. These categories are also industries in which there is not much importance given to marketing investments.

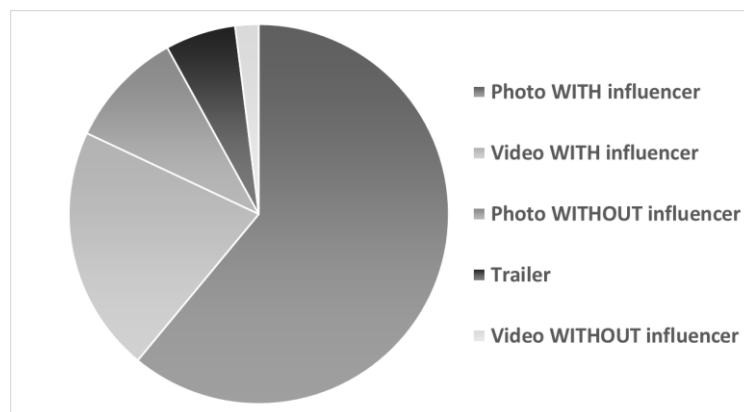


Figure 2. Product placement staging

Most of the Instagram posts from the top influencers we have studied feature product placements through a photo of product with influencer that accounts for 61% of the posts followed by promotion videos with influencers that accounts for 21% of the posts.

Finally, the most common caption used by these Instagram influencers are Formal with at Tag representing 73% of posts. The next highest caption style is Formal with a paid partnership symbol with 13% which is considerably much lower than the first category.

#### 4. Discussion

Over the course of analysis, we have come to following observations or hypotheses:

##### Women are more influential than men.

“As a new digital opinion leader, the influencer is able to affect purchasing behavior through the keeping of an Instagram account accompanied by intense social activity and high media exposure” (Bour 2017): on Instagram, having a high media exposure means having a high engagement rate and a lot of likes and comments in general on every post. Even if women are more present on Instagram than men (both on the side of users and influencers), are women more appreciated and so more influential as a result?

Therefore, we created a pivot table linking the gender to the engagement rate, ratio of likes to followers, ratio of comments to followers, the total comments and total likes:

Table 2. Gender differences.

	Engagement Rate Average	Ratio of likes to followers Average	Ratio of comments to followers Average	Total Likes	Total Comments
Females	0,0498	0,0495	0,00033	807 122 719	5 383 561
Males	0,0421	0,0418	0,00035	717 565 983	5 592 979
Total	0,0459	0,0456	0,00034	1 524 688 702	10 976 540

We can see that, on average, the engagement rate, the ratio of likes to followers, the ratio of comments to followers and the total likes are **higher for females than males**, but the difference is not very large between the two genders. We can also notice that for the total of comments, *males outnumber females*.

##### The category of the product is not much differentiated by the gender of the influencer.

Women have two predominant categories: Beauty & Fashion and Clothes, Shoes, Handbags & Accessories which represent both 31% and 28%. The others are not represented that much except for

some standing out from the crowd like Entertainment, How to & Style, Movies & TV and Music. The rest has only 10 posts or less. The lower ones are Travel & Tourism and Video Games with only 2 posts.

Concerning the male gender, the distribution is less divided compared to the female gender. Several categories step out of the line like Beauty & Fashion with 62 posts, Entertainment with 70, Movies & T with 59 and Sports with 78. The predominant one is Clothes, Shoes, Handbags & Accessories with 105 posts.

The rest of the categories are quite low, under 15 posts except for a few like How to & Style, Music, Restaurant, Food & Grocery.

**Women make much more product placements in the "Beauty & Fashion" and "Clothes, Shoes" categories.**

Thanks to our data analysis, we can confirm this. Out of 50 female influencers, 36 have made at least one post around "Beauty & Fashion", which corresponds to 159 posts. As for men, we have 21 out of 50 male influencers who actually have, which is equivalent to 62 posts. Similar difference is also in "Clothes ....". On the other hand, males are much more active in "Sports" and "Movies" categories.

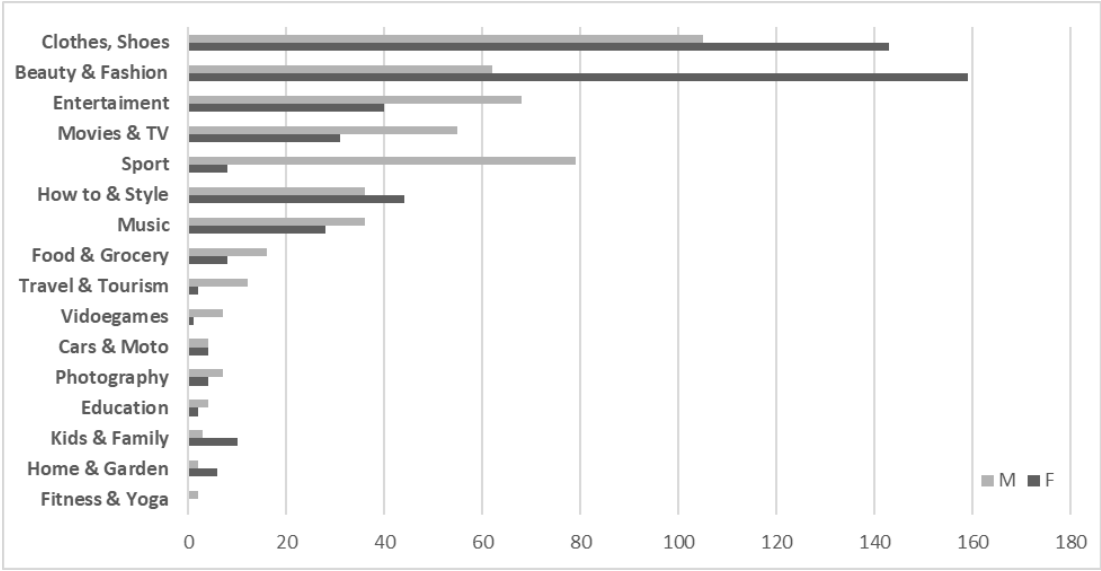


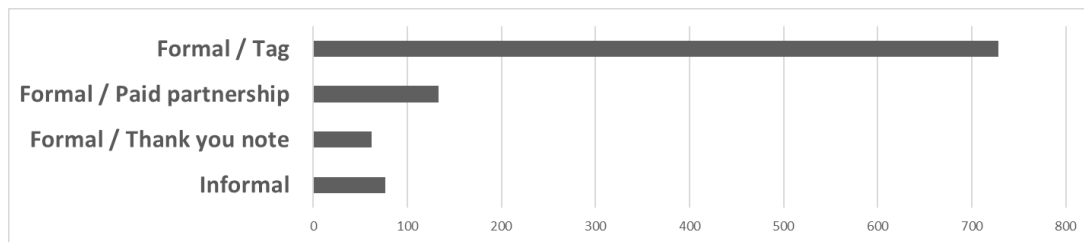
Figure 3. Number of posts per category per gender.

**A Category determines a popularity in terms of likes.**

To answer this hypothesis, we used a pivot table once more to calculate the average of likes according to each category of product placement posts. Based on the data below, most of the categories are relatively popular to the same extent at around 1,518,509 million likes. However, there are some outliers (very high or very low value) present in these categories that could show that some categories are much more popular. The category of Photography and Fitness & Yoga are the highest with 5,169,820 and 3,132,338 likes each. The lowest in popularity concerns Home & Garden. This hypothesis cannot be confirmed as the outliers represent categories that are very little represented in our database with less than 15 posts each out of 1,000 and is thus statistically invalid. There is not enough statistical power that a category determines a popularity in terms of likes.

**More transparent influencers admit a paid partnership.**

728 posts out of 1,000 posts were formal, and the influencer puts a tag but does not explicitly say "Paid Partnership" when it has the possibility to do so since 133 posts out of 1,000 specify it. We can note that James Rodriguez and Zlatan Ibrahimović, are the only two personalities who have put on their last 10 posts the caption "Paid Partnership".



**Figure 4.** Number of posts per caption

**Sport categories correlates positively with paid partnership captions**

A pivot table counting the different categories and caption was created to answer this question. It can clearly be seen from the table below that the Sports category has the highest amount of paid partnership caption both in terms of absolute number and relative proportions. It has 32 paid partnership posts out of 87 total posts which means that 36.8 % of all sports product placement are made with a paid partnership caption. The second-highest relative number concerns the entertainment category with 20.6% of posts concerning paid partnership captions. We can thus confirm the hypothesis once again and state that the sports category correlates positively with paid partnership captions.

**Table 3.** Caption per categories,

	Formal / Paid	Formal / Tag	Formal / Thank you note	Informal	Total
Clothes, Shoes	27	178	10	19	240
Beauty & Fashion	27	177	17	9	230
Entertainment	21	63	9	9	102
Movies & TV		77	4	7	88
Sport	32	45	8	2	87
How to & Style	8	65	5	3	81
Music	1	50	7	9	67
Food & Grocery	2	21		3	26
Travel & Tourism	3	8	1	5	17
Videogames	7	5		1	13
Cars & Moto	1	10	1		12
Photography		10		1	11
Education		6	3		9
Kids & Family	4	5			9
Home & Garden		7			7
Fitness & Yoga		1			1

**The video format has a lower popularity in terms of likes.**

The average number of photo likes is considerably higher than videos. The popularity of photos is approximately 36% higher compared to videos. On average, a product placement post consisting of a video has 440 030 lesser likes.

**The posts with products and influencers in the same photo are more appreciated than other staging.**

As the photo is the more appreciated format, we wanted to know which staging of photo would be the best one for users (and as a result, for influencers). This pivot table represents the average of likes and comments for different Format and Staging:

**Table 4.** Average of likes and comments per staging.

Stagings	Average of Likes	Average of Comments
Photo	1,638,813	11,381
Photo of product with influencer	1,671,340	11,802
Photo of product without influencer	1,454,137	8,872
Photo of influencer without product	1,312,345	8,746
Video	1,204,186	9,867
Promotion video with influencer	1,237,519	9,783
Trailer	1,141,318	10,429
Promotion video without influencer	533,023	8,123
Grand Total	1,519,606	10,967

So, as expected, we can notice that the photo with the product and the influencer has more engagement with an average of 1,671,340 likes per post than the other staging. Same for the average of comments which is the highest (11,802 comments) for this staging. It makes sense because the Instagram users have more reasons to like the post when the influencer is in the picture, especially when they are promoting something. Placing a product is also making new content for followers, it makes influencer speaking about new subjects and as a result, it attracts more followers, and then gives more engagement.

## 5. Conclusions

Based on the descriptive analysis and the hypothesis answered in the previous section, several different interrelated strategies will be shown in this section to increase the marketing efficiency of product placement on Instagram. The answer to the hypothesis provided us with a clearer picture on the inner workings of brands product placement strategy.

Since women make much more product placement in the "Beauty & Fashion" category, we think it would be wise for companies to set aside a budget for product placements in their marketing plan to favor women when it comes to promoting products around beauty and fashion. But a brand can also stand out by asking a male influencer to make a product placement around beauty and fashion because few do, and this could clearly make the brand stand out. It would be interesting to start this strategy with a very well-trained male influencer so that it reaches as many followers as possible.

Also, we know that Females are slightly more influential than males. Nevertheless, we can't tell that companies should choose females influencers instead of males to promote their product because it basically depends on the category in which the product refers (and according to the 3rd hypothesis, we can see that categories and gender are narrowly linked) and does not depend on the gender that much. Companies can and should choose an influencer to promote their product for the way they are and for what they represent rather than for their gender.

As the "Clothes, Shoes, Handbags & Accessories" category is the most placed on Instagram, we think it would be wise for the companies concerned by this category to choose their influencers carefully and to ask them to stand out in their product placements since this is the most competitive category. By making posts, for example, explicit, that would explain why one should choose this make-up palette and not another by explaining its advantages and more.

Since we know the favorite staging for Instagram users is a picture with the influencer and the product according to the 6th hypothesis, companies that want to promote their product through an influencer on Instagram should ask the influencer to post a picture of the product with themselves in it. It is indeed more relevant to bet on the more likes and comments they could have, because each like they get are a potential customer for their brand.

Brands that wants the most effective dispersion and highest audition rate should place their product in the format of a photo instead of a video as the engagement rate for the former is considerably lower. Of course, not every advertisement can be made in the format of a photo and it must be noted that most of the video formats were advertisements made for other means of marketing

placement as well such as YouTube and television ads. This strategy thus only works in the case that a brand advertises its product only through Instagram. This is also subsequently cost effective as making a video with the presence of influencers generally cost much higher.

On the same argument, we have discovered that generally, influencers with a lower number of followers (>40 million), has an engagement rate twice as much as those with more than 40 million followers. It may be that the fanbase of relatively smaller influencers are closer to the influencer and relate themselves more. Having this information, Brands should target their audience accurately and then find an influencer represented by this audience even though the number of followers is lesser. This would result in a higher engagement rate and thus audience reactivity.

Since most influencers are not transparent when it comes to explicitly stating that the post is a paid partnership, we think it would be wise for brands to ask influencers to be transparent with their audience by explicitly stating that it is a paid partnership or for example an "#Ad" hashtag. This is very important because it is more professional, more moral and ethical. Several influencers do this, especially in France where several personalities start their positions with the "#Sponsored" hashtag. French influencers have every interest in maintaining this transparency since the ARPP (Professional Advertising Regulatory Authority) warns fraudulent influencers who do not clearly indicate that their publication is sponsored. This hashtag law was set up because there was a period when many people complained about the abuse of product placement by certain personalities.

On the same note, concerning brands promoting sports good, it is recommended that it follows the industry norm by explicitly showing the paid partnership caption as it allows for an honest interaction with the customers that are then perfectly aware that the concerned post is an advertisement for a specific product.

These are thus the 8 strategies that we have come up with in order to increase the efficiency and marketing capabilities for brands to promote their product through the use of an influencer on Instagram.

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# Nonlinear Vehicle Routing Problem

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**Abstract:** The article is focused on a new modification of vehicle routing problem (VRP), which differs from linear VRP in two points. The first difference is the objective function which in case of linear VRP expresses the total travel costs whereas in nonlinear VRP it is the travel cost per unit volume that is represented by the nonlinear function being equal to linear-fractional function. The second difference is the set of nodes, which in linear VRP must be involved in the vehicle routes. The set of nodes in nonlinear VRP is divided into mandatory and optional ones. The mandatory nodes must be involved in the vehicle routes, the optional nodes can be either involved in the vehicle routes or neglected. Thus, the objective function of the nonlinear VRP is linear-fractional function. The first step is to linearize this function using Charles-Cooper transformation, and then solve the model using linear programming software. The methods are demonstrated on a numerical example.

**Keywords:** vehicle routing problem; integer programming; linear-fractional object function

**JEL Classification:** C44

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## 1. Introduction

Traditional formulation of VRP assumes  $n$  nodes, where the first node represents the depot and the remaining ones the customers. The merchandise is transported using the routes starting and ending in the depot. The transport itself is realized by the vehicles with certain capacity and the customer-node requests are given by the volume used for the containment of the requested merchandise in a given vehicle. The route length depends on the order of the nodes of a given route and can be calculated using the distance matrix between each pair of nodes. Instead of the node distance one can also calculate the transport cost of a given vehicle from one node to another. The aim is to minimize the total sum of route distances or eventually to minimize the transport cost of the routes using given vehicles.

The solution procedure of VRP must ensure the following two conditions:

- a) All nodes are included at least in one of the routes.
- b) The sum requests of all nodes of a route must not exceed the capacity of the vehicle for this route.

This problem can be formulated as integer linear programming model and solved using appropriate software tools. VRP and in general, linear integer programming problems, belong among NP hard problems, i.e. if the number of nodes is higher, in reality more than approx. 30 nodes, it is impossible to obtain optimal solution using standard LP integer solvers (branch and bound method) in a reasonable time. Except for mathematical models one can use heuristic methods such as nearest neighborhood method, insert method or savings method, which can help to obtain a suboptimal solution in reasonable time.

There are many modifications of the conventional form of VRP, which arise as a results of merchandise transport in praxis (Laporte 1992). The following ones belong among the most interesting ones - VRP involving vehicles with different capacities and transport cost; VRP with more than one depot; split delivery VRP; VRP involving stochastic demand in nodes; VRP with time windows, where the time of vehicle arrival in the node must be inside to a certain time interval denoted as time window (Braysy and Gendreau 2005), (Desrochers et al. 1992), and others.

The traditional VRP problem is described in the literature enough, heuristic methods are proposed, and a survey of these approaches is summarized in (Laporte 1992). Nonlinear vehicle routing problem (NVRP) we propose in this article differs from the classical one in two main points:

- a) The set of nodes is divided into two subsets consisting of either mandatory or optional nodes. The mandatory nodes along the designed vehicle route need to be served. We assume at least one of the nodes to belong to the subset of mandatory nodes.
- b) The objective function of the model is non-linear.

NVRP is based on a real case study, in which the career has many orders with some of them being urgent, i.e. taking priority, while the others can be postponed unless the maximal expected delivery time is not exceeded. The order becomes a target of higher priority if its delivery time cannot be extended anymore and thus must be delivered to the customer as soon as possible. Given the fact that every day there are new orders coming up we might come across a situation when the number of items on the list of orders will grow as well and therefore it will be efficient to include the delayed orders in designed routes. On the other hand, if we involve all of the optional nodes in the routes the total route distance and the use of vehicle capacity might become inefficient.

If we assume the objective function is of standard type, i.e. the total sum of all route distances, then the optimal solution would not involve the optional nodes as that would increase the objective function itself. In case we chose the objective function to be represented by the total transported volume, which needs to be maximized, on the contrary the optimal solution would involve all optional nodes, which as noted before would lead to inefficiency in route distance planning as well as in use of vehicle capacity. Based on these reasons we propose a form of objective function that represents the average route distance per transported volume unit. This function, defined as ratio of total route distance and total transported volume, will be minimized. The proposed problem will be first modelled assuming non-linear objective function, that is represented by the linear-fractional function and set of constraints, which is essentially identical to that of classical VRP.

To find the solution for this non-linear problem we use Charles-Cooper transformation that converts our problem to a linear programming one. Despite the fact that the transformation process treats the binary variables the binary condition does not have to hold. Except for the mathematical model one can also modify the heuristic methods designed to solve the classical VRP. Finally, at the end of the article, we present a numerical solution to a problem demonstrating both approaches.

## 2. Mathematical Model of NVRP

*Parameters of the model:*

- $n$  the total number of nodes,
- $m$  the number of optional nodes; assume that nodes  $2, 3, \dots, m$  are optional nodes, nodes  $m+1, m+2, \dots, n$  are compulsory nodes, and node 1 is depot,
- $c_{ij}$  the distance between node  $i$  and node  $j$ ,
- $q_i$  the demand of node  $i$ ,
- $W$  the capacity of vehicle.

*Variables of the model are:*

- $x_{ij}$  the binary variable with value 1 if a vehicle goes from node  $i$  to node  $j$ , otherwise its value is zero,
- $u_j$  the variables used in anti-cyclic constraints.

The objective function (1) is the ratio where the denominator expresses the total amount of loads of all routes and the numerator is the total length of all routes. Equation (2) ensures that compulsory nodes will be entered and its demand  $q_j$  is covered. If the vehicle enters a node it has to leave it – it is ensured by constraints (3). Standard anti-cyclic conditions are in (4). Inequality (5) assures that the capacity of vehicles is not exceeded.

Mathematical model of NVRP can be written as follows:

$$f(x) = \frac{\sum_{i=1}^n \sum_{j=1}^n c_{ij} x_{ij}}{\sum_{i=1}^n \sum_{j=1}^n q_i x_{ij}} \rightarrow \min \quad (1)$$

$$\sum_{i=1}^n x_{ij} = 1 \quad i = 1, 2, \dots, m \quad (2)$$

$$\sum_{i=1}^n x_{ij} = \sum_{i=1}^n x_{ji} \quad i = 1, 2, \dots, n \quad (3)$$

$$u_i + q_j - W(1 - x_{ij}) \leq u_j \quad i = 1, 2, \dots, n, j = 2, 3, \dots, n, i \neq j \quad (4)$$

$$u_j \leq W \quad j = 2, 3, \dots, n \quad (5)$$

$$x_{ij} \quad i, j = 1, 2, \dots, n, \quad i \neq j \text{ binary} \quad (6)$$

### 3. Charnes-Cooper Transformation of Linear Fractional Program to Linear Program

Model (1)-(6) is not linear in its objective function but can be moved into a linear program rather easily using Charnes-Cooper transformation. Let us assume a general fractional program as follows:

$$g(x) = \frac{c^T x + d}{e^T x + f} \rightarrow \min, \quad (7)$$

$$Gx \leq h \quad (8)$$

$$Ax = b \quad (9)$$

$$x \geq 0 \quad (10)$$

where  $e^T x + f > 0$  for all feasible solutions and the feasible set is nonempty.  $x$  is a vector of variables and  $G$  and  $A$  are matrices. Under these assumptions, the linear fractional program (7)-(10) can be transformed into equivalent linear program (11)-(15) - see e.g. (Martos 1975) and (Barros 1998):

$$g'(x) = c^T x' + d \rightarrow \min \quad (11)$$

$$Gx' - h t \leq 0 \quad (12)$$

$$Ax' - b t = 0 \quad (13)$$

$$e^T x' + f t = 1 \quad (14)$$

$$x' \geq 0, \quad t \geq 0 \quad (15)$$

where  $x' = \frac{x}{e^T x + f}$  and  $t = \frac{1}{e^T x + f}$ .

Now we can apply this transformation to NVRP (1)-(5), i.e. without binary constraint (6). The linear program after this transformation is formulated below - (16)-(21).

$$f'(x) = \sum_{i,j=1}^n c_{ij}x'_{ij} \rightarrow \min \quad (16)$$

$$\sum_{i=1}^n x'_{ij} = t \quad i = 1, 2, \dots, m \quad (17)$$

$$\sum_{i=1}^n x'_{ij} = \sum_{i=1}^n x'_{ji} \quad i = 1, 2, \dots, n \quad (18)$$

$$u'_i + q_j t - W t + W x'_{ij} \leq u'_j \quad i = 1, 2, \dots, n, j = 2, 3, \dots, n, i \neq j \quad (19)$$

$$u'_j \leq W t \quad j = 2, 3, \dots, n \quad (20)$$

$$x'_{ij} \geq 0 \quad i, j = 1, 2, \dots, n, \quad i \neq j, \quad t \geq 0 \quad (21)$$

where  $x'_{ij} = \frac{x_{ij}}{\sum_{i=1}^n q_i x_{ij}}$ ,  $u'_j = \frac{u_j}{\sum_{i=1}^n q_i x_{ij}}$ ,  $t = \frac{1}{\sum_{i=1}^n q_i x_{ij}}$ .

Original variables can be derived as  $x_{ij} = x'_{ij}/t$  for all  $i, j$ . Binary conditions for variables  $x_{ij}$  can be ensured by additional conditions (22) and (23). If  $x'_{ij} = t$ , then  $x_{ij} = 1$ , and if  $x'_{ij} = 0$ , then  $x_{ij} = 0$ .

$$-M(1 - y_{ij}) \leq x'_{ij} - t \leq M(1 - y_{ij}) \quad i \neq j \quad (22)$$

$$-M y_{ij} \leq x'_{ij} \leq y_{ij}, \quad i \neq j \quad (23)$$

$$y_{ij} \text{ binary for all } i \neq j \quad (24)$$

The mathematical model (16)-(24) is binary linear program and can be solved using conventional LP packages like GUROBI, CPLEX, etc.

#### 4. Numerical Example

The proposed mathematical model was verified on an illustrative example. Consider 11 nodes where node 1 is a depot, and the capacity of each vehicle is  $W=100$ . The requirements of the nodes are  $q = (0 \ 19 \ 24 \ 30 \ 20 \ 35 \ 25 \ 32 \ 20 \ 22 \ 37)$ . The distance matrix  $C$  is as below:

0	13	6	55	93	164	166	168	169	241	212
13	0	11	66	261	175	177	179	180	239	208
6	11	0	60	97	168	171	173	174	239	209
55	66	60	0	82	113	115	117	117	295	265
93	261	97	82	0	113	115	117	118	333	302
164	175	168	113	113	0	6	4	2	403	374
166	177	171	115	115	6	0	8	7	406	376
168	179	173	117	117	4	8	0	2	408	378
169	180	174	117	118	2	7	2	0	409	379
241	239	239	295	333	403	406	408	409	0	46
212	208	209	265	302	374	376	378	379	46	0

The optimal objective function of model (16)-(24)  $f'(x) = 3$  and the optimal value of variable  $t = 0.0058$ . Therefore,  $x'_{ij} = 0.0058$ , if  $y_{ij} = 1$  otherwise  $x'_{ij} = 0$ . From optimal values of variables  $x'_{ij}$ ,  $y'_{ij}$  and  $x_{ij}$  it is possible to derive that the optimal routes are:

1. route: 1-3-2-4-1 with transport volume 73 and length of the route 138,
2. route: 1-5-7-9-6-1 with transport volume 100 and length of the route 381,

The total length of all routes is 519, and the total load is 173. The length on one unit of load is 3 which is the optimal value of the objective function.

## 5. Conclusions

VRP is one of the most discussed optimization problems with variety of real-world applications. Traditional formulation of VRP is linear, i.e. linear objective function and linear set of constraints. In this paper, a new modification of VRP was introduced. This formulation was motivated by real-world study and, in our best of knowledge, it is original and unpublished elsewhere yet. The problem itself is non-linear in its objective function but an original way how to transform it into a linear program was proposed. The solution of the model was illustrated on a simple numerical example. Mathematical model (16)-(24) is hardly solvable for real instances even by using high-quality solvers as GUROBI or CPLEX. Therefore, future research will be focused on solving real examples of this nature using various heuristic methods and on their comparison.

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# Usage of Coefficients for Real Estate Tax in Regional Cities of the Czech Republic

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**Abstract:** The paper is focused on municipalities' possibility to use the real estate tax coefficients and increase their budget revenues. Municipal budgets should be balanced and expenditures covered by real expected revenues. Tax revenues represent the most significant part of the municipal budget, while local taxes support a partial autonomy of the municipality. On the basis of the council's decision, municipalities in the Czech Republic may adjust the coefficients amount and thus increase the real estate tax yield. Our paper is aimed to evaluate the use of this power in the regional cities of the Czech republic: Brno (BR), Ceske Budejovice (CB), Hradec Kralove (HK), Jihlava (JI), Karlovy Vary (KV), Liberec (LI), Olomouc (OL), Ostrava (OT), Pardubice (PU), Plzen (PL), Usti nad Labem (UL) and Zlin (ZL). The evaluation covers the period 2009 – 2018. Based on the analyses of the general binding regulations, governing these coefficients adjustments, the coefficients usage in the selected regional cities was compared. During the reviewed period, there occurred some legislative changes affecting the real estate taxes yields in the monitored regional cities. On account of the study performed, we have found that the coefficients usage in the regional cities is higher than in other municipalities.

**Keywords:** real estate tax; municipality; coefficient; yield; budget

**JEL Classification:** H7

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## 1. Introduction

The systematic use of property taxes has taken place since the beginning of the 19th century and, according to Kabatova (2015), Provaznikova (2015), it can be classified as the oldest form of tax revenues for public budgets. For municipalities and regions management and development, it is important to know basic principles of financing, financial management as well as tax revenues redistribution. This is also related to tax issues knowledge (Kukalova et al. 2019). Positive aspects of the property taxes, primarily from the view of the municipal budgets financing, are dealt in the paper written by Becica (2014). According to Provaznikova (2015), Janouskova and Sobotovicova (2016), the real estate tax is considered to be one of the stable municipal budget revenues, in the theory of fiscal federalism. According to Drabek (2015), the realization of a conscious tax policy on real estate taxes is also a basic condition for autonomy and financial self-sufficiency of the municipalities. Tax revenues together with grant programs enact a decisive role in municipal budget revenues and have a great influence on their financial stability and autonomy (Janouskova and Sobotovicova, 2016). Moravec and Kukalova (2014) present the impact of the tax burden on investments. Their study deals also with the impact of the direct tax burden, including also the real estate tax, on investments allocation.

In most advanced economies, property taxes represent a very stable public budgets revenue. Real estate tax revenues are an exclusive revenue to municipal budgets, to which cadastral territory the real estate belongs. At the same time, it represents an incentive instrument of the local autonomies. According to the research by Zrobek et al. (2016), this tax yield, except from the other economic factors, depends also on the correct setting of the tax base. Poliak (2016) analysed in his work the importance of local taxes as an instrument for municipal policy in the Slovak republic. On the basis of performed analyses, also Balazova et al. (2016) evaluated the real estate tax development as the most significant municipal revenue in the Slovak Republic. According to Janez et al. (2016), the amount of the real estate

taxation may positively influence internal migration flows. According to Roubinek et al. (2015), the amount of the tax burden can also influence smaller municipalities in decision to ally to a larger city. Blazic et al. (2016) deal with the issue of the local real estate tax introduction in Croatia and emphasize a different perception of this tax introduction effects by qualified professionals and by general public. Huang (2018) solves the importance of the real estate tax as a stable source for local governments, in context of problems connected with this tax collection in China.

In the Czech Republic, the real estate tax consists of two partial taxes: land value taxes and taxes on buildings and housing units. The tax rate on buildings and on most lands is imposed in units, while the tax base is set according to size of or floors area the land area, built-up area. The entire revenue of this tax goes to the municipal budget. Therefore, it is important that municipalities may, within their partial tax jurisdiction, influence the total amount of funds, which become a part of the municipal budget, by adjusting the basic tax rates of both, the land tax and building tax.

With reference to the Czech Republic (Collection of Laws, 1992), § 6, section 4, letter b) and § 11, section 3, letter a), a municipality can increase or decrease the coefficient for multiplying the basic tax rate (the coefficient is assigned to the municipalities based on population). Further, according to the Czech Republic (Collection of Laws, 1992), for specific taxable buildings as defined in § 11, section 1, letter b) to d) and housing units according to the § 11, section 1, letter c) and d), a municipality may introduce the coefficient of 1.5 multiplying the basic tax rate (coefficient 1.5). The municipalities may also set the coefficient under the rule of the Law No. 338/1992 Coll., § 12 (local coefficient). This coefficient is in amount of 2, 3, 4 or 5 and allows to increase the tax liability for the real estates located in this cadastral territory (The Czech Republic, 1992). Thus, the existence of big industrial and recreational areas can significantly increase the revenues of the individual municipalities. According to Kamenickova (2016), the real estate tax revenues take a long-term percentage in amount of 4 - 5 % in the total revenues of the Czech municipalities. The paper written by Becica (2014) deals with the relation between the real estate tax yield and the local coefficient introduction in the Czech municipalities. Sedmihradská and Bakos (2016) state that the local coefficient is used only at 8 % of the Czech municipalities and its setting depends on the political format of their executive bodies and on the total structure of the budget receipts and expenditures.

As proved in the previous studies, increasing the real estate tax coefficients can serve as an option for strengthening financial self-sufficiency of the municipalities. Our research is aimed to evaluate how the individual regional cities use their partial tax jurisdiction in the area of adjustment the real estate tax coefficients.

## **2. Data and Methodology**

The article evaluates the coefficients usage in the Czech regional cities: Brno (BR), Ceske Budejovice (CB), Hradec Kralove (HK), Jihlava (JI), Karlovy Vary (KV), Liberec (LI), Olomouc (OL), Ostrava (OT), Pardubice (PU), Plzen (PL), Usti nad Labem (UL) and Zlin (ZL). From the reason of the specific position, Prague has not been included in the evaluation. The evaluated period 2009 till 2018 also includes the year 2009, i.e. the period before the change in real estate tax rates under the Law No. 362/2009 Coll. (The Czech Republic, 2009).

A comparison of the coefficients used in the selected municipalities (regional cities) is another part of the analyses. For the period 2009 - 2018, an analysis of the general binding regulations concerning the introduction and adjustment of the real estate tax coefficients in the mentioned municipalities was performed. It is the coefficient assigned to the municipalities on the basis of the population, coefficient 1.5 and the local coefficient (Table 1). To get an overview of when the individual coefficients were changed, the general binding regulations were analysed from the chronological point of view.



**Table 1.** The real estate tax coefficients set in the Czech regional cities. Source: General binding regulations of the mentioned municipalities.

	<b>Effectiveness of the general binding regulation</b>	<b>Coefficient assigned to the municipalities according to the population</b>	<b>Coefficient 1.5</b>	<b>Local coefficient</b>
BR	since 01/01/1997	<ul style="list-style-type: none"> <li>• 3.5 for building lands in the whole territory</li> <li>• for residential buildings and units 1.6 or 2.0 or 2.5 for specific parts of the territory</li> </ul>	for the whole territory	has not been set
CB	since 01/01/2005	<ul style="list-style-type: none"> <li>• 2.5 or 3.5 for specific parts of the territory</li> </ul>	for the whole territory	has not been set
HK	01/01/2009 - 31/12/2019	<ul style="list-style-type: none"> <li>• 4.5 for building lands in the whole territory</li> <li>• 3.5 or 4.5 for residential buildings and units for specific parts of the territory</li> </ul>	for the whole territory	has not been set
	since 01/01/2010	<ul style="list-style-type: none"> <li>• 4.5 for building lands in the whole territory</li> <li>• 2.0 or 1.6 for residential buildings and units for specific parts of the territory</li> </ul>	for the whole territory	3
JI	01/01/2009 - 31/12/2019	<ul style="list-style-type: none"> <li>• 4.5. or 2.0 for residential buildings for specific parts of the territory</li> </ul>	for the whole territory	2
	since 01/01/2010	<ul style="list-style-type: none"> <li>• 4.5. or 2.0 for residential buildings for specific parts of the territory</li> </ul>	for the whole territory	has not been set
KV	03/2008, since 01/01/2009	<ul style="list-style-type: none"> <li>• 4.5 for the whole territory</li> </ul>	for the whole territory	2
LI	01/01/2009 - 31/12/2009	<ul style="list-style-type: none"> <li>• 1.6 or 2.0 or 2.5 or 3.5 for specific parts of the territory</li> </ul>	for the whole territory	2
	01/01/2010 - 31/12/2011	<ul style="list-style-type: none"> <li>• 1.6 or 2.0 or 2.5 or 3.5 for specific parts of the territory</li> <li>• 2.5 or 3.5 for specific parts of the territory</li> </ul>	for the whole territory for the whole territory	has not been set 2
OL	01/01/1997 - 31/12/2009	<ul style="list-style-type: none"> <li>• 1.6 or 2.0 or 2.5 or 3.5 or 4.5 for specific parts of the territory</li> </ul>	for the whole territory	has not been set
	01/01/2010 - 31/12/2010	<ul style="list-style-type: none"> <li>• 3.5 for the whole territory</li> </ul>	for the whole territory	2
	since 01/01/2011	<ul style="list-style-type: none"> <li>• 3.5 for the whole territory</li> </ul>	for the whole territory	has not been set
OT	since 01/01/2013	<ul style="list-style-type: none"> <li>• 2.0 or 2.5 or 4.5 for specific parts of the territory</li> </ul>	for the whole territory	has not been set
PU	01/01/2009 - 31/12/2012	<ul style="list-style-type: none"> <li>• 2.0 or 2.5 or 3.5 or 4.5 for specific parts of the territory</li> </ul>	for the whole territory	2
	since 01/01/2013	<ul style="list-style-type: none"> <li>• 2.5 or 3.5 or 4.5 for specific parts of the territory</li> </ul>	for the whole territory	2
PL	since 01/01/2009	<ul style="list-style-type: none"> <li>• 1.6 or 2.0 or 2.5 or 3.5 or 4.5 for specific parts of the territory</li> </ul>	for the whole territory	has not been set
UL	01/01/2009 – 31/12/2009	<ul style="list-style-type: none"> <li>• 4.5 for the whole territory</li> </ul>	for the whole territory	3
	since 01/01/2010	<ul style="list-style-type: none"> <li>• 3.5 for the whole territory</li> </ul>	for the whole territory	2
ZL	since 01/01/2009	<ul style="list-style-type: none"> <li>• 2.0 or 2.5 or 4.5 for specific parts of the territory</li> </ul>	for the whole territory	has not been set

Table 2 shows the real estate tax revenues in absolute terms for the given regional cities. The real revenues are analysed in the period from 2009 to 2018 and data are drawn from the final accounts of

the individual regional cities. These data have been further analysed in relation to the population of the specific regional city, its total receipts and its tax revenues.

**Table 2.** Real estate tax revenues in the Czech regional cities (mil. CZK). Source: The final accounts of the mentioned cities.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BR	128.879	202.860	212.266	216.237	227.460	233.623	237.110	240.148	245.105	246.125
CB	35.379	34.238	35.282	52.868	57.552	59.554	61.323	61.991	61.600	61.889
HK	132.102	162.010	160.731	169.388	168.609	173.718	171.767	171.016	177.192	178.273
JI	48.768	39.446	42.649	45.451	45.568	46.617	47.099	47.157	48.386	48.630
KV	45.377	69.544	70.794	74.593	73.020	74.612	76.257	77.644	77.128	77.630
LI	71.364	53.435	55.146	125.154	127.762	125.306	132.175	131.915	134.711	136.222
OL	51.325	148.426	72.749	77.914	77.398	81.393	83.770	85.531	88.275	88.097
OT	104.417	161.886	163.455	187.034	210.730	242.452	227.618	231.400	224.970	234.198
PU	80.681	130.142	133.893	138.333	135.652	135.955	138.635	138.642	142.740	140.271
PL	78.508	129.087	130.884	134.906	133.376	134.689	137.641	140.713	140.890	143.372
UL	106.126	96.472	97.844	99.912	105.966	106.071	108.976	108.999	106.883	107.610
ZL	34.200	47.851	45.918	51.410	52.440	51.892	53.835	54.045	54.663	54.429

### 3. Results

In the reviewed period, the attitude towards usage of the real estate tax coefficients varied in the selected regional cities. In the Table 1, it is apparent that since 2010, the coefficients assigned to the municipalities according to the population have been adjusted at the prevailing number of the regional cities. All the regional cities used the coefficient 1.5 for taxable buildings in the period under review. The local coefficients multiplying the resulting tax liability were used by 7 regional cities during the reviewed period. Most regional cities used the local coefficient of 2; while the local coefficient of 3 was used in Hradec Kralove and Usti nad Labem in some years of the reviewed period. In 2018, the last year of the period reviewed, the local coefficient was used only in 5 out of the 12 regional cities surveyed (see Table 1).

Based on the real estate tax revenues data (presented in Table 2), it can be stated that there was an increase in real estate tax revenues in all the monitored regional cities except Jihlava, in the period under review. Some coefficients have been abolished or adjusted in connection with the increase in tax rates since 1 January 2010 (Table 1). The local coefficient abolition was reflected in the real estate tax revenues in Jihlava. The revenue in 2018 reaches almost the value in 2009.

Further, the real estate tax revenues per one inhabitant in the individual regional cities were compared. The highest yield of the tax revenue per one inhabitant is in: Hradec Kralove, Karlovy Vary, Liberec, Pardubice and Usti nad Labem. In terms of the absolute amount of the real estate tax revenues, the regional capital of Brno ranks among the cities with the highest revenues, however, in terms of the revenues per inhabitant, it ranks among the cities with the lowest revenues (see Table 3). This is mainly due to the fact that Brno does not take the advantage of increasing this tax revenue by setting a local coefficient. The real estate tax revenues are also affected by a reduction in the coefficient allocated to the municipalities according to the population. In 2018, the real estate tax yield per inhabitant in Brno was CZK 646.54 (see Table 3).

**Table 3.** Real estate tax revenues per one inhabitant (in CZK).

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BR	338.55	532.89	557.60	568.03	597.51	613.70	622.86	630.84	643.86	646.54
CB	376.32	364.18	375.28	562.34	612.17	633.46	652.27	659.38	655.22	658.29
HK	1,424.41	1,746.89	1,733.10	1,826.44	1,818.04	1,873.13	1,852.10	1,844.00	1,910.59	1,922.25
JI	959.15	775.81	838.80	893.91	896.21	916.85	926.33	927.47	951.64	956.44
KV	935.59	1,433.88	1,459.65	1,537.97	1,505.53	1,538.36	1,572.28	1,600.88	1,284.06	1,600.59
LI	686.20	513.80	530.25	1,203.40	1,228.48	1,204.87	1,270.91	1,268.42	1,295.30	1,309.83
OL	510.58	1,477.54	723.71	775.09	769.95	809.70	833.34	850.87	878.16	876.39
OT	361.14	559.91	471.95	646.89	728.85	838.87	787.26	800.34	778.10	810.01
PU	889.56	1,435.06	1,476.41	1,525.37	1,495.81	1,499.59	1,528.70	1,528.79	1,573.97	1,546.74
PL	455.27	748.59	759.01	782.33	773.46	781.07	898.19	816.01	817.03	831.46
UL	1,141.73	1,037.87	1,052.63	1,074.88	1,140.01	1,141.14	1,172.39	1,172.63	1,149.88	1,157.69
ZL	456.02	638.04	612.27	685.50	699.23	691.92	717.83	720.63	728.87	725.75

In the first year of the analysed period, the percentage of the real estate tax revenues in total revenues of the regional cities was approximately 2 % in Ceske Budejovice, Olomouc, Pardubice and Plzen. On the contrary, the highest percentage of this tax revenues in total revenues was achieved in 2009, namely in Hradec Kralove (6.44%) and Usti nad Labem (6.2%) (see Table 4.). In the period between 2009 and 2011, there occurred fluctuation of the tax yields in relative terms; there was an apparent relation with the coefficient changes set by general binding regulations and with the increase in real estate tax rates since 1 January 2010 (The Czech Republic, 2009). Between 2012 and 2017, the real estate tax yields percentage in the total revenues stabilised namely in Hradec Kralove, Olomouc and Liberec. In 2017 and 2018, the percentage of the real estate tax yields slightly decreased in most of the regional cities (see Table 4).

**Table 4.** Percentage of the real estate tax revenues in the total revenues of the selected municipalities (%).

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BR	1.12	1.59	1.67	1.78	2.34	2.38	2.25	2.07	2.05	1.85
CB	1.73	1.54	1.69	2.40	3.14	3.16	3.03	3.19	2.89	2.55
HK	6.44	7.32	7.01	8.15	8.94	8.64	8.67	8.71	8.52	7.87
JI	3.79	3.11	3.62	4.30	3.95	3.60	3.74	4.11	4.23	3.82
KV	3.64	5.42	6.36	7.30	5.74	7.07	6.67	6.20	6.14	6.46
LI	3.88	2.72	2.31	7.67	6.64	8.37	8.38	6.45	5.98	5.81
OL	2.53	6.55	3.31	3.53	3.57	3.86	3.73	4.06	3.76	3.38
OT	0.97	1.48	1.24	1.87	1.93	2.99	2.92	2.67	2.49	2.40
PU	1.47	2.50	2.94	3.36	3.62	3.21	2.69	2.67	2.36	2.34
PL	1.50	2.22	2.43	2.30	2.56	2.33	2.41	2.23	2.22	2.24
UL	6.20	4.35	4.95	6.77	7.08	6.68	5.01	5.55	4.92	4.48
ZL	2.12	2.97	2.92	3.63	3.77	3.29	3.61	3.56	3.42	3.09

Tax incomes represent the most significant part of the municipal budget revenues. They consist of shared taxes, commissioned taxes (real estate tax), local and administrative charges. The percentage of the real estate tax revenues in the tax revenues was the highest in Hradec Kralove. In the regional capital Karlovy Vary, the real estate tax yield is approximately 10% of all tax revenues, with the exception of the years 2009, 2017 and 2018. In the budget of the regional city Pardubice, the real estate tax revenue is also around 10% under the reviewed period. While the lowest percentage of the real estate tax revenues in total tax revenues was recorded in Brno and Ostrava (see Table 5). Since 2016, the percentage of the real estate tax in tax revenues has decreased; this was particularly evident in 2018 (Table 5). This situation is mainly caused by an increase in municipal revenues from shared taxes (part of the national income tax and value added tax revenues). Due to this fact the shared taxes receipts percentage in the total tax revenues of the municipalities has increased, while the real estate tax revenues percentage has decreased, although there has been no decrease in absolute revenues from this tax.

**Table 5.** Percentage of the real estate tax revenues in the tax revenues of the selected municipalities (%).

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
BR	1.82	2.71	2.80	2.77	2.81	2.84	2.95	2.77	2.60	2.38
CB	3.04	2.71	3.20	4.76	4.61	4.69	4.83	4.47	4.10	3.67
HK	11.18	13.05	13.07	12.87	12.12	12.54	12.00	11.29	10.89	9.98
JI	7.89	6.45	7.16	7.25	6.87	6.67	6.62	6.35	6.07	5.52
KV	7.14	10.80	10.82	11.07	9.53	9.98	10.17	9.67	8.01	8.47
LI	6.21	4.62	4.79	10.57	10.10	10.81	10.09	8.70	8.22	7.73
OL	4.32	11.10	5.54	5.91	5.59	5.56	5.69	5.22	5.04	4.59
OT	1.77	2.68	2.25	3.06	3.34	3.72	3.50	3.28	3.01	2.89
PU	7.57	11.09	11.54	11.87	10.97	10.71	10.43	9.66	9.12	8.26
PL	2.39	3.77	3.85	3.76	3.81	3.69	3.62	3.35	3.01	2.88
UL	9.90	8.83	8.82	8.08	8.96	8.05	8.65	8.25	7.23	6.84
ZL	3.36	5.39	5.14	5.47	5.28	5.10	5.15	4.78	4.53	4.20

#### 4. Discussion

The setting of the real estate tax coefficients affects both the municipality revenue from this tax and its percentage in total and tax revenues. According to Kamenickova (2016), real estate tax yields have a long-term share of 4-5% in total municipal budgets revenues in the Czech Republic. The analyses of the real estate tax revenues in the given regional cities show that this average corresponds to the real estate tax percentage in the total revenues in Jihlava, Olomouc and Usti nad Labem. According to Kamenickova (2019), the real estate tax represented share of 7% in total revenues for all municipalities in 2017. Its amount is influenced not only by the rate and coefficients set by the municipalities, but also by the relation between the real estate intended for permanent living and for recreation, and also by the amount of real estate used for business purposes (Kamenickova, 2019). According to our analysis, this value is almost reached only in Hradec Kralove, where the percentage is around 8% in the reviewed period. Since 2010, this regional city has been using a local coefficient of 3 (see Table 1). According to Kamenickova (2019), the municipalities in the region of Karlovy Vary have a relatively high value of the real estate tax revenues per inhabitant. Also, according to our analysis, the regional capital Karlovy Vary ranks among the regional cities with the highest tax revenue per inhabitant. Since 2009, the regional capital Karlovy Vary has been using all the coefficients to increase the real estate tax revenues (Table 1).

The real estate tax coefficients allow municipalities to increase their revenues without direct costs, since the costs associated with the tax collection are defrayed by the state, or more precisely by the taxpayers. Municipalities can also increase their revenues through non-taxable items; however, these are connected with some related costs (Kamenickova, 2016). Relevant costs related to the real estate tax have rather a political status for municipality. The political parties composing the municipal authorities influence, among other factors, the local coefficient setting (Sedmihradská and Bakos, 2016). As presented by Svihel (2019), a minister Alena Schiller states that city halls do not take the advantage of increasing the real estate tax, even though it is money coming to their budget revenues. As an example of the cities which did not take this advantage, Alena Schillerová named the city Prague. Olomouc, Plzeň, Ceské Budejovice, Brno, Ostrava and Zlín are also at the minimum (Svihel, 2019). All the mentioned cities were part of our analysis, which shows that none of these regional cities has set the local coefficient.

## 5. Conclusions

In terms of municipal budgets, the real estate tax in the Czech Republic is an exclusive tax which revenues flow into the municipal budget. This is the only tax whose yield may be influenced by the municipality with adjusting or setting coefficients that increase the rate or with using a local coefficient to multiply the calculated tax. The analyses of general binding regulations performed for these regional cities show that the coefficient 1.5 was set in all cities in the reviewed period 2009-2018. The coefficient assigned to the municipalities on the basis of population was increased only in seven regional cities (HK, JI, KV, PL, PU, UL, ZL). The local coefficient was set in seven regional cities for at least one year during the period under review. In 2018, the local coefficient was set only in five regional cities (KV, LI, PU, UL - value 2, HK - value 3).

The real estate tax revenue per inhabitant has always been highest in cities with set local coefficient. In 2018, it was set in five regional cities (HK, KV, LI, PU, UL). The percentage of the real estate tax revenues in the total revenues was 1.12 - 8.94% in the reviewed period. This percentage was the lowest in Brno and the highest in Hradec Králové. In the period, the percentage of the real estate tax revenues in the tax revenues of the monitored regional cities was 1.82 - 12.54%. The percentage of the real estate tax revenues in both, total and tax revenues, is related to the use of coefficients in the reviewed cities, in particular to setting of the local coefficient.

The analysis presented in our research resulted from the set target and available data. Possible extension of the analysis will be subjected to follow-up research, focused on all municipalities in the Czech Republic.

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# Axiomatic Definition of Fuzzy Present Value from the Economic Point-view

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**Abstract:** The concept of present value (PV) may be determined as the cash flow utility which additionally satisfies the conditions: 1° the utility of any current payment is equal to nominal value of this payment; 2° the utility is always an odd function of payment nominal value. Obtained in this way PV definition is called generalized PV definition because of it is more general than the Peccati's axiomatic PV definition. Due behavioral reasons the PV may be imprecisely valued. The fuzzy set theory is applied as effective tool of this imprecision description. Proposed by Calzi's axiomatic definition of fuzzy PV (F-PV) is strictly connected with the Peccati's definition which is weakly consistent with the economics. It is shown that from economical point view the general PV definition is better than the Peccati's one. Thus, we take into account the generalized definition of PV as the starting point for construction of a new axiomatic F-PV definition. All axioms of generalized PV definition are extended to the case when the imprecise present value is given as any fuzzy number. Attached at the end mathematical Appendix contains explicit definitions of all notions of mathematics for fuzzy systems which are applied in this paper.

**Keywords:** imprecision; present value; fuzzy number

**JEL Classification:** C65; G39; G40

## 1. Introduction

The current equivalent value of any cash flow is called the present value (PV) of this cash flow. In financial arithmetic PV is used for discounting money value. The application basis of the financial arithmetic is the interest theory. The financial arithmetic theory is based on axioms formulated by Peccati (1972). Using this theoretical approach Peccati has defined PV as an additive function of payment value. This approach to financial arithmetic was extensively developed in recent years (Janssen et al 2009). In (Piasecki 2012), the Peccati's PV definition is generalized in such way that PV is defined as a utility of the multi-criterial comparison determined by the temporal preference (Mises 1962) and the wealth preference. If PV is defined as utility, then it may be non-additive function of payment value.

The behavioral premises imply that PV may be imprecise. It is widely accepted that imprecise PV is modelled by fuzzy numbers. Such particular PV model is called fuzzy PV (F-PV). In (Piasecki 2014c), the evolution of F-PV notion is described in detail.

An axiomatic F-PV definition is given by Calzi (1990). The Calzi's definition is closely related to the Peccati's PV definition. Hence, the Calzi's definition is valid only for cases when PV is additive function of payment.

The PV additivity is weakly consistent with such basic economic principles as, for example, the Gossen's First Law. For this reason, the main aim of this article is to propose such an axiomatic definition of F-PV which will be valid also for the case when the PV may be non-additive function of payment. The starting point for discussion will be the Piasecki's generalization of Peccati's definitions. An important premise for giving final form to the axiomatic F-PV definition will be experience gained by the author during his research Piasecki (2011a, 2011b, 2013, 2014a, 2014b, 2014c) and Piasecki and Siwek (2015, 2017a, 2018a, 2018b, 2018c, 2018d, 2019).

This paper is organized as follows. Different axiomatic definitions of PV are discussed in Section 2. An axiomatic definition of fuzzy PV is proposed in Section 3. Section 4 contains final conclusions. Applied specific mathematical concepts are explained in the Appendix included in Section 5.

## 2. Axiomatic Definitions of Present Value

The main task of financial arithmetic is to dynamically assess the value of money. The basic assumption of financial arithmetic is that the value of circulating money increases over time. In general, this assumption is justified by the analysis of the Fisher's equation of exchange (Begg et al 2005). We additionally assume here that the amount of circulating money is constant. This assumption is a typical normative condition. For this reason, the money value taken into account in financial arithmetic is called the normative value of money. A growth process of normative money value is called a capital appreciation process. In economic-financial practice, the increase in the money amount is generally faster than the increase in production volume. Therefore, the real value of money decreases over time. We see that the normative money value is different from the real value of money. This implies a question about the essence of normative value. The answer to this question will explain the essence of the basic functions of financial arithmetic.

Let a fixed set of moments  $\Theta \subseteq [0, +\infty[$  be given. Each payment is represented by cash flow  $(t, C) \in \Phi = \Theta \times \mathbb{R}$ , where  $t \in \Theta$  is the cash flow moment and  $C \in \mathbb{R}$  is the nominal value of this cash flow. Each of these cash flows can be either an executed receivable or matured liability. It is obvious that each nominal value of receivable is non-negative. The debtor's liability is always the creditor's receivable. In this situation, each nominal value of liability is equal to the minus value of corresponding receivable. The set  $\Phi$  is called a payments set. The symbol  $\Phi^+ = \Theta \times \mathbb{R}_0^+$  denotes a receivables set.

In financial arithmetic, a future value (FV) is a formal model of normative value. For any payments set  $\Phi$ , Peccati (1972) defines FV as a function  $FV: \Phi \rightarrow \mathbb{R}$  fulfilling the conditions:

$$\forall_{C \in \mathbb{R}}: FV(0, C) = C, \quad (1)$$

$$\forall_{(t, C) \in \Phi^+ \vee \Delta t > 0}: FV(t + \Delta t, C) > FV(t, C), \quad (2)$$

$$\forall_{(t, C_1), (t, C_2) \in \Phi}: FV(t, C_1) + FV(t, C_2) = FV(t, C_1 + C_2). \quad (3)$$

Peccati uniquely determines PV as the function  $PV: \Phi \rightarrow \mathbb{R}$ , given by the identity

$$FV(t, PV(t, C)) = C. \quad (4)$$

Defined above PV fulfils the conditions

$$\forall_{C \in \mathbb{R}}: PV(0, C) = C, \quad (5)$$

$$\forall_{(t, C) \in \Phi^+ \vee \Delta t > 0}: PV(t + \Delta t, C) < PV(t, C), \quad (6)$$

$$\forall_{(t, C_1), (t, C_2) \in \Phi}: PV(t, C_1) + PV(t, C_2) = PV(t, C_1 + C_2). \quad (7)$$

The conditions (2) and (6) are equivalent to analogous original conditions of temporal monotonicity used by Peccati. Applied here the descriptions of temporal monotonicity are more convenient for our further considerations.

Peccati proves that if the fixed PV satisfies conditions (5), (6) and (7) then uniquely determined by the identity (4) future value satisfies conditions (1), (2) and (3). This means that the Peccati's axiomatic theory may be equivalently developed on the basis of PV defined as any function  $PV: \Phi \rightarrow \mathbb{R}$  having the properties (5), (6) and (7). Among other things we have here the following theorem:

*Theorem (Peccati 1972): Any function  $PV: \Phi \rightarrow \mathbb{R}$  meets the conditions (5), (6) and (7) if it is given by the identity*



$$PV(t, C) = C \cdot v(t), \quad (8)$$

where the discount factor  $v: \Theta \rightarrow ]0; 1]$  is decreasing time function fulfilling equation

$$v(0) = 1. \quad (9)$$

For a fixed payment value, the PV function is reduced to the discounted utility notion considered by many researchers. Multithreaded research results on discounted utility are competently discussed in (Doyle 2013). Among other things, there is shown that the Peccati's theory omits the problem of PV dependence on the interaction between payment value and payment time.

The capital synergy effect is that an increase in the capital value implies an increase in the relative appreciation speed. Using the Peccati's theory we over the synergy capital effect (Piasecki 2012).

The diversification principle states that financial funds should be allocated among different investments. This principle is justified by the portfolio theory (Markowitz 1952). Applying the Peccati theory we ignore the diversification principle (Piasecki 2012).

All the above facts point to weak coherence the Peccati's theory with the theory and practice of economics. Among other things it implies that the interest theory is weakly coherent with economy.

The Peccati's axiomatic approach has been extensively studied by many researchers. The results of these studies are presented in (Janssen et al 2009).

The process of capital appreciation is described above by the axiom (2). Despite this, the Peccati's theory does not explain the capital appreciation phenomenon. This explanation was obtained by showing that any payment PV is equal to the utility of this payment (Piasecki, 2012). Then the PV is defined as any function  $PV: \Phi \rightarrow \mathbb{R}$  satisfying the conditions (5), (6) and

$$\forall_{(t,C) \in \Phi} \forall_{\Delta C > 0}: \quad PV(t, C) < PV(t, C + \Delta C) . \quad (10)$$

$$\forall_{(t,C) \in \Phi}: \quad PV(t, -C) = -PV(t, C) , \quad (11)$$

Fulfillment of condition (11) may be obtained via the assumption that the utility of any liability is non-positive. The notion of negative utility is discussed in (Becker et al. 1960), (Cooper et al. 2001) and (Rabin 1993). Presented above definition is a generalization of the Peccati's definition of PV. Therefore, above definition is called generalized one.

In (Piasecki 2015) we can find examples of such PV which is not additive function of payment nominal value. The variability of these PV is fully justified by economic reasons. The significance of generalization the Peccati's definition to the PV generalized definition is shown in this way.

The synergy capital effect and the diversification principle may be considered in the framework of financial arithmetic based on the generalized definition of PV (Piasecki, 2012).

Any payment PV is identical with the utility of the cash flow representing this payment. For this reason, the Gossen's First Law may be considered as an additional PV feature. This law says that the marginal utility of wealth is diminishing (Begg et al, 2005). Therefore, any function  $PV: \Phi \rightarrow \mathbb{R}$  fulfills the inequality

$$\forall_{(t,C_1),(t,C_2) \in \Phi^+} \forall_{\alpha \in ]0;1[}: \quad \alpha \cdot PV(t, C_1) + (1 - \alpha)PV(t, C_2) < PV(t, \alpha C_1 + (1 - \alpha)C_2) \quad (12)$$

The example of PV satisfying the Gossen's first Law is given in (Piasecki, 2015). On the other side each PV satisfying the conditions (1), (2) and (3) does not fulfil the condition (12). As we see the Peccati's theory rejects the Gossen's First Law, too.

All above facts show the usefulness of this new generalized theory of financial arithmetic. The generalized definition of PV is more coherent with economics than the Peccati's definition. Therefore, we take into account the generalized definition of PV as the starting point for our further considerations.

### 3. Fuzzy Present Value

If PV is determined as payment utility, then it is subjective in its nature. Subjective evaluations always depend on behavioral factors. The behavioral environment states are imprecisely described. Therefore, it is necessary to disclose imprecision in PV estimation. Effective tool of the imprecision

description is the fuzzy set theory. Attached at the end Appendix contains explicit definitions of all these concepts of mathematics for fuzzy systems which are used in this Section.

The first axiomatic approach to F-PV was given by Calzi (1990) who takes into account the condition (8) as start-point for his considerations. He assumed that value of future cash flow, flow moment and interest rate are imprecise. All of these values are described by means of fuzzy assessment which is called a fuzzy interval in original Calzi's work. At the first Calzi proved that in this situation the discounting factor is also fuzzy assessment. Calzi finally defines F-PV by applying the Zadeh's extension principle for the condition (8). Obtained in this way F-PV is fuzzy assessment.

Due the condition (8), the Calzi's approach to F-PV is strictly connected with the Peccati's definition which is weakly coherent with the economics. Moreover, the Peccati's axioms (5), (6) and (7) are passed over in the Calzi's definition. These facts show that the reconsideration of the fuzzy PV definition is necessary.

Any imprecise PV should be an approximation of a value determined by the normative PV function. Therefore we consider the financial space  $(\Phi, PV)$ , where  $PV: \Phi \rightarrow \mathbb{R}$  is any fixed function fulfilling the axioms (5), (6), (10) and (11) of generalized PV definition. This function assigns to the cash flow  $(t, C) \in \Phi$  its exact normative it is necessary to disclose imprecision in PV estimation. Then imprecise PV may be expressed, as fuzzy number  $\tilde{\mathcal{R}}(PV(t, C)) \in \mathbb{F}$ . In this way, all imprecise evaluations of PV constitute a family  $\Xi = \{\mu(\cdot | t, C): (t, C) \in \Phi\} \subset [0; 1]^{\mathbb{R}}$  of fuzzy number memberships function. From the point-view of multi-valued logics, for fixed  $x \in \mathbb{R}$  the value  $\mu(x|t, C)$  can be considered as truth value of the sentence

$$x = PV(t, C) . \quad (13)$$

Therefore the value  $\mu(x|t, C)$  is called the fulfilment degree the above equality.

The conditions (25) and (26) imply that any membership function  $\mu(\cdot | t, C): \mathbb{R} \rightarrow [0; 1]$  fulfils the conditions

$$\mu(PV(t, C)|t, C) = 1, \quad (14)$$

$$\forall_{x,y,z \in \mathbb{R}}: x \leq y \leq z \Rightarrow \mu(y|t, C) \geq \min\{\mu(x|t, C), \mu(z|t, C)\}. \quad (15)$$

When we are aiming to replace the exact normative assessment  $PV(t, C)$  by its approximation, then for the family of membership functions  $\Xi$  we impose the conditions which are the generalization axioms (5), (6), (10) and (11) to the fuzzy case.

The condition (5) may be written in an equivalent way as follows

$$\forall_{C \in \mathbb{R}}: \mu(x|0, C) = \begin{cases} 1 & x = C \\ 0 & x \neq C \end{cases} \quad (16)$$

Using the Zadeh's extension principle, we generalize the condition (11) to the condition

$$\forall_{(t,C) \in \Phi}: \mu(x|t, -C) = \mu(-x|t, C). \quad (17)$$

Unlike thing happens with the conditions (6) and (10) determining the PV, as the discounted utility of cash flow. These conditions can be replaced respectively by the inequalities

$$\forall_{(t,C) \in \Phi^+ \forall_{\Delta t > 0}: \tilde{\mathcal{R}}(PV(t + \Delta t, C)) < \tilde{\mathcal{R}}(PV(t, C)), \quad (18)$$

$$\forall_{(t,C) \in \Phi \forall_{\Delta C > 0}: \tilde{\mathcal{R}}(PV(t, C)) < \tilde{\mathcal{R}}(PV(t, C + \Delta C)) . \quad (19)$$

Each of the above-described relationship is a fuzzy relation. It means the necessity of taking this into account when the conditions (6) and (10) are extended to the fuzzy case. To meet this postulate we apply the membership function  $\nu_{<}: [\mathcal{F}(\mathbb{R})]^2 \rightarrow [0, 1]$  of relations used in the inequalities (18) and (19). This function is explicitly determined by (30).

For any fixed pair  $(t, C) \in \Phi^+$ , we consider the function  $f_t: \mathbb{R}^+ \rightarrow [0; 1]$  determined as follows

$$f_t(\Delta t) = \nu_{<}(\tilde{\mathcal{R}}(PV(t + \Delta t, C)), \tilde{\mathcal{R}}(PV(t, C))) \quad (20)$$

For fixed pair  $(t, C) \in \Phi^+$  the value  $f_t(\Delta t)$  can be considered as truth value of the sentence (18). Therefore the value  $f_t(\Delta t)$  is called the degree of fulfilment this inequality. We can expect that with

the increase in change  $\Delta t$  the degree of fulfilment the inequality (18) is not decreasing. According to (33), this condition is equivalent to the condition:

[A] For any fixed pair  $(t, C) \in \Phi^+$  the function  $g_t: \mathbb{R}^+ \rightarrow [0; 1]$  given by the identity

$$g_t(\Delta t) = \sup\{\min\{\mu(x|t + \Delta t, C), \mu(x|t, C)\}: x \in \mathbb{R}\} \quad (21)$$

is non-increasing function.

In the crisp case, the condition [A] is reduced to the condition (6). All of the above insights cause that the condition [A] may act out as extension of the condition (6) to the fuzzy case.

For any fixed pair  $(t, C) \in \Phi$  let us consider the function  $f_C: \mathbb{R}^+ \rightarrow [0; 1]$  given by the identity

$$f_C(\Delta C) = \nu_{<}(\tilde{\mathcal{R}}(PV(t, C)), \tilde{\mathcal{R}}(PV(t, C + \Delta C))) \quad (22)$$

From the point-view of multi-valued logics, for fixed  $(t, C) \in \Phi$  the value  $f_C(\Delta C)$  can be considered as truth value of the sentence (19). Therefore the value  $f_C(\Delta C)$  is called the degree of fulfilment this inequality. We can expect that with the increase in change  $\Delta C$  the degree of fulfilment the inequality (19) is not decreasing. According to (33), this condition is equivalent to the condition:

[B] For any fixed pair  $(t, C) \in \Phi$  the function  $g_C: \mathbb{R}^+ \rightarrow [0; 1]$  given by the identity

$$g_C(\Delta C) = \sup\{\min\{\mu(x|t, C), \mu(x|t, C + \Delta C)\}: x \in \mathbb{R}\} \quad (23)$$

is non-increasing function.

In the crisp case of non-fuzzy PV, the condition [B] is reduced to the condition (10). All of the above insights cause that the condition [B] may act out as extension of the condition (10) to the fuzzy case.

In this way we define F-PV as function  $\tilde{P}\tilde{V}: \Phi \rightarrow \mathcal{F}(\mathbb{R})$  given by the identity

$$\tilde{P}\tilde{V}(t, C) = \tilde{\mathcal{R}}(PV(t, C)), \quad (24)$$

where  $\tilde{\mathcal{R}}(PV(t, C))$  is such fuzzy number that its membership function  $\mu(\cdot | t, C): \mathbb{R} \rightarrow [0; 1]$  fulfills the conditions (14), (15), (16), (17) [A] and [B].

#### 4. Concluding Remarks

Proposed in this paper axiomatic definition of F-PV is a strong generalization of Peccati's F-PV definition. Thanks to this generalization, we have been able to include the following effects in any particular F-PV definition (Piasecki 2012):

- the phenomenon of capital synergy effect,
- the phenomenon of diminishing marginal utility of wealth,
- the principle of portfolio diversification.

When using the Peccati F-PV definition, these effects had to be ignored.

In general, the imprecision of F-PV is an image of behavioral aspects of financial funds evaluation. In line with the uncertainty principle (Mises 1961, Kaplan et al., 1967), any anticipated future value is always uncertain. Thus FV is usually described as a random variable. In this situation, any return rate is determined as fuzzy probabilistic set (Hirota 1981). Thanks to this, it is possible to combine subjective premises for the assessment of financial funds with extensive empirical knowledge of financial market. In this way we can simultaneously take into account the subjective and empirical premises for investment-making. When a return rate is described by a fuzzy probabilistic set then it is burdened with a composition of imprecision risk and non-knightian uncertainty risk. The concept such defined return rate may be a starting point for the development of a general theory of financial markets at imprecision risk. Elements of such theory are formulated in Piasecki (2011b, 2014) for the case of F-PV defined as any fuzzy number. Application the conditions (16), (17) [A] and [B] of the F-PV definition will make the thesis of this theory more specific. Then we can obtain new original conclusions. All this will allow us to propose and explore new investment strategies.

Model of F-PV may be used not only to determine return rate as fuzzy probabilistic set. This model may be applied wherever their fuzzy evaluation of PV is used. Examples of such applications can be

found in the works (Boussabaine and Elhag 1999), (Chiu and Park 1994), (Fang Yong et al. 2008), (Huang, 2007a, b) and (Haifeng et al 2012).

Summing up, proposed in this article axiomatic definition of F-PV is a significant contribution to the development of a financial markets formal theory.

## 5. Appendix

The symbol  $\mathcal{F}(\mathbb{R})$  indicates the family of all fuzzy subsets in the real numbers space  $\mathbb{R}$ . Each fuzzy set  $\tilde{A} \in \mathcal{F}(\mathbb{R})$  is described by means of its membership function  $\mu_A: \mathbb{R} \rightarrow [0; 1]$ .

Any subset  $\tilde{A} \in \mathcal{F}(\mathbb{R})$  represents the imprecise estimation. In addition, if its membership function  $\mu_A \in [0; 1]^{\mathbb{R}}$  satisfies the condition

$$\forall_{x,y,z \in \mathbb{R}}: x \leq y \leq z \Rightarrow \mu_A(y) \geq \min\{\mu_A(x), \mu_A(z)\}, \quad (25)$$

then this imprecise estimation is called fuzzy assessment. The space of all fuzzy assessments is denoted by the symbol  $\mathbb{A}$ .

Any real number  $k \in \mathbb{R}$  may be approximately estimated using fuzzy number  $\tilde{\mathcal{R}}(k)$  (Dubois and Prade 1979) which is a particular case of fuzzy assessment represented by its membership function  $\mu(\cdot | k): \mathbb{R} \rightarrow [0; 1]$  fulfilling the condition

$$\mu(k|k) = 1. \quad (26)$$

The space of all fuzzy numbers is denoted by the symbol  $\mathbb{F}$ . It is obvious that we have  $\mathbb{F} \subset \mathbb{A}$ .

Fuzzy assessments can be used to ordering objects represented by these assessments. At the outset, we define the order relations on the set of all fuzzy assessments. These order relations are defined using only the Zadeh's extension principle.

Let us take into account the assessments  $\tilde{A}, \tilde{B} \in \mathbb{A}$  represented respectively by their membership functions  $\mu_A, \mu_B \in [0; 1]^{\mathbb{R}}$ . Fuzzy preorder  $\preceq$  is defined by the equivalence

$$\tilde{A} \preceq \tilde{B} \Leftrightarrow \text{„The assessment } \tilde{A} \text{ is less than or equal to the assessment } \tilde{B}\text{”}. \quad (27)$$

The preorder  $\preceq$  is determined by its membership function  $\nu_{\preceq}: [\mathcal{F}(\mathbb{R})]^2 \rightarrow [0; 1]$  given by the identity

$$\nu_{\preceq}(\tilde{A}, \tilde{B}) = \sup\{\min\{\mu_A(x), \mu_B(y)\}: x \leq y\}. \quad (28)$$

If all compared fuzzy assessments are fuzzy numbers, then above preorder is identical with fuzzy preorder determined by Orlovsky (1978).

Fuzzy strict order  $<$  is defined by the equivalence

$$\tilde{A} < \tilde{B} \Leftrightarrow \text{„The assessment } \tilde{A} \text{ is less than the assessment } \tilde{B}\text{”}. \quad (29)$$

The strict  $<$  is determined by its membership function  $\nu_{<}: [\mathcal{F}(\mathbb{R})]^2 \rightarrow [0; 1]$  given by the identity

$$\nu_{<}(\tilde{A}, \tilde{B}) = \min\{\nu_{\preceq}(\tilde{A}, \tilde{B}), 1 - \nu_{\preceq}(\tilde{B}, \tilde{A})\}. \quad (30)$$

Let us consider the pair of real numbers  $k, l \in \mathbb{R}$  such that  $k < l$ . We take into account a pair of fuzzy numbers  $\tilde{\mathcal{R}}(k), \tilde{\mathcal{R}}(l)$  determined respectively by their membership functions  $\mu(\cdot | k), \mu(\cdot | l) \in [0; 1]^{\mathbb{R}}$ . From the condition (26) we obtain

$$1 \geq \sup\{\min\{\mu(x|k), \mu(y|l)\}: x \leq y\} \geq \min\{\mu(k|k), \mu(l|l)\} = 1, \quad (31)$$

On the other side, from the condition (25) we have

$$\sup\{\min\{\mu(x|l), \mu(y|k)\}: x \leq y\} = \sup\{\min\{\mu(x|l), \mu(x|k)\}: x \in \mathbb{R}\}. \quad (32)$$

Due these facts we can say that

$$\nu_{<}(\tilde{\mathcal{R}}(k), \tilde{\mathcal{R}}(l)) = 1 - \sup\{\min\{\mu(x|l), \mu(x|k)\}: x \in \mathbb{R}\}. \quad (33)$$

The last identity will be applied for determining the axiomatic definition of F-PV.

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# Verification of the Precious Metals Market Effectiveness – Gold and Silver

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**Abstract:** The requirement for using technical analysis and for constructing algorithmic trading system based on it, is the assumption about possible dependencies between historical data and the future direction of a rate change. Making this kind of assumption leads to rejecting the hypothesis of market effectiveness. In the article a verification method for the assumption is presented for the case of precious metals – gold and silver. The base of proposed method is statistical testing performed on the binary course representation, which is more precise than the candlestick representation. The article also presents an analysis of obtained results in terms of possible construction of HFT systems.

**Keywords:** market effectiveness; high frequency econometric; technical analysis; investment decision support

**JEL Classification:** F14; G11; G14; C49

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## 1. Introduction

For many years there has been a dispute over the justification for the use of technical analysis methods (Peters 1991). Due to the lack of positive rates of return generated by many traditional methods (Kirkpatrick and Dahlquist 2010) and the difficulty of statistical verification of others (e.g. those based on visual analysis, such as Elliott's wave detection (Frost and Prechter 2005), many researchers are inclined to adopt the hypothesis of market effectiveness. The hypothesis was formulated by Fama (Fama and Malkiel 1970) and states that the price of a given asset reflects the current situation on the market. All versions of the hypothesis assume the lack of effectiveness of technical analysis methods. The effective market hypothesis has been repeatedly tested for various financial instruments. However, all research was conducted based on quotations expressed in a candlestick representation and for a specific timeframe (e.g. for daily data (García, Gaytán, and Wolfskill 2012)). The use of quotations in the candlestick format leads to a poor credibility of results, especially when examining the relationship between small-scale changes that are crucial in the construction of HFT systems. For this reason, the article proposes a method of verifying the existence of statistical relationships between historical data and the current direction of exchange rate changes. The method is based on a binary representation of the course (Stasiak 2016) and statistical tests recommended by NIST (Rukhin et al. 2010). The results of the silver and gold exchange rate analysis expressed in dollars (XAU/USD and XAG/USD) were then used to verify the possibility of constructing HFT systems.

The article is organized in the following way. After a short introduction, the second chapter presents the concept of a binary representation of the course. In Section 3, a schema for verifying possible dependences between subsequent course changes is presented. Chapter 4 presents the results of statistical analysis and conclusions regarding the possibility of constructing HFT systems. In Chapter 5, the most important research results are discussed and summarized.

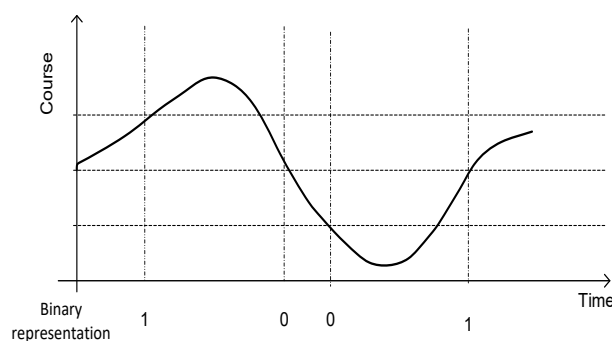
## 2. Binary Representation

Due to the high volatility of quotations (changes often occur even every 1, 2 seconds) and the existence of the noise phenomenon (Logue and Sweeney 1977; Lo, Mamaysky, and Wang 2000), while

analyzing the financial data, it is necessary to use appropriate representation. The vast majority of research (including those regarding effectiveness of a given market) is carried out based on quotations of an asset expressed in a candlestick representation. In such representation, the course in a given timeframe is described by 4 parameters: the opening price, closing price and the maximum and minimum exchange rate. In fact, the intensity of changes in a certain range depends on many factors (e.g. time of day). Also, in case of events influencing the quotations of a given resource, we often register large fluctuations of the exchange rate in a short time. Therefore, the representation dependence on a set time period leads to a loss of many valuable information about the variability 'inside' the candle during high investors' activity and to registering many small-size candles (which are irrelevant to the analysis), during periods of reduced investors' activity. This phenomenon is especially important in the study of course changes with a small range, the results of which are used in HFT systems which are based on the statistical advantage of transactions that resulted in profit over those resulting in a loss. Even within 1 minute (the smallest timeframe used), there may be several changes that are not included in the candlestick analysis. However, these changes may result in making or ending many transactions and, as a consequence, the operation of a HFT system may cause losses, despite the fact that the analysis of candlestick data indicates a profit. Therefore, the use of a candlestick representation leads to imprecise and ambiguous results.

Due to the above stated disadvantages of the candlestick representation, a more accurate binary representation was used to analyze the quotation efficiency of selected resources. The concept of a binary representation is based on the assumption that, rather than time, the direction and range of changes stand as a base for the course description.

The course binarization approach was first used in the 1930s, in order to build and analyze graphs in the so-called point-symbolic method (De Villiers 1933). Unfortunately, this method of course representation was replaced by the candlestick representation. The basis of the binary representation (Fama and Malkiel 1970) is the discretization of an exchange rate, with a given discretization unit. The representation is described by a sequence  $\{\varepsilon_i\}_{i=1}^n$ . Figure 1 shows an example of the course binarization algorithm. This algorithm assigns '0' to the ensuing sequence element  $\varepsilon_i$  if the rate drops by the unit of discretization, or the value '1' in case of an analogous increase. If price gaps occur, the algorithm checks what value would have been achieved, and then analyzes the rate relative to the first price after the price gap. As a result of the algorithm's operation, the exchange rate can be presented in the form of a binary sequence. The use of a binary representation eliminates time periods characterized by a non-volatility of the course (e.g. nights), and records all changes of a certain range in the times of investors' high activity.



**Figure 1.** Course in binary representation.

### 3. Research of Possible Relations Between Ensuing Rate Changes

The character of quotation changes depends on the assumed discretization unit. Assuming too small discretization unit can lead to registering noise (random fluctuations of a small range). On the other hand, taking too big discretization unit can lead to a loss of informative value, which will make the obtained representation totally worthless. Because of above stated reasons, statistical verification of binary representations was performed, obtained for all discretization units from the range of 10



pips (the accuracy of XAU/USD and XAG/USD quotations, with the step of 10 pips, to the value for which the obtained number of changes in the binary representation is lower than 128 (that is, the value of the sample below which it is impossible to perform all the tests).

For each binary representation (binary sequence), three statistical tests were performed, that is: Monobit Test (Chung 1979; Pitman 1993), Series Test (Gibbons 1985; Godbole and Papastavridis 1994) and The Longest Series in the Block Test (David and Burton 1962). Procedures of these tests are presented in the Appendix. Each of the tests verifies a following null hypothesis:

$H_0$ : Observed binary representation is a sequence of unpredictable values.

Which is opposed by the alternative hypothesis:

$H_1$ : Observed binary representation is a sequence of predictable values.

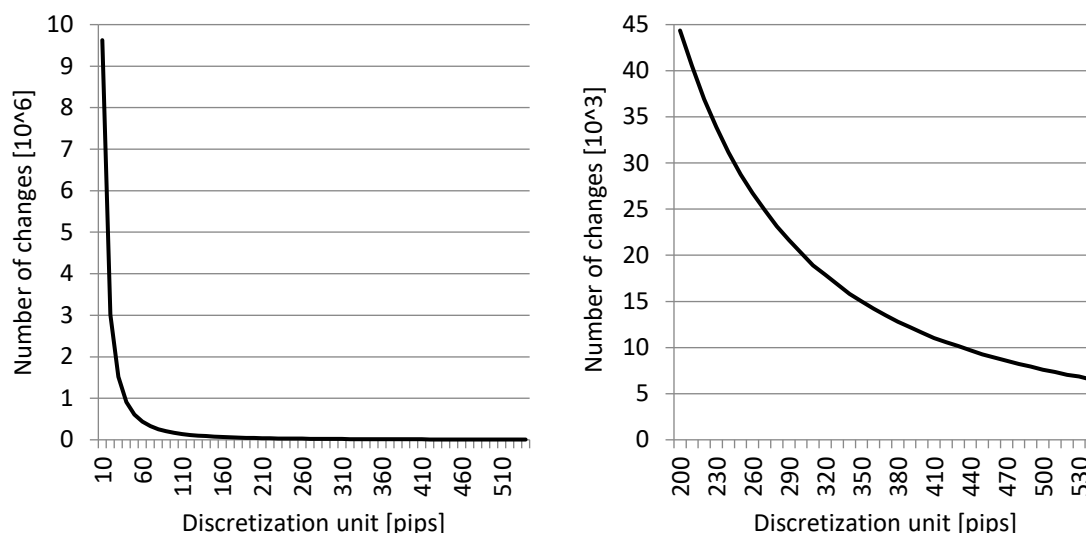
The verification of null hypothesis is conducted for an assumed significance level  $\alpha = 0.01$ . If at least one of the applied tests rejects the null hypothesis, then we conclude that the binary representation is, in fact, a sequence of predictable values and can stand as a premise to predict future exchange rate trajectory changes.

#### 4. Study of Precious Metals Exchange Rate Changes

In order to perform appropriate research, a dedicated software in C++ and Mql4 languages was written. Research uses tick data of gold and silver exchange rate quotations, expressed in American dollar (XAU/USD and XAG/USD), taken from Ducascopy broker. Data consist of quotations from a six-year time period from 01.01.2013 to 01.01.2019. The time period was chosen due to the changes introduced in recent years on the market, that is the development of tele-informatic devices (e.g. MetaTrader and JForex platforms, etc.), allowing for making transactions in time close to real (the realization time is expressed in ms) and market automation support (based on MQL4 and Java languages), etc. A huge influence on the character of course changes also recently stems from the reduction of spreads and minimal contributions. Lower spreads allow for transactions of a smaller range, and lower minimal contributions opened the market for a wider group of investors. In this context, analyzing older data can introduce distortions in current regularities to be found in today's investors' behaviors.

##### 4.1. Research results

As a result of analyzing the XAU/USD security, for all discretization units from range of 1 to 547 pips, we reject the hypothesis suggesting an unpredictable character of course changes for the assumed significance level. For most of the cases the Monobit Test indicates an unpredictable character of changes, yet for all discretization units from before mentioned range, remaining two tests (Series Test and Test for the Longest Run of Ones in a Block Test) reject the hypothesis of lack of dependencies between historical quotations and future change direction. This kind of result suggests that the number of registered decreases and increases is comparable and does not deviate from the number of changes registered in a truly random sequence, yet the order and number of particular change schemas definitely deviates from statistics of truly random sequences. This results indicates the existence of dependencies between historical data and the current direction of a change. Obtained results therefore justify the possibility of applying advanced technical analysis methods (e.g. prediction models dedicated to a binary representation (e.g. BSM (Stasiak 2016), BFMS (Stasiak 2017)). One can also conclude that using discretization units higher than 547 pips, the loss of informative value of the binary representation is so significant, that it makes it impossible to assess the future direction of a change. This means that for transactions in which the SL and TP levels are distanced from each other by the value higher than 547 pips, the probability of achieving a profit is not possible to be assessed.

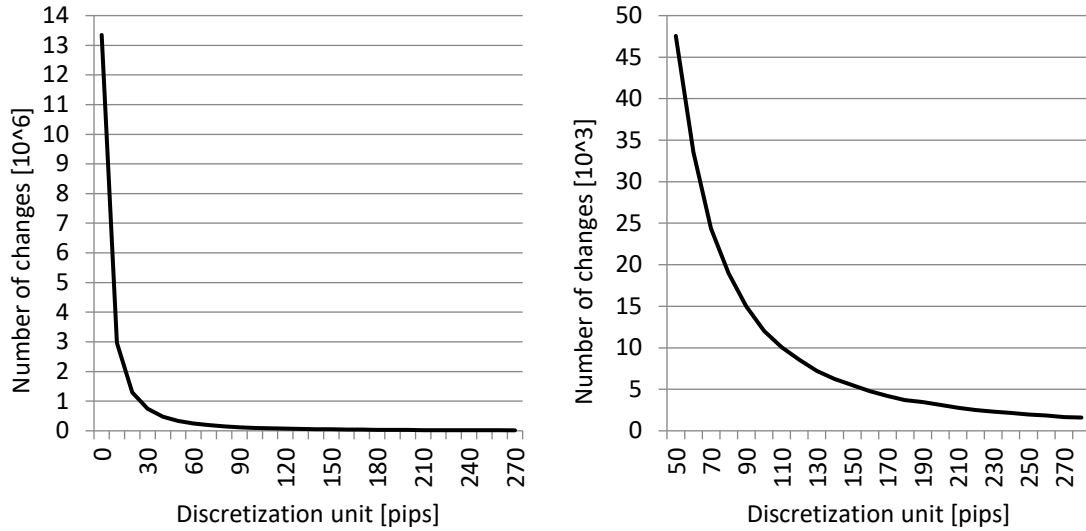


**Figure 2.** Number of changes (in millions) observed in the research period, depending on the discretization unit: a) for all positively verified discretization unit (1-547 pips); b) for a chosen interval discretization unit (200-547 pips).

In the Figure 2a we can see the number of observed changes in a six-year period, depending on the value of used discretization unit. This kind of analysis allows for an assessment of the number of potential transaction signals for constructed HFT system, based on a binary representation. Figure 2b presents results for these discretization units, which are at least four times higher than the average spread offered by one of the most popular brokers (ICMarkets).

Analogous research was performed for the XAG/USD valor. For the silver exchange rate and for all discretization units from the range of 1 to 281 pips, the hypothesis about unpredictable character of changes was rejected at assumed level of significance. Also in this case, only the monobit test indicates an unpredictable character of rate changes. Obtained results show, that for transactions in which SL and TP are separated from each other by a higher value, from the point of view of historical data analysis we cannot assess the probability of success.

In the Figure 3 we can see the number of changes observed in a binary representation for these discretization units, for which the binary representation retains its informative value. Results allow for formulating a conclusion that the transactions in which SL and TP levels are distanced by value higher than 281 pips, from the point of view of historical data analysis we cannot assess the probability of reaching a potential profit.



**Figure 3.** Number of changes (in millions) observed in the research period, depending on the discretization unit: a) for all positively verified discretization unit (1-281 pips); b) for a chosen interval discretization unit (50-281 pips).

#### 4.2. Practical application of obtained results in constructing HFT systems

Binary representation also allows for a simple implementation in HFT systems (Piasecki and Stasiak 2019). In traditional technical analysis of a candlestick chart, there arise a problem of proper TP and SL levels appointment and credible probability assessment of investment resulting in actual profit. Because of this, in many publications those parameters are omitted, and only levels of future rate increase or decrease in a given time is assessed, (which makes it impossible to evaluate this kind of strategy).

In the binary representation, course change by one discretization unit can be connected with TP and SL levels. Let us consider an exemplary HFT system, in which TP and SL parameters are distanced from the opening price by one discretization unit ( $\delta$ ). In this situation, the value of possible loss or profit (including the spread (*spr*)) of a single transaction can be calculated with the following formula:

$$Profit = (\delta - spr) * \nu, \quad (1)$$

$$Loss = (\delta + spr) * \nu, \quad (2)$$

where  $\nu$  is the transaction size expressed in Lot (Lot is a unit describing the transaction size). Assuming the same value of each transaction, this parameter only scales the position value and has no influence on considerations presented in the article. Based on the formulas (1) and (2), after simple transformations, we can indicate the limit probability assessment of the future direction change  $P_g$ , above which the HFT system will generate a constant profit:

$$P_g = \frac{(\delta + spr)}{2\delta}. \quad (3)$$

By the formula (3) and knowing the offered spread and chosen discretization unit, we can then describe the required level of probability assessment for future direction of a change, which has to be guaranteed by the applied technical analysis method in order for an investment to be characterized by a positive return rate. If this probability is higher than the threshold value, then the system will generate profit.

In the presented article, authors focused on presenting a solution schema for the problem formulated in a following way: do the precious metals exchange rates (XAU/USD and XAG/USD) show any dependencies between the historical and future quotations, and for which discretization units this kind of dependencies are visible. Performed research showed that for discretization units from the range of 1-547 pips (for gold), there exist a possibility of applying technical analysis in order to predict the exchange rate trajectory. Average spread offered by one of the most popular brokers (ICMarkets) equals 20 pips for XAU/USD. For higher discretization unit, the lower the spread influence. According to the formula (3), for example for the discretization unit of 420 pips, the level of prediction equal to 0.53 of accurate predictions, allows for obtaining a positive return rate.

The authors' current research focuses on developing new prediction models dedicated to the precious metals market in order to build and analyze the risk of algorithmic trading systems for this market.

## 5. Summary

In the article, the verification method for possible dependencies between the current change direction and the historical quotations of precious metals exchange rates (XAU/USD and XAG/USD) is presented. In the researched method, statistical testing and binary rate representation was used, which eliminates the loss of informative value usually created by using the candlestick representation.

As a result of the research, the hypothesis about the market effectiveness for XAU/USD and XAG/USD was rejected and existence of possible dependencies between historical data and current change direction was proved. These conclusions justify the application of technical analysis methods like state modeling etc. in assessing the probability of the direction of future changes.

In the article, for researched securities, the range of discretization units was also indicated, for which the binary representation retains its informative value and can be used in technical analysis. Moreover, minimal requirements for prediction tools were also pointed out, by fulfilling which the investor achieves a positive return rate.

## Appendix

Let the sequence of random values  $\{\varepsilon_i\}_{i=1}^n$  describe the observed binary representation of given currency pair. Function  $erf(\cdot)$  is defined by following formula:

$$erf(x) = \frac{2}{\pi} \int_{-\infty}^x e^{-\frac{t}{2}t^2} dt. \quad (A1)$$

*Monobit Test (Chung 1979; Pitman 1993)*

Statistic of this test is given by the relation:

$$S_{obs} = \frac{2 \cdot \sum_{i=1}^n \varepsilon_i - n}{\sqrt{n}}. \quad (A2)$$

If the below stated condition is met:

$$p_{value} = 2 \cdot (1 - erf(|S_{obs}|)) < \alpha, \quad (A3)$$

then we can say that there is a basis to reject the null hypothesis  $H_0$  in favor to the alternative hypothesis  $H_1$ .

*Series Test (Gibbons 1985; Godbole and Papastavridis 1994)*

$$V_{obs} = 1 + \sum_{i=1}^{n-1} |\varepsilon_{i+1} - \varepsilon_i|. \quad (A4)$$

Statistic of this test is given by the relation:

$$Z_{obs} = \frac{V_{obs} - E(V_{obs})}{\sqrt{D(V_{obs})}}, \quad (A5)$$

where:

$$V_{obs} = 1 + \sum_{i=1}^{n-1} |\varepsilon_{i+1} - \varepsilon_i|. \quad (A6)$$

$$E(V_{obs}) = 2 \cdot \frac{n_1 \cdot (n - n_1)}{n} + 1, \quad (A7)$$

$$D(V_{obs}) = 2 \cdot \frac{n_1 \cdot (n - n_1) \cdot (2 \cdot n_1 \cdot (n - n_1) - n)}{(n - 1) \cdot n^2}, \quad (A8)$$

$$n_1 = \sum_{i=1}^n \varepsilon_i. \quad (A9)$$

If the following condition is met:

$$p_{value} = 2 \cdot (1 - erf(|Z_{obs}|)) < \alpha, \quad (A10)$$

then we can say that there is a basis to reject the null hypothesis  $H_0$  in favor to the alternative hypothesis  $H_1$ .

*Test for the Longest Run of Ones in a Block (David and Barton 1962).*

By the term of 'series' we understand a random and possibly longest subsequence of ensuing '1'. In order to perform the Longest Series Test, the binary representation  $\{\varepsilon_i\}_{i=1}^n$  is divided into  $N$  subsequences, consisting of  $M$  ensuing elements of  $\{\varepsilon_i\}_{i=1}^n$  sequence. Each representation subsequence obtained this way is called a block. Next, we appoint probabilities  $\pi_m^*$  of events  $\Pi_m^*$  defined this way, that the length of the longest series in  $M$ -element block is equal to  $m = 0, 1, 2, \dots, M$ . Probabilities  $\pi_m^*$  are appointed based on following formulas:

$$\pi_m^* = \begin{cases} q_0 & m = 0 \\ q_m - q_{m-1} & m > 0 \end{cases} \quad (A11)$$

$$q_m = \frac{1}{2^M} \sum_{r=0}^M \sum_{j=0}^{U(r)} (-1)^j \cdot \binom{M-r+1}{j} \cdot \binom{M-j \cdot (m+1)}{M-r} \quad (A12)$$

$$U(r) = \min \left\{ M - r + 1, \text{entier} \left( \frac{r}{m+1} \right) \right\}, \quad (A13)$$

Next, we indicate such minimal values of  $k, l$  parametes, that the following conditions are met:

$$\sum_{t=0}^k \pi_t^* \cdot N > 5, \quad (A14)$$

$$\sum_{t=M-l}^M \pi_t^* \cdot N > 5, \quad (A15)$$

Next step consist of appointing a sequence of events  $\{\Pi_s\}_{s=k}^l$  described by relations (Revesz 1990):

$$\Pi_s = \begin{cases} \prod_{t=0}^k \Pi_t^* & s = k \\ \Pi_s^* & k < s < M - l \\ \prod_{t=M-l}^M \Pi_t^* & s = M - l \end{cases}, \quad (\text{A16})$$

Probability  $\pi_s$  of an event occurring is calculated the following way:

$$\pi_s = \begin{cases} \sum_{t=0}^k \pi_t^* & s = k \\ \pi_s^* & k < s < M - l \\ \sum_{t=M-l}^M \pi_t^* & s = M - l \end{cases}. \quad (\text{A17})$$

In the last step, for each event  $\Pi_s$   $s = k, k + 1, \dots, M - l$  we describe the number of blocks  $v_s$ , corresponding to given event. Statistic of the thest of Longest Series in the Block is defined in the following way:

$$V_{obs} = \sum_{s=k}^{M-l} \frac{(v_s - N\pi_s)^2}{N\pi_s}. \quad (\text{A18})$$

If the following condition is met:

$$p_{value} = 1 - \chi^2(V_{obs}, M - k - l + 1) < \alpha, \quad (\text{A19})$$

where:

$$\chi^2(x, N) = \frac{\int_0^x t^{N/2-1} e^{-t} dt}{2^{N/2-1} \cdot \int_0^\infty t^{N/2-1} e^{-t} dt}. \quad (\text{A20})$$

then we can say that there is a basis to reject the null hypothesis  $H_0$  in favor to the alternative hypothesis  $H_1$ .

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# Conditions of Corruptive Behavior – the Example of Poland and Ukraine

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**Abstract:** Corruption is not a new phenomenon. It is timeless, common, universal. It is not only an economic or moral, but also a cultural problem occurring in everyday interpersonal relations in modern society. There are many reasons for corruption. They should be sought in morality, culture and customs - in politics, economic and sociological factors. Corruption is fundamentally negative. It is often viewed as a social disease that disrupts the functioning of individuals, societies, entire economies. The subject of the study is an analysis of corruption behavior determinants. It draws attention to their specificity, causes and negative consequences for various entities - individuals, enterprises and economies. Theoretical considerations in this area were supported by the authors' own research that was carried out in 2018, using a survey method in Poland and Ukraine. In the research participated 337 people. A comparative analysis of the propensity to corruption among Polish and Ukrainian respondents was made. A number of conclusions and recommendations were formulated regarding the analyzed aspects.

**Keywords:** corruption; corruptional behavior; corruption in Poland; corruption in Ukraine

**JEL Classification:** D73; E26

## 1. Introduction

Corruption is a permanent although imperfect element of social and political life (Jakubowski 2016). It is included in the group of so-called paradoxical social phenomena, due to the contradictory feelings and emotions that it triggers (Walczak 2016). It can occur not only within public, private and non-governmental sectors but also between them. It most often takes place in the state and local government administration; health care; education and higher education; customs and tax administration; institutions implementing EU programs; law enforcement agencies; judiciary system; economic sector (Mapa korupcji w Polsce... 2010). Corruption-related relations can be established between individuals representing particular entities operating within the sectors and /or between them (Jak zwalczyć korupcję... 2010). Corruption can acquire local, regional, national or even international character. Bribery acts can be performed by renowned businessmen, big or small companies, as well as ordinary people wishing to settle their everyday matters (Lampart 2015).

In order to examine the citizens' attitude towards the issue of corruption, own research has been carried out in Poland and Ukraine. The choice of these two countries is justified by the attempt to explain such meaningful discrepancies in corruptive behaviour despite numerous similarities between Poland and Ukraine (direct neighbourhood, former socialist system experience, similar language, culture, traditions). Poland is a country where the problem in question is far less significant, whereas in Ukraine corruption is almost common, often it is hardly possible to deal with any official matter without paying a bribe. There is social consent observed for both giving and receiving bribes. The research was carried out in March 2018 among 337 respondents - 164 Ukrainians and 173 Poles. This work encompasses theoretical elaboration on the phenomenon of corruption, its specificity, consequences, the most important conclusions and recommendations resulting from the conducted research.



## 2. Corruption Specificity

Corruption constitutes a social pathology, i.e. the behaviour of an institution or a part of social system that conflicts with the world views and the generally accepted system of values in a given community. This act is committed by anyone who, out of one's own direct or indirect interests, violates the rules which they themselves are responsible for. It is an act during which the person in charge of goods distribution in the social system violates the distribution in favour of someone for which they receive or expect gratification (Szwejkowski 2013). It is also using power for your own private purposes (Budsaratragoon, Jitmaneeroj 2018).

The corruption features include, among others: universality (it occurs on a large scale, in various areas, in almost every aspect of social life), entropy (i.e. the phenomenon spreading quickly and becoming more popular), interactionism (the participation of two entities - the "recipient" and "donor" – is required for the corruption to occur), the confidentiality or secrecy of benefit exchange (Fleszar 2014).

The corruption is commonly associated with offering and accepting bribes – from the practical point of view bribery is the most popular corruption form. On the other hand, it is less often related to other forms, such as: bribery, venality, influence peddling, using one's favourable position to achieve private, family or friend-related objectives, nepotism, embezzlement, and dishonest mediation (Lampart 2015). However, regardless of the form it is defined as a complex scheme of cooperation during which either a public or private good is claimed.

The scheme comprises (Jakubowski 2016):

- corrupting party - along with their official position (professional, social), owned resources and expected benefits;
- corrupt party - it refers to the business partner of the corrupting proposal, their competitive edge towards the bidder, possessed public or private goods along with their value;
- transaction beneficiary - they directly or indirectly gain tangible benefits as a result of corruption;
- funds, involved in order for the corruption transaction to take place;
- techniques employed to execute corruption transactions and securing methods;
- frequency of corrupt agreements constituting the transaction;
- environment in which the transaction is performed.

It is commonly believed that the main reasons for corruption are the strength and wide scope of authority attributed to civil servants as well as their low salaries. The first factor contributes to creating an official's privileged position over the "petitioner", since it is up to the official whether a particular matter is considered in favour of the client, or not. What is more, a huge number of unclear regulations, bureaucracy and excessive formalism also facilitate corruption incidents. The Supreme Audit Office identifies four fundamental corruption mechanisms, i.e. irregularities that increase the risk of corruption, based on performed controls and systemic analyses. These are as follows (Hussein 2017):

- flexibility of proceedings,
- conflict of interest,
- lack of proceedings transparency,
- lack of control system or its weakness.

Corruption is fundamentally negative (Chan, Dang, Li 2019; Sumah 2018). It is referred to as a social disease destroying (Turska-Kawa 2015) not only the "soft tissue of civil society" (trust, sense of empowerment), but also disrupting the operations of fundamental organisations and institutions. However, it impinges on the lowest income individuals. The negative aspects of corruption result from the fact that it (Bil 2014; Lampart 2015):

- mostly affects individuals with the lowest income depriving them of the access to necessities;
- is often accompanied by the other forms of organised and economic crime, including money laundering;
- is often linked to direct or indirect human rights violation;
- threatens political stability and sustainable economic development;
- undermines the whole society's morale;
- contributes to building individuals' unauthorized, unjust and illegal wealth that threatens democracy and the rule of law.

Counteracting the phenomenon of corruption is very difficult, it requires a comprehensive and multifaceted approach at the international level since, due to the globalisation process, its negative consequences are distributed among cooperating countries. Therefore, it is absolutely vital to detect and stop the international flow of unlawfully acquired funds in a more decisive, consistent and effective manner as well as strengthen the international cooperation in the fight against corruption. Only then will the poorer countries be able to combat corruption effectively and, indirectly, gain opportunity to improve in this respect. Each and every country is in charge of preventing and fighting corruption, and in order to guarantee the success in this field they must cooperate with the support of individuals and groups from outside of the public sector, such as associations, NGOs and environmental organizations (Lampart 2015).

### 3. Corruption in Ukraine and Poland

Corruption constitutes an issue in many countries around the world, but it literally plaques Ukraine. International rankings on corruption every year classify Ukraine on a very low position in this aspect. For instance, according to the Transparency International Report (a social organization, a leader in the fight against global corruption) for 2018, it held 130 position (out of 180 analysed countries) with the score of 28 points (maximum score in the ranking – 100 points, the higher score transparency, the lower score the higher corruption). In the period 2015-2018 its situation was slightly but gradually improving. The rate of growth calculated for 2018 as compared to 2015 equals 118.52%, which means that the index value increased by 18.52% showing slight improvement. What is more, 2018 is the first year when Ukraine ceases to occupy the last position in the ranking among European countries – it precedes Russia that holds 135th position in 2018. Poland, on the other hand, takes the 36th position with the score of 60 points. In the corresponding period Poland's corruption index is far more favourable although it deteriorates by 4.76%. According to the data in Table 1, Denmark scored the total of 88 points and was the leader in the Corruption Perceptions Index (CPI) report in 2018. It was followed by New Zealand with 87 points (the ranking leader in 2017); Finland, Sweden and Switzerland (85 points each). On the other hand, the countries with the lowest indices and positions in the ranking were: Somalia (mere 10 points out of 100), Syria, South Sudan (13 points each), Yemen and South Korea (14 points each).

**Table 1.** Corruption indices for selected countries.

No	Country	2015	2016	2017	2018
1.	Denmark	91	90	88	88
2.	New Zealand	91	90	89	87
3.	Finland	90	89	85	85
4.	Sweden	89	88	84	85
5.	Switzerland	86	86	85	85
6.	Canada	83	82	82	81
7.	Germany	81	81	81	80
8.	Great Britain	81	81	82	80
9.	Estonia	70	70	71	73
10.	France	70	69	70	72
11.	United States of America	76	74	75	71
12.	Portugal	64	62	63	64
13.	Poland	63	62	60	60
14.	Czech Republic	56	55	57	59
15.	Lithuania	59	59	59	59
16.	Italy	44	47	50	52
17.	Slovakia	51	51	50	50
18.	Romania	46	48	48	47
19.	Bielarus	32	40	44	44
20.	Bulgaria	41	41	43	42

21. China	37	40	41	39
22. Ukraine	27	29	30	32
23. Russia	29	29	29	28

Source: Own elaboration based on <https://www.transparency.org/cpi2018>, (retrieved on December 15, 2019).

Based on the considered report, the corruption in Poland is still a problem, which is illustrated by the decreasing corruption index in the period 2015-2018. However, according to the periodical public opinion survey conducted by the Public Opinion Research Centre (CBOS) some positive aspects can be identified. Positive answer to a question "Do you know anybody accepting bribes?" in 2000 was given by 29% respondents, in 2013 and 2017, respectively 16% and 10%. Respondents who declare knowing somebody accepting bribes are mostly highly educated, with high income, living in large cities, aged 25-34, assessing their own financial situation as poor and declaring left-wing political views. Considering the occupational groups one may note that these are usually representatives of management and senior specialists, administration specialists and office clerks, and employees in the service sector. Simultaneously, the number of respondents declaring offering bribes is also decreasing. The CBOS survey's question "Have you been forced in the last 3-4 years to offer a bribe?" was answered in an affirmative way by 16% respondents in 1993, 20% in 1999 (the worst result up to date) and 9% in 2013. The 2017 survey confirmed the falling trend with 6% respondents declaring having been made to pay a bribe in the preceding 3-4 years (CBOS nt. korupcyjnych... 2017; CBOS nt. stosunku... 2014). Thus, it proves some positive trends occurring in the phenomenon of corruption in Poland.

Because as stated above, the most common indicator of corruption CPI is defective instrument (De Maria 2008), the study also refers to the Rule of Law Index (RLI). It is prepared annually by an international organisation aiming to consolidate the idea of the rule of law around the world (the World Justice Project). In 2017 according to RLI Index, Poland was ranked on 27 position (out of 126 countries considered in the report) with the index score 0.66 points; Ukraine on 77 position with the score of 0.55 points. There are eight aspects of state affairs evaluated in the index: (1) mechanisms of government powers, (2) issue of corruption, (3) government openness, (4) fundamental human and civil rights, (5) order and security, (6) regulatory enforcement, (7) civil justice, (8) criminal justice). Taking into consideration the neighbours of Poland, the best score was obtained by the Federal Republic of Germany (0.84 points; 6th place) followed by the Czech Republic (0.73 points; 19th place). Less favourable results were obtained by Belarus (0.52 points; 66th place) and Russia (0.47 points; 88th place). The leaders of the RLI Law Rule Index were Scandinavian countries with the leading positions: Denmark (0.90 points), Norway (0.89 points), Finland (0.87 points) and Sweden (0.85 points). On the contrary, the lowest positions in the ranking were occupied by: Congo (0.33 points), Cambodia (0.32 points) and Venezuela (0.28 points) (WJP Rule of... 2019).

Corruption is a common worldwide phenomenon. However, in Ukraine it constitutes an extremely serious, fundamental social problem (Denisova-Schmidt, Prytula 2018). For years, the country has been occupying very distant positions in world rankings on corruption. To exemplify, one may buy any court decision in any court in exchange for a bribe. It is not rare that the court verdict is explicitly contrary to the law – all due to the corruption. One can come across a bribery pricing list for various types of "services" in Ukraine. For example: (1) \$ 100 – being granted the possibility to meet a lower-level office clerk; (2) \$ 400 – obtaining competitor's bank account statement at one of the largest Ukrainian banks; (3) \$ 1,000 – persuading an office clerk to deal with one's case; (4) \$ 3,000 - a monthly tribute charged by the General Prosecutor's Office in Kiev required to conduct the case; (5) \$ 10-30 - minor, simple cases in the court (Sikorski 2008). This has a serious adverse impact on the economy. Ukraine lacks internal investors (no capital market) and external investors quit doing business in the Ukrainian market, even though it is very receptive, mainly due to the corruption. The investments in Ukraine are usually blocked by the fear of insufficiently protected property rights as well as a corrupted judiciary system. What is more, international institutions, which could deliver sufficient investment capital, condition their support for the Ukrainian economy by clearly visible and effective anti-corruption measures, which also limits the capital inflow (Stodolak 2018). All in all, the corruption destroys the Ukrainian economy, hinders its development and negatively affects the morale of citizens.

#### 4. Methodology

The research was carried out among Polish and Ukrainian inhabitants and was based on a questionnaire which included questions on various areas related to the corruption in micro and macro - scale. The research was performed in March of 2018. For the research two statistical tests were used to allow for the indication of dependency and variations between Polish and Ukrainian group: Chi- square Independence test and the Mann- Whitney – U test.

The Chi-Square test of independence is used to determine if there is a significant relationship between two nominal (categorical) variables. The frequency of each category for one nominal variable is compared across the categories of the second nominal variable. The data can be displayed in a contingency table where each row represents a category for one variable and each column represents a category for the other variable. The null hypothesis for the test states that there is no relationship between two variables. This test could be used when: the sampling method is simple random sampling, the variables under study are each categorical and if sample data are displayed in a contingency table, the expected frequency count for each cell of the table is at least 5.

The Mann–Whitney U test can be used to investigate whether two independent samples were selected from populations having the same distribution. It is a nonparametric test of the null hypothesis that it is equally likely that a randomly selected value from one population will be less than or greater than a randomly selected value from a second population.

The significance level for a study -  $\alpha$  is 0.05. All the developed results were presented using the graphic form.

#### 5. Propensity for Corruption in Poland and Ukraine – Research Perspective

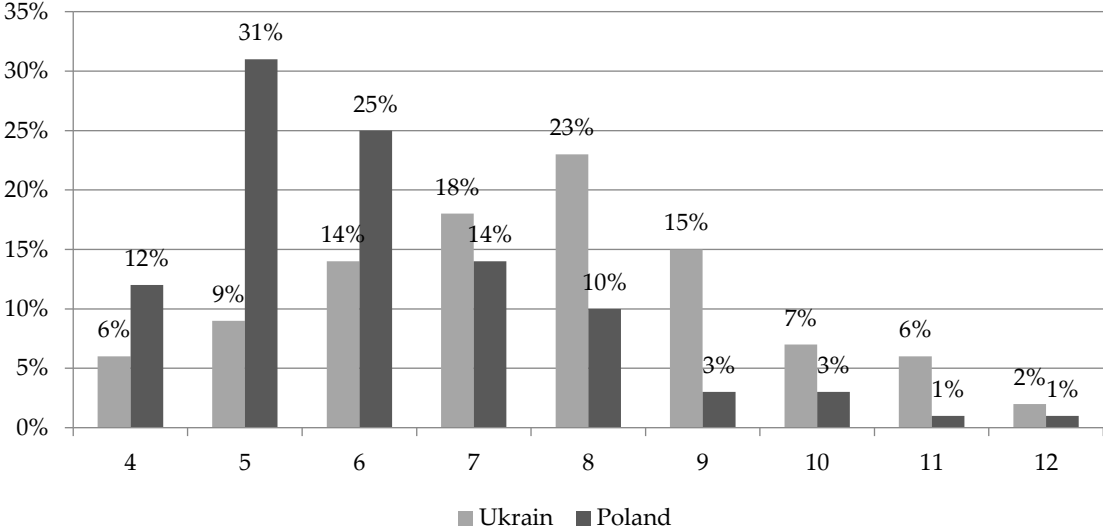
In order to examine the propensity for corruption of Polish and Ukrainian citizens, own research was conducted with the use of a questionnaire. The research was performed in March 2018, there were 337 respondents - 164 from Ukraine (49% of the entire research sample), and 173 from Poland (51%). One shall note that the age distribution in the research sample varies according to the nationality – the Ukrainian group is dominated by respondents aged between 36 and 55 (52%) whereas, the Polish group mainly includes younger respondents aged up to 35 years (54%). In both groups there are more females, in Ukrainian there are more (61%), though. Three quarters of Ukrainian respondents live in towns, whereas in Poland comparable amount of them live in towns (51%) and villages (49%). The respondents have higher or secondary education background, the share is very similar in groups from both countries (for secondary education in Ukraine and Poland 51% and 49%, respectively; for higher education 49% and 51%, respectively).

The research was aimed at examining the respondents' approach towards corruption in everyday life (in education, in healthcare, etc.). Four questions regarding "material stimulation" in these spheres and feelings associated with such activities were used. Each question was scored from 1 ("I do not agree") to 3. In total, 16 points could be obtained in a situation that confirmed or supported corrupt activities. Thus, the higher the score the greater the propensity for corrupt behaviour and vice versa. A comparative analysis of the responses in Ukraine and Poland was held by means of the Pearson chi-square independence test. The results are presented below in the form of "p" probability value for each detailed question:

- Most of the respondents believe that a bribe is absolutely necessary, and "things will move only if you pay a bribe" ( $p = 0.08138$ ); this question was answered in a similar manner, although the respondents from Ukraine agreed more often with this statement (22% provided the answer - "I completely agree with this", in the case of Poland it was 13%);
- In the case of children education (in general and vocational schools as well as in higher education) material stimulation of teachers (lecturers) is the right thing to do -  $p = 0,0000$ ;
- The favour should be returned personally to medical doctors for their service in a material form -  $p = 0,0000$ ;
- Material „stimulation” or „gratitude” is nothing extraordinary, it does not lead to unpleasant feelings (humiliation, shame or embarrassment), neither on the side of the offering party nor the accepting one ( $p = 0.0058$ ); 53% respondents from Poland and 36% from Ukraine disagreed.

The test of independence identified significant discrepancies in the following three situations regarding: children education, medical care and attitudes towards the bribery. In Poland, the share of respondents against that kind "stimulation" is much higher than in Ukraine, especially when it comes to education and medical care, where such situations occur on regular basis. In Poland, fewer people are in favour of offering bribes to teachers, lecturers (78% Polish respondents disagreed with such practice, 42% for Ukrainian respondents) and doctors (70% and 31% respondents in Poland and Ukraine, respectively, were against offering bribes). According to CBOS, the problem of corruption in Poland most often occurs in the case of politicians (47%), healthcare system (38%), judiciary system (32%) and local government administration (30%). Another public opinion survey performed by the TNS Polska in 2015, medical doctor is the most corrupt Polish occupation (65% responses) (CBOS nt. korupcyjnych... 2017).

Based on the answers provided by the respondents and regarding corruption in everyday life situations an indicator was constructed with the value ranging from 4 to 16 points. The higher the score the greater consent to corrupt behaviour. The score distribution in the case of Polish and Ukrainian respondents is presented in Figure 31. It shows that in Poland the highest number of respondents scored 5 points, while in Ukraine most often 8 points were obtained. It clearly shows that in Poland the biggest number of respondents scored 5 points and in Ukraine the score was higher and equalled 8 points.



**Figure 1.** Score distribution regarding the study on corruption in everyday life situations in two examined research groups.

Based on the above score distribution, the U-Mann-Whitney test was implemented to verify possible differences in the amount of points scored by the respondents from the two countries. It turns out that there is a statistically significant difference in the number of points gained by the respondents in the populations,  $p < \alpha$  ( $p = 0.0000$ ). This may lead to a conclusion that the public acceptance of everyday corruption in Poland is much lower (average at 6.11 points) than in Ukraine (average 7.56).

The ability to counteract corruption also matters, especially when it already constitutes a well-grounded phenomenon. This kind of situation was also examined in this research on corruption. In order to diagnose the problem 7 questions were used regarding various aspects of corruption (in social, professional and political life). The higher the score achieved the better skills to counteract corruption. Each question was scored from 1 to 3 ("I completely agree"). Four questions were scaled quite opposite.

A comparative analysis of the research carried out in Ukraine and Poland was performed by means of the chi-square Pearson independence test. The results are given in the form of "p" probability value for each of the particular questions:

- I had to openly argue with my supervisor about working issues or my supervisor's unreasonable requirements ( $p = 0.00131$ );
- I am afraid to refuse my supervisor so as not to harm my own business. ( $p=0.96462$ );
- There are ambitious co-workers in the team who speak their mind openly without hesitation ( $p=0.24074$ );
- I do not care if my vote was (is) changed during elections ( $p=0.00982$ );
- If I am offered a sufficient amount of money I will vote as I am asked ( $p = 0.01573$ );
- I have attended and will attend public protest demonstrations against political corruption ( $p=0.00000$ );
- I am not personally affected by corruption, misuse of powers is not a problem for me ( $p= 0.0000$ ).

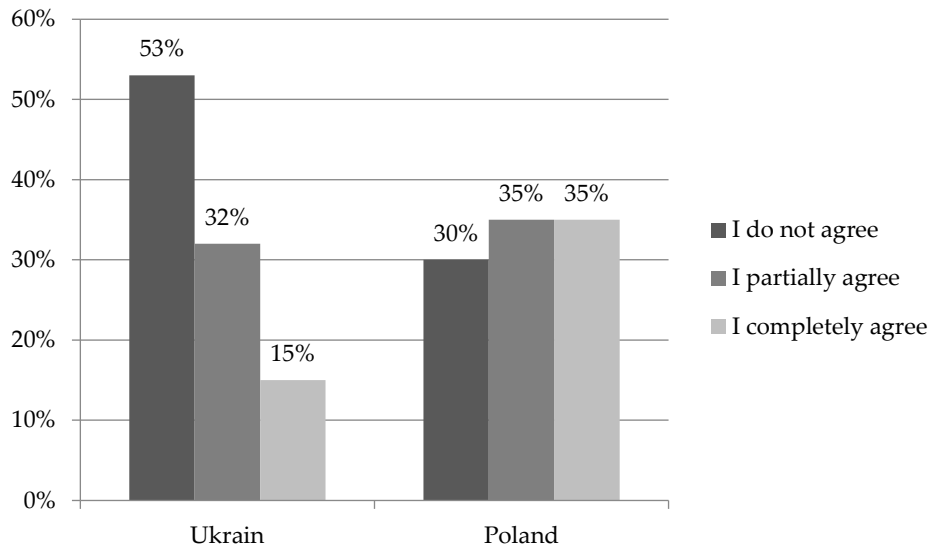
There are only two areas that do not differentiate the respondents – one of them is the fear of refusing one's supervisor  $p>\alpha$  (0.96426) and the presence of other co-workers able to speak their mind in front of their supervisor regardless of consequences  $p>\alpha$  ( $p=0.24074$ ). The research outcome revealed some differences in the answers regarding an open dispute with one's supervisor on working issues or unreasonable requirements. Almost 43% Polish respondents never faced such situation and 12% completely agree with the above statement. In the case of respondents from Ukraine – around 30% do not agree with the statement but every fifth respondent experienced similar situation. Examined respondents generally have similar impressions regarding the fear of refusing a supervisor; the research showed no differences in their responses ( $p> \alpha$ ). Majority of the respondents partially agree with the statement (45%) or disagree (approx. 42%). No significant differences are noted in the case of the presence of ambitious co-workers expressing their opinions in front of supervisors – majority of them either partially or completely agree with the statement.

Taking into account the respondents' attitude towards their vote being distorted in the elections, differences between nationality groups are already statistically significant. Polish respondents pay more attention to their votes in elections (82%). In the case of respondents from Ukraine - the same option was indicated by 67% of individuals. Surprisingly, every tenth person in Ukraine pay little attention to this issue.

Another question regarding elections also differentiates the answers in the examined research samples. For 85% Poles it is impossible to change one's vote, even if offered a sufficient amount of money. In the case of Ukrainian respondents, similar attitude is presented by 76% respondents. This means that Ukrainian voters are more flexible as far as changing their vote is concerned - 10% respondents would not hesitate to change their vote if offered a proper bribe.

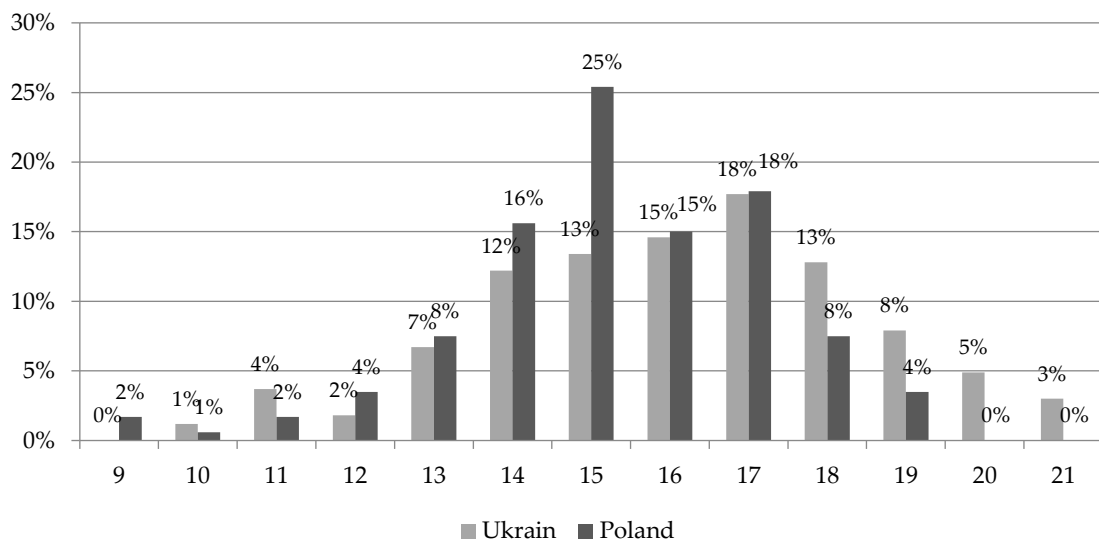
Respondents were also asked about their active participation in corruption counteracting. Over half of Poles (57%) did not participate in mass demonstrations against corruption, whereas in the group of Ukrainians only 34% did not attend such event. As many as 66% of respondents from Ukraine admitted doing so (answers "I partially agree" and "I completely agree"), so either they already participated in such protests or intend to.

Respondents taking part in the research were also asked whether they had personally faced corruption. Their answers are presented in Fig. 2. Clearly, Ukrainian respondents more often have to deal with corruption instances.



**Figure 2.** I am not personally affected by corruption, misuse of powers is not a problem for me.

Questions regarding the ability to counteract corruption (more precisely the sum of points collected for the questions) served as basis for creating an indicator measuring the ability to stay corruption-resistant. The indicator ranged from 7 to 21 points – the higher the indicator’s value the better abilities (stronger determination) to counteract corruption. Score distribution obtained in the two examined groups is shown in Fig. 3. In Poland the biggest share of respondents scored 15 points, whereas in Ukraine – 17 points. What can be learned from the distribution is that Ukrainians are well aware of their country struggling corruption, but they show far more determination than Poles in fighting and preventing it. Less involvement of Poles in fighting corruption may be explained by the fact that they generally do not regard it a vital Polish problem.



**Figure 3.** Score distribution in the study on the ability to fight against corruption in the two examined groups.

By means of the U-Mann-Whitney test, differences in the level of points obtained by respondents from Poland and Ukraine were studied. The test showed a statistically significant difference in the number of points obtained in the examined populations,  $p < \alpha$  ( $p = 0.0006$ ). In the case of Ukraine, the indicator's value is higher (16.11 points), whereas in Poland the average value equals 15.26 points. Therefore, the research proves greater skills in fighting corruption in a Ukrainian group of respondents.

## 6. Discussion

Summing up theoretical background presented in this elaboration, own research performed by the authors as well as findings provided by various institutions dealing with the issue of corruption a number of interesting conclusions can be formulated. First of all, the problem of corruption is far more significant in Ukraine, it occurs on a daily basis at both private and professional levels. In Poland the phenomenon of corruption is not as accepted as in Ukraine – its social support is much lower. The ability to resist corruption is also a factor differentiating the nationality groups. Ukrainian respondents show much more determination to fight corruption (Denisova-Schmidt, Prytula 2018). It is worth noting that in the group of Ukrainian respondents religion significantly differentiated the approach towards corruption in everyday life. Surprisingly enough, believers in Ukraine tend to accept corruption more than atheists. On the contrary, Polish respondents practicing some religion showed the least consent to corrupt behaviour. It is also interesting to note that Ukrainians do not seem to notice positive changes occurring in the phenomenon of corruption, such as attempts to reduce corruption or downward trends in the scale of corruption, which are evident according to numerous statistics and quantitative research (CBOS nt. korupcyjnych... 2017). Similar results were obtained in surveys conducted in 1998 by the Kiev International Institute of Sociology on a group of 2,600 respondents. The study showed that only a small percentage of respondents admitted that the Ukrainian government was taking effective measures to fight corruption (Cabelkova 2019). This may be explained by the massive scale of the phenomenon which actually prevents ordinary people from noticing positive but still small changes.

Due to the mainly negative character of corruption (although few researchers identify some positive aspects of corruption (Czepil 2014; Makowski 2012; Cichocki 2012)), it is absolutely necessary to minimize it. The most important issue in the process of its limitation are the cultural environment, in particular social consent to this type of activity. Corruptive behaviour is deeply rooted in morality, culture, customs and habits, politics and sociological factors (Brol 2015). Fundamental causes of corruption are the very human nature, low moral costs of corruptive behaviour, weakened so called immune ethical system of a society (Szwejkowski 2013) and some space (opportunities) for corruptive decisions. Thus, corruptive behaviour is so difficult to eliminate.

It is commonly known that corruption cannot be completely eradicated, since it is a natural phenomenon (Sumah, 2018), cannot be limited by top-down regulations or strict sanctions for offering and accepting bribes. The key importance is attributed to social attitude towards this kind of behaviour and lack of social consent to the so-called soft forms of corruption (e.g. petty bribe, protectionism or intermediating non-entirely legal transactions) (Holyst 2014), stigmatising ethically questionable activities, manifesting and spreading one's strong moral assessment of bribery.

Preventing corruption should be focused on limiting opportunities that aim to create space for corrupt behaviour (e.g. harmonise legal regulations, close gaps in law, reduce bureaucracy and discretion, improve procedures, emphasise the transparency of certain activities) by means of not only formal regulations but, most of all, at social and cultural level (suitable up-bringing, education or providing proper values); ethical behaviour should be promoted, whereas social acceptance of corruption should be eliminated (Dąbrowska-Mikuta 2013; Aktan 2015). Media may play a key role in modelling public attitude towards corruption and its perception as an essentially negative phenomenon (Cabelkova 2019). In countries such as Ukraine, where corruption scandals very rarely end up with strict court verdicts for the accused and charged, mass media can support corruption and encourage this kind of behaviour. From this perspective, people see corruption as something natural or even legal, since no penalties are imposed, especially for high-level authorities.



Comparing situation regarding corruption in Poland and Ukraine one shall consider the development level of the countries. Corruption in Poland after the economic transformation of 1989 seemed to have been far more problematic. It constituted some kind of transformation cost (economic transformation, legal changes, lack of harmonised regulations, etc.) (Denisova-Schmidt, Prytula 2018). Along with social and economic recovery and general situation becoming more stable, the propensity for corruption decreases. For instance, in the late 1990s in highly-developed countries (including France, the Netherlands or Germany) entrepreneurs offering bribes to officials in order to obtain a significant public contract were allowed to deduct this special cost from their tax. It was only after the introduction of the OECD convention on combating bribery of foreign public officials in international business transactions of 1997 (Makowski 2012) when the situation began to change. A. Hussein claimed that consent to corruption, especially in post-communist countries, is essentially a symptom of helplessness regarding corruption and corrupt authorities (Hussein 2017). However, the most often it is rather a manifestation of the system weakness or poor management (Why corruption matters...2015), not the result of acceptance of this type of activities or other unethical behaviour.

## 5. Conclusions

Corruption is a huge economic, but also political and social problem. It affects entire societies, each individual person. It should be undoubtedly reduced. Corruption has been, is and will be present in every country, although in some it's level is very high. As An example it would be Ukraine, where corruption prevents economic development, destroys and destabilizes the functioning of the state, as well as reduces the comfort of citizens' lives. It must be strictly limited using specific system solutions. However, this requires time, it is a very difficult and lengthy process, and complex cultural changes are needed that would change the attitude of all citizens to corruption. In particular, young people should be educated, ethical behavior promoted, which, as a result, may gradually reduce corruption in the long run.

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# Outline of the Problem of Energy Poverty in Poland – Trend and Extent

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**Abstract:** Energy poverty is a social and economic phenomenon that consists in experiencing difficulties in meeting basic energy needs. This paper presents analyses of trends and current status in this respect in Poland. Statistical data of the Central Statistical Office in Poland and Eurostat provided the basis for this study. The analyses were carried out in the period of 2007–2017. The analyses show that an improvement in the extent of poverty and energy exclusion in Poland took place in the investigated period. However, a significant percentage of the population still struggles with problems related to energy poverty, such as maintaining an appropriate air temperature in living quarters and paying for electricity. It is necessary not only to continue to build awareness among local and national authorities and to monitor the situation, but also to create scenarios for the expected increase in electricity prices. Particular attention should be paid to helping the economically weakest households.

**Keywords:** energy poverty; expenditures on energy; family economics; Poland

**JEL Classification:** Q41; D10; G50

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## 1. Introduction

Poverty and research on poverty are very important elements of knowledge and economic science; (Santos et al. 2019; Zhang and Naceur 2019). The topicality of issues related to poverty and social exclusion in economic sciences is proved, inter alia, by the Nobel Prize in Economics awarded in 2019. Esther Duflo, Abhijit Banerjee and Michael Kremer received the prize for using an experimental approach for reducing the poverty in the entire world. Also in 2015, the Nobel Prize in economic sciences was awarded for the analysis of issues of consumption, poverty and prosperity (Angus Deaton). The problem of poverty can be considered in macro, meso and microeconomic aspects. Both analyses from a broad perspective (from the perspective of the entire world, continents and countries) and those on a regional and local scale are important (Charlier and Legendre 2019; Marchand et al. 2019).

The subject of this study concerns the poverty in Poland. The analyses of this phenomenon in this region have over a hundred years of tradition (the 1820s) (Panek 2008). Regardless of the methodological framework adopted, the analysis of the extent of poverty is an important factor when taking measures in the area of social policy. Reducing the poverty in urban and rural through the implementation of effective and inclusive policies and strategies is a major political challenge in each country (Romero et al. 2018; Pojar 2018; Adusah-Poku and Takeuchi 2019; Tàbara et al. 2019). According to statistical data, in 2017, 112.8 million people in the EU lived in households at risk of poverty or social exclusion (22.4% of the population). In Poland, this problem affected 19.5% of citizens, i.e. 7.3 million people.

A specific type of poverty is energy poverty. This type of poverty is associated with the problem of meeting energy needs: heating, hot water and electricity (Dagoumas and Kitsios 2014, González-Eguino 2015; Maxim et al. 2016; Aristondo and Onaindia 2018). Therefore, this issue concerns the basic needs of both biological and social functioning. Undoubtedly, energy poverty is strongly associated with poverty understood in an economic way (deprivation of access to material goods and resources). The literature of the subject mentions various types of causes of energy poverty. According to Weglarz et al. (2014), in addition to economic reasons, the technical and functional reasons (also known as behavioural, cognitive or emotional reasons) are also important. The problem of energy poverty is multidimensional (Santos et al. 2019). This phenomenon has negative consequences for cognitive development, health or even life.

The literature of the subject emphasizes the issue of the social and health costs of energy poverty and its relation to the problem of air pollution. Energy poverty is associated with social exclusion (Jász 2010; Libor and Bouzarovski 2018). As part of the analysis of the subject matter, there can be indicated, inter alia, a positive correlation between energy consumption per capita and gross domestic product (GDP) (Brown et al. 2011). The issue of energy poverty is closely related to the inefficient functioning of socio-technical paths that allow meeting the energy needs of households (Bouzarovski and Petrova 2015).

The main purpose of this paper is to estimate and demonstrate the variability of the extent of energy poverty in Poland (in various methodological breakdowns, described later in this paper). The analyses concerned not only the issues of internal variability (in Poland), but also partly the comparison of the phenomenon in Poland in relation to other countries in the European Union.

## 2. Material and Research Methods

This paper analyses statistical data both from the Central Statistical Office in Poland and Eurostat. The indicators presented in Table 1 were used for the analyses.

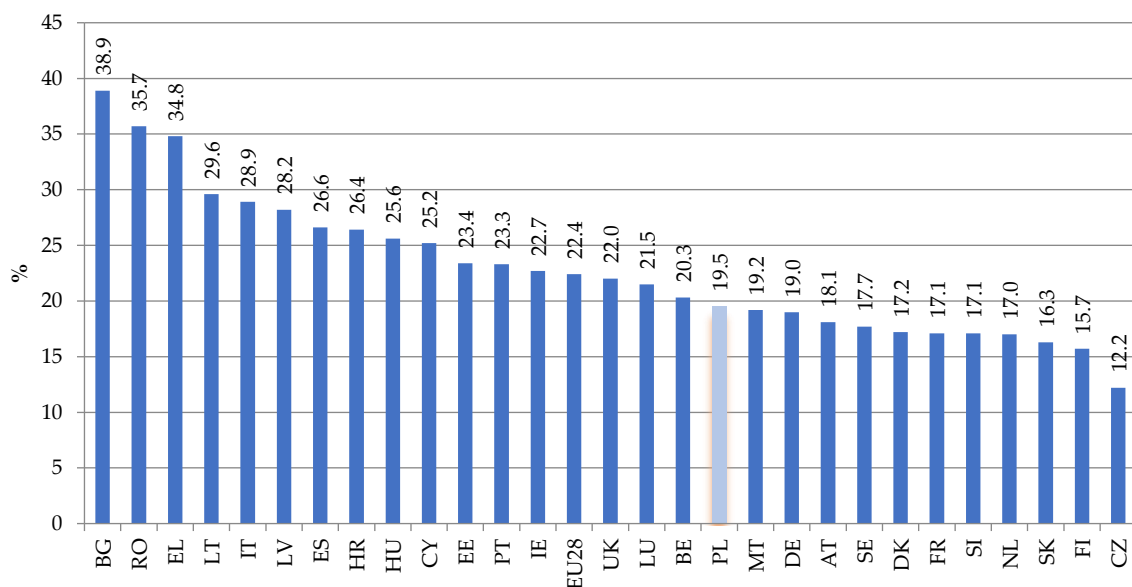
**Table 1.** A set of indicators used in this study to analyse the problems of energy poverty. (Energy Poverty Observatory 2019a)

Indicator	Description
Arrears on utility bills	The share of (sub-) population having arrears on utility bills, based on question "In the last twelve months, has the household been in arrears, i.e. has been unable to pay on time due to financial difficulties for utility bills (heating, electricity, gas, water, etc.) for the main dwelling?"
Inability to keep home adequately warm	The share of (sub-) population not able to keep their home adequately warm, based on question "Can your household afford to keep its home adequately warm?"
At-risk-of-poverty rate	The share of people with an equivalised disposable income (after social transfer) below the at-risk-of-poverty threshold, which is set at 60 % of the national median equivalised disposable income after social transfers.

The first two indicators are among the four basic indicators in the investigated subject matter analysed by the EU Energy Poverty Observatory. In turn, the at-risk-of-poverty rate (after inclusion of social transfers) is defined as the percentage of people whose equivalent disposable income is less than the at-risk-of-poverty threshold (expressed in purchasing power standard – PPS) set at the level of 60% of the national median of the equivalent disposable income. This indicator is also one of the basic indicators in the investigated problem area. In addition, there were presented analyses concerning the relationships between income and expenditures associated with the purchase of energy in households in Poland. The main time range of the analyses covered the period of 2007–2017.

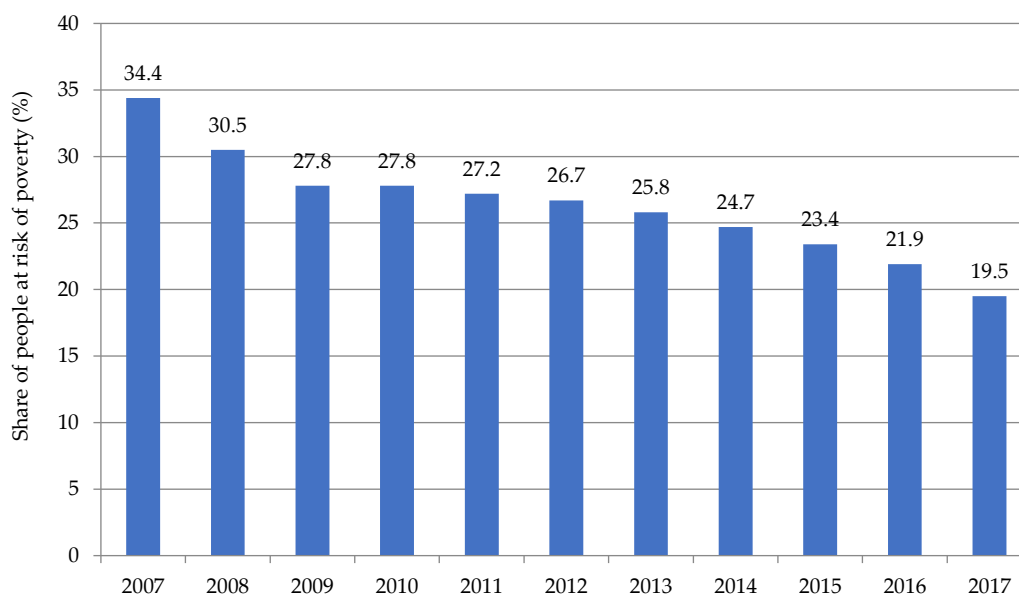
## 3. Results and Discussion

Eurostat data for 2017 show that 19.5% of the population in Poland was at risk of poverty and social exclusion. On the EU scale, this placed Poland on the 12th position among all EU-28 countries – counting from the country with the lowest scale of this problem (Fig. 1).



**Figure 1.** Share of the total population at risk of poverty or social exclusion by country in 2017. (Eurostat 2019b)

The lowest risk among all countries in the European Union was in the Czech Republic (12.2%), while the highest – in Bulgaria (38.9%). The main purpose of this paper is to show the scale and changes in the phenomenon of the poverty in Poland, hence it is worth noting that the value of this indicator keeps decreasing (Fig. 2).



**Figure 2.** Share of people at risk of poverty or social exclusion in the total population of Poland from 2007 to 2017. (Eurostat 2019a)

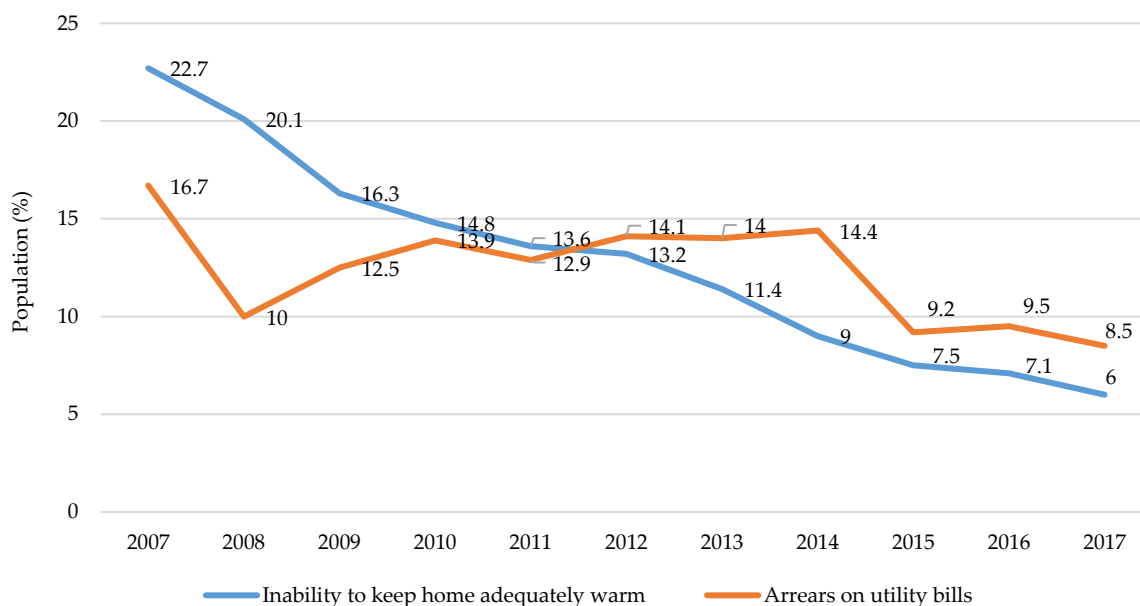
The possibility of satisfying basic energy needs in the place of residence is related to the income and costs of purchasing energy carriers. Relations between expenditures (expenditures on energy in relation to the total expenditures) and between incomes and expenditures on energy purposes are important (Table 2).

**Table 2.** Expenditures on energy purposes in relation to the total expenditures and incomes of a statistical household per capita in Poland in 2007–2017. (Statistic Poland 2019a; Statistic Poland 2019b)

Specification	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Expenditures (PLN)	809.9	904.3	956.7	991.4	1015.1	1050.8	1061.7	1078.7	1091.2	1131.6	1176.4
Expenditures on energy - electricity, gas and other fuels (PLN)	84.6	96.4	107.6	118.2	124.2	127.3	129.8	123.7	124.4	121.8	125.5
Expenditures on energy / expenditures (%)	10.4	10.7	11.3	11.9	12.2	12.1	12.2	11.5	11.4	10.8	10.7
Available income (PLN)	929	1046	1114	1201	1235	1278	1299	1340	1386	1475	1598
Expenditures on energy / available income (%)	9.1	9.2	9.7	9.8	10.1	10.0	10.0	9.2	9.0	8.3	7.9

The causes of energy poverty should be seen, inter alia, in low incomes of households and high prices of energy, often resulting in an increase in consumer debt beyond their income capabilities. As it results from analyses, the expenditures on energy in Poland (statistical household per capita) in 2017 accounted for 10.7% of the total expenditures. A downward trend regarding this indicator has been observed in Poland since 2013. The share of expenditures on energy in the disposable income also becomes lower and lower. The lowest level of this indicator in the entire investigated period was recorded in 2017. Along with an increase in income, the share of expenditures on energy in the structure of the total expenditures decreases.

Subjective measures of energy poverty include also answers to questions about difficulties in maintaining an adequate temperature in the place of residence as well as problems with paying for the energy supplied to the household (Fig. 3).



**Figure 3.** “Inability to keep home adequately warm” and “Arrears on utility bills” in Poland in 2007–2017 3. (Energy Poverty Observatory 2019b)

According to data of the EU Energy Poverty Observatory, the difficulty in maintaining an adequate temperature in the place of residence is becoming less and less of a problem. In 2007–2017, the percentage of the population declaring such a problem decreased in Poland by 16.7 p.p. The research shows that in 2017 six percent of the population of Poland considered the need for keeping their homes adequately warm to be satisfied insufficiently. The percentage of people declaring problems with paying their energy bills also decreased. In this case, the decrease in the investigated period was smaller – 8.2 p.p. It is worth noting that there is a clear downward trend in the first indicator (inability to keep home adequately warm). In turn, the second indicator distinctly decreased after 2014 (an increase in the value of this indicator was recorded in 2008–2014).

The calculations presented above show a clear improvement with respect to energy poverty in Poland. In the last decade, there was not only a decrease in the extent of the overall poverty, but also in the extent of energy poverty. There is no doubt that this resulted from an improvement in incomes, as evidenced by the dynamics of changes in income and declining indicators regarding expenditures on energy purposes in relation to incomes. The improvement of incomes in Poland in recent years was achieved also thanks to the "Family 500 plus" program. This program has been implemented since 1 April 2016 and is designed to help families raise children through monthly parental benefits for each child in the family in the amount of PLN 500 (Ruzik-Sierdzińska 2018). Programs aimed at improving the technical infrastructure (subsidies for thermomodernization of buildings, financial incentives for RES development, etc.) are also important for reducing the energy poverty (Dzikuć et al. 2017; Dzikuć and Dzikuć 2019). This is very important because many apartments are located in uninsulated buildings. Thermomodernization of a significant part of houses in Poland also needs to be performed again. There are few residential buildings in Poland, especially in rural areas, with a high and very high standard of thermal insulation. The low technical standard of buildings leads to an increase in energy consumption (Piwowar 2019).

However, the positive trend in reducing the energy poverty may be hampered by an increase in the price of electricity, which, combined with the economic slowdown, can intensify the problems related to energy poverty. Introduction of widespread trade in CO<sub>2</sub> emission permits as well as drastic reduction of emission levels in the EU and individual countries lead to an increase in prices of CO<sub>2</sub> emission permits and contribute to higher energy prices (Dzikuć, Tomaszewski 2016; Rosicki 2018). In Poland, due to the dependence of energy production on coal, the rate of CO<sub>2</sub> price pass-through to energy prices will be the highest in the EU, which will result in an increase in the expenditures on

energy (Jurdziak and Kawalec 2011; Woźniak 2012; Jurdziak 2012). Thus, it becomes necessary to continue monitoring the problems of energy poverty, especially in the social groups and areas with relatively low incomes. In Poland, this concerns mainly rural areas, especially farmer's households (Piwowar and Dzikuć 2019; Piwowar 2019b). This makes it necessary to prepare integrated and sustainable scenarios and action plans for improving the energy efficiency and counteracting the energy exclusion.

#### 4. Conclusions

The difficulty in satisfying the basic energy needs in the place of residence is a problem not only in countries with a relatively low level of social and economic development. Energy poverty is a serious problem in EU countries, including Poland. This paper describes the phenomenon of energy poverty in Poland. The main point is to show the differences in this phenomenon in statistical terms, based on data from 2007-2017.

The analyses show that the level of the indicators decreased significantly in the examined period of time. Particularly positive changes were observed in the case of the "Inability to keep home adequately warm" indicator. As the income of the population increases, the structure of expenditures changes. It is worth emphasizing here that the share of energy expenditures in the structure of the total expenditures in Poland decreased in the analysed period only by 0.3 pp and was 10.7% in 2017. In turn, the share of expenditures on energy in the disposable income decreased in 2007–2017 by 1.2 p.p.

The changes in electricity prices in Poland anticipated in the coming years mean that the energy sector will have to face the transformations related to climate change, as well as problems associated with energy security and poverty. This also requires involving the local and national authorities as well as monitoring the situation, including the development of scenarios for the expected increase in electricity prices. Particular attention should be paid to helping the economically weakest households.

This section is not mandatory but can be added to sum up the topic if results and discussion sections are long or complex.

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# Maintenance Ideal Model in Industry 4.0 – A Transformation Strategy Roadmap to Readiness Factor Calculation

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**Abstract:** The main purpose of this article is to analyze current status of companies' readiness factor for 4<sup>th</sup> industrial revolution. Also, we wanted to present a maintenance model idea for a company implementing Industry 4.0. principles. Based on our previous research, firstly machinery maintenance as a phenomenon and its place in a production process is presented. Since every author defines machinery maintenance on its own, we try to choose one, which "fits" best for us. Various types of different approaches to maintenance (based on historical, socio-economic or production factors) are presented here. Also, a correlation between the industrial revolutions and machinery maintenance is shown. In the next part of the article various types of machinery maintenance (according to many different conditions) are presented. Also, based on the previous research there is an obvious correlation between the level of Maintenance and Industrial Revolutions presented. Main part of the article presents an ideal model proposition of maintenance in Industry 4.0. This is based on three main components: hardware, software, humans and organization. This also correlates with the previous research which was made.

**Keywords:** industry 4.0; machinery; maintenance; predictive; model

**JEL Classification:** L62

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## 1. Introduction

Every industrial revolution causes technological, socio-economic and cultural changes. Technological aspects include maintenance management. Machinery (machines and equipment) always had one of the main positions in enterprises. Statistically, over € 1,500 billion a year is spent on maintenance, repair and renovation (MRO) only in the EU and over € 7,000 billion globally. Also, jobs are directly linked directly (more than 50 million) and indirectly (more than 150 million) with machinery maintenance. Thus, it is very important to deal with machinery maintenance in industrial environment. In this article we try to present the most advanced maintenance up to date, with some clarification of our model.

## 2. Methodology

If we want to present a maintenance model idea for a company implementing Industry 4.0. principles, we need to properly define maintenance first. Machinery maintenance was never a factor commonly monitored in companies. Studies show, that a closer look on the maintenance is shown after World War II. Of course, there were some kinds of industrial maintenance earlier (during Industrial revolutions 1-2), but maintenance as a specific key factor in production is carefully observed in 1950s. There are a lot of different approaches and definitions on machinery maintenance, below is a list of few. Maintenance thus, as a "science", can be defined as:

- "Combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function" (SS-EN 13306 2001).

- “The main purpose of maintenance engineering is to reduce the adverse effects of breakdown and to increase the availability at a lower cost, in order to increase performance and improve the dependability level” (Simeu-Abazi and Sassine 2001).
- process that the production process needs; it is the primary process where input is transformed in output and Maintenance is a secondary process that helps the first to the achievement of production. (Gits 1994).
- Maintenance management covers all actions including inspection, adjustments, cleaning, lubrication, testing, and replacement of expendable parts, as necessary to maintain the serviceability of the equipment (API RP 8B 2012).
- maintenance implies all measures that assist to save and re-make the required condition of machinery and equipment. (Bagadia 2006)

Maintenance has, according to terminology and standards, a direct link to reliability and thus to readiness, under which maintainability and maintenance is ensured. Machinery maintenance, as any other science, also developed depending on the circumstances. There are various types of maintenance. As our previous research indicates, maintenance used can be related to the development of industry. (Poór et al. 2019).

The oldest type is simply called reactive maintenance, where after maintenance was carried out only after failure, which could simply prolong machine's useful life. Of course, this brought unplanned breakdowns and possible long machine downtime. Another type was immediate or delayed maintenance, as the machines began to be larger and more complex. We are referring to second industrial revolution, coming of production lines, which operation became more expensive.

Regular inspections and repairs come to play here, maintenance is started being called preventive, and its main goal is to prevent failures. Also, regular inspections and revisions are made by maintenance personnel, which also is under development. Basic perceptions such as hearing, sight and touch of machine operator are used. The basic principles of predictive maintenance (which is another evolution step) are diagnostics and condition monitoring equipment. Now, machines are not repaired at regular intervals but only if the repair is required. This allows us to reduce costs on material, workforce, time and resources.

Proactive maintenance goes even further by identification of the causes of failure by means of technical diagnostics. Reliability-based maintenance is "a procedure to establish maintenance requirements for any physical asset in its operational context." (Jardine 2006).

Total Productive Maintenance - TPM - is the state-of-the-art philosophy, organization of machine maintenance in the production process, with a significant share in increasing productivity and eliminating costs. It is a set of maintenance activities performed throughout the lifetime - the existence of machines in order to improve their accuracy, reliability, performance and efficiency as well as reducing all possible losses. (Sullivan et al. 2004)

Since there is a lot of different approaches to machinery maintenance and every author defines maintenance on its own (based on conditions, type of production, resources, technological development), there are a lot of different kinds of “maintenance types”. For our purpose, this division according to (Project services 2017) fits the best.

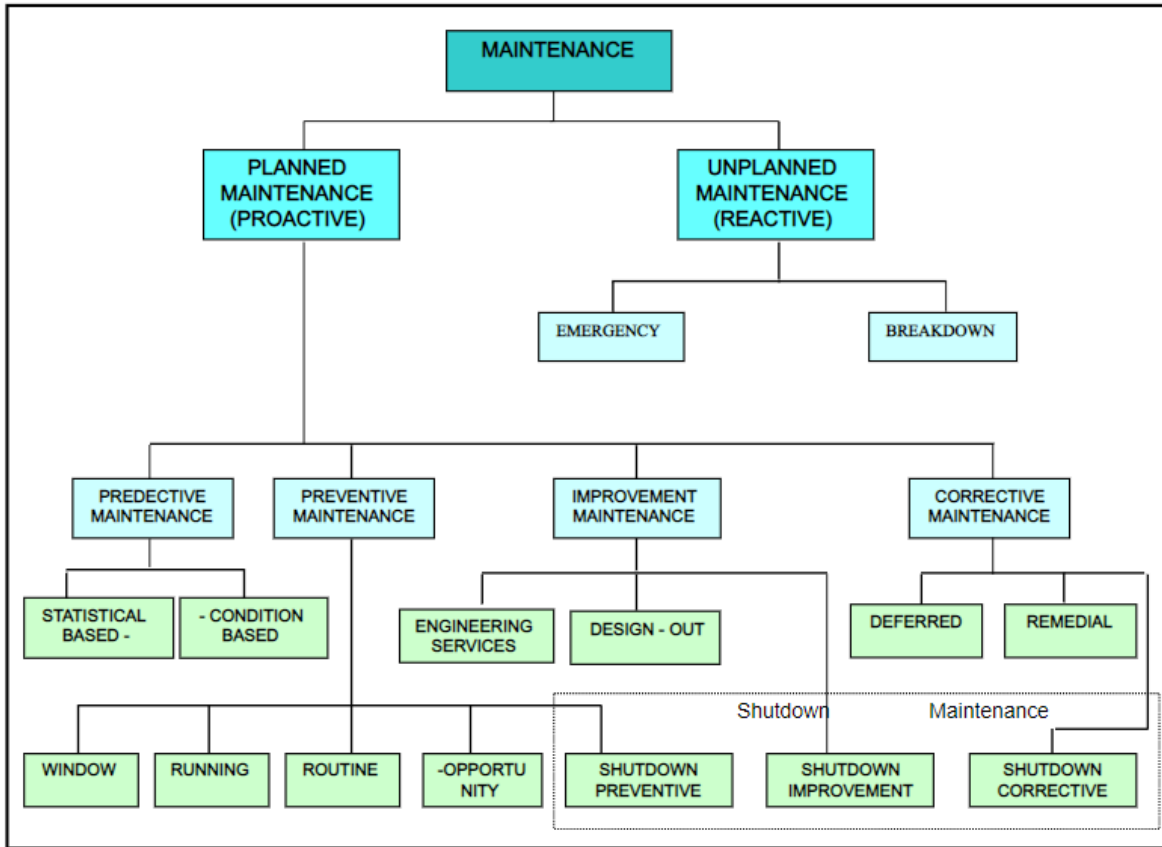


Figure 1. Types of machinery maintenance. (Project Services Co. - Qatar 2017)

As mentioned before, in our previous research we were trying to find a correlation between the industrial revolutions and machinery maintenance.

An English economic historian Arnold Toynbee firstly used the term Industrial Revolution to describe Britain’s economic growth from 1760 to 1840. It is defined as “the comparatively sudden and violent change which launches the industrialized society into being, transforming that society in a way which none of the earlier so-called industrial revolutions ever did” (Coleman 1956)

The first industrial revolution started in England. One of the main changes was in use of energy sources, forms of transport, information transfer and industrialization of production. There has been a massive increase in labor productivity, which resulted in transformation from the agrarian country into an industrial one. The symbol of the first industrial revolution was a steam engine invented by James Watt in 1765 (Spear 2008). As previously said, we are dealing with machinery maintenance since 1950s. But there were some hints of using “maintenance”, in basic forms of breakdown maintenance, when repairs were done only after complete machine breakdown. This strategy of "letting the device work until it goes wrong" was the first that people naturally applied.

The Second Industrial Revolution began about 1870 and was connected to mass production mostly. Assembly lines (Henry Ford for his Model T automobiles factories) and other technological innovations needed new approach to maintenance. Science was suddenly connected to the technology, research results from natural sciences were being applied in industry. Also, from the point of view of machinery, machines became more complex and production grew rapidly. Breakdowns caused higher and higher expenses and therefore first attempts of preventive maintenance (also known as planned maintenance) appeared. Preventive maintenance can be characterized as: “Action based on a specific timetable that identifies, avoids or mitigates the decay of component or framework state so in order to maintain or expand its life by means of controlled corruption to an adequate level” (Butler 1996). Using this kind of maintenance has several advantages over purely reactive maintenance (higher device efficiency, which will be reflected in savings).

With the Third Industrial Revolution first programmable logic controller, e.g. PLC, was made (Jensen 1993). Also automation, electronics and expansion of information technology characterize this era. Productive Maintenance is the most prevalent type of machinery maintenance here, which combines Corrective and Preventive Maintenance with a data-driven, analytical approach, and is performed to increase the broadly economic efficiency of production (Aziz et al. 2012). Maintenance is integrated into the company strategy (TPM), screens the activity of every component and characterizes the outcomes of its failures (RCM), or deals with the assessment of possible causes of device failures. Total productive maintenance and its motto "Protect your machine and take care of it with your own hands." (Legat 2013) relies on machine operators understand them and take care as their "very own".

With the Fourth industrial revolution (which is still happening) predictive maintenance (nowadays also called PdM 4.0) is the highest form of maintenance. By combination of big data analytics and artificial intelligence we try to prevent asset failure by analyzing production data to identify patterns and predict issues before they happen.

To sum up this part of the article, there really is a correlation between the industrial revolutions and machinery maintenance. Table 1 also presents characteristics of four industrial revolutions (from the point of technologies and principles of taking care of industrial equipment), what is described above. We choose only four "main" types of maintenance. Also, the "inspection" row is interesting here, you can see the development from only visual inspection at the beginning, through instrumental inspection to more sophisticated use of technologies, like sensors and predictions nowadays. There is also an inverse correlation between the level of Maintenance and its "main important factor" - Overall Effectivity of Equipment. The more developed maintenance, the higher OEE is. (Poór et al. 2019)

**Table 1.** Correlation between the level of Maintenance and Industrial Revolutions.

<b>Industry revolution</b>	<b>Industry 1.0</b>	<b>Industry 2.0</b>	<b>Industry 3.0</b>	<b>Industry 4.0</b>
Characteristics of the industrial revolution	Mechanization, steam power, weaving loom	Mass production, assembly lines, electrical energy	Automation, computers, electronics	Cyber Physical Systems, IoT, networks, cloud, BDA
<b>Type of maintenance</b>	<b>Reactive maintenance</b>	<b>Planned maintenance</b>	<b>Productive maintenance</b>	<b>Predictive maintenance</b>
Inspection	Visual inspection	Instrumental inspection	Sensor monitoring	Predictive analysis
OEE	<50%	50-75%	75*90%	>90%
Maintenance teams reinforcement	Trained craftsmen	Inspectors	Reliability engineers	Data scientists

### 3. Results

Based on the previous results, we try to propose an ideal model of maintenance in Industry 4.0. Since digitalization and acceptance of Industry 4.0 concept requires more or less radical changes within the working environment, the adequate strategy has to be formed in order to create final result that will gain profit in the future. Certain parts of the digital concept have already been achieved within the company, since the market has already started to change and the working environment requires the use of Internet, but not in every company the use of digital methods is yet on the same level. Therefore, some require more and some less changes which require certain level of financial investment. General and complete transformation usually is financially very demanding, that is why the readiness factor of the company has to be calculated accurately before the digital transformation process begins. Not every company nor department requires same level of change, but each has to be compared to the ideal model.

Based on previous research results the focus is set on the maintenance for which the ideal model of Industry 4.0 concept is shown on Figure 2.

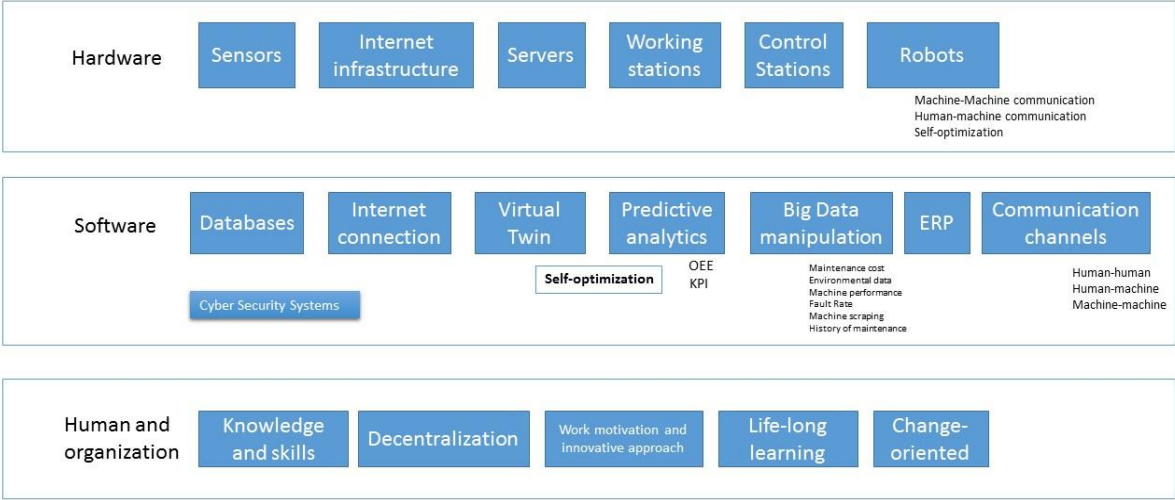


Figure 2. Maintenance ideal model in Industry 4.0.

The ideal model describes the segments in three major groups - Hardware, Software and Human and Organization. Those are the three major segments of every company and describe the working environment in full. Each segment of the ideal model has to be compared with the current state and use of it in the company, what in the end gives a clear overview where the changes are mostly required. Also, in the future use of the advanced decision support methods, the importance of each segment for the unique case studies can be measured so that the strategic plan can be created in the end.

On the hardware level, there are six segments of the Maintenance 4.0 included. Sensors are the main hardware that enable the collection of the real-time data from the machines (Gregor et al. 2015) Internet infrastructure enables the distribution of the data collected within the system. State-of-art Internet infrastructure enables fast and accurate data distribution within the company and other parts of the supply chain, if needed. Servers are closely connected to Internet infrastructure, but yet they enable the independence and flexibility of the single company. Working Stations is the hardware present at the manufacturing hall, machines or the single working environments where the final product is physically created. Those require high level of modularity, flexibility and adaptivness for the data collection via sensors (Mihalov et al. 2018). Control Stations are the computers that deal with data analytics and enable the performance of the advanced analytics. Robots are also one of the main segments of the Industry 4.0 (Broum and Šimon 2019) hardware, within the Maintenance 4.0 they can also have the possibility to assist in the maintenance activities, therefore they have the advanced capacities of machine-machine and machine-human communication so they could be realization of the self-optimization requirements in the real-time.

Software group is defined in 7+1 segments. Databases and its capacity are important for big data storage and its grouping (Orosz et al. 2015). Internet connection is connected to internet infrastructure which enable the proper connection, which also has to be functioning on the high level. Virtual twin enables the real-time monitoring of the all processes and development of the maintenance plans (Kliment and Trebuňa 2014)

In the case of the unplanned events, digital twin enables the easy failure detection and maintenance plan development. Predictive analytics enable the proactive maintenance and are the result of the capacity and the possibilities of the big data manipulation segment. Predictive analytics are implemented in software that can also measure OEE and various KPI that company requires, especially within the maintenance department. Virtual Twin in combination with predictive analytics enables the self-optimization of the system. (Simon and Broum 2018).

The complete software unification and the connection of the maintenance department with other departments within the company or the supply chain is enabled with complex, unique and personalized

ERP systems. Communication channels have to be highly functioning and flexible, and enable the machine-machine, human-machine and human-human communication. Each of the software segments deal with the challenges of the security issues (Balaz et al. 2018), so that special cyber security systems within the company and the maintenance department are to be developed.

The hardware and software changes aren't sufficient in order to complete digital transformation of the maintenance department in the company. The changes are to happen on the human and organizational level, which could be most challenging in the whole process (Pollák and Tkáč 2019). That is why the Human and organization group consists of five crucial segments. Change of the working environment requires new knowledge and skills of the worker, that is why they have to be ready to accept and function within new working environment. Their work motivation is also key factor and innovative approach which enables the flexibility that can lead to leading position on the market and, in the maintenance department, shorten the time-loss or the failures in general. Growth of the workers is continuous that is why the company should organize special educational system for its workers. Both workers and the organizational system has to be change-oriented, flexible and modular in order to gain sustainable digital system. Decentralization is also important factor of the Maintenance 4.0, where the decision possibilities are spread horizontally that enable the shorter reaction and action time.

#### 4. Discussion and Conclusions

There are various readiness level calculation methods already presented in the literature, but the basic framework is universal – the comparison of the current with the ideal state is needed to be concluded and the gap between current and future state is to be detected. Each previously described segments have to be evaluated by its importance by the unique user, therefore the criteria tree with its ponders could be created. Additional segments can also be added, depending of the unique demands of the certain company. Users evaluate current state of each segment, based on the certain evaluation model. The results are then being calculated with previously described maturity model and the readiness level is therefore formed. The importance of priority changes within each segment is then viewable so that the adequate strategic plan for the digital transformation to Maintenance 4.0 can be created.

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# Analysis of Factors with Impact on Earnings and their Management in Commercial Companies

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**Abstract:** This paper aims to analyse in more detail the factors affecting earnings and management of companies. The presented paper consists of four parts. The first part is focused on the explanation and theoretical aspects of earnings. In the theoretical part definitions of earnings, functions of earnings and basic division of earnings and management commercial companies are introduced. The second part of the paper deals with analysis of factors affecting earnings and management of companies. The factors are divided into two groups. The first group are factors resulting from the State's earnings and second group of factors from side of companies. The basic methods used in presented paper are descriptive method, analysis, selected mathematical-statistical methods, graphical methods, comparison, and synthesis. The third part paper deals with results of analysis of the earnings of Slovak companies based on factors defined in previous part paper. The fourth part of paper is devoted to discussions on solved and researched issues. In the fifth part, the paper deals with the conclusions on factors affecting earnings and management of companies. The result of presented paper is a comprehensive view of factors that affect earnings management of commercial companies.

**Keywords:** earnings; loss; commercial companies; earnings impact factors; economic results; earnings management

**JEL Classification:** M20; G10; G30; O10

## 1. Introduction

Earnings are in the definition of business itself. Therefore, it is very important at the beginning to define what is a business and then earnings. Business is a systematic activity carried out separately, on its behalf and under its responsibility to make earnings. During the business period, the company manages and performs various operations on the market, thus generating costs on the one hand and revenues on the other. Consequently, if revenue exceeds the cost, earnings are generated. If the revenues do not exceed the costs, the company incurs a loss. The difference between the revenues and costs of indicates the economic result, which the companies have reported for its business periods. (Dhole and Gul 2019) It follows from the foregoing that, in order to make earnings, the revenues must exceed.

There exist 4 earnings functions:

- Criterion function - deciding on economic issues of the company
- Accumulation function - creation of financial resources for business development
- Splitting function - transfer of funds to owners, investors and the State
- Incentive function - earnings here is the main motivation for business and interested workers

The primary and individual purpose of earnings is to express the economic aspect of the company explicitly. If returns, in the long run, exceed costs, it is the evidence of prosperity for the company. (Campa 2019) Also evidence about in-house processes, responsible management or properly selected goals and strategies of the company. (Chapman 2018) At the same time, earnings can be seen from the perspective of business owners and investors. The feedback for them is that their capital is appropriately used and thus assured of a positive share of the economic result. It is also possible to perceive earnings from the perspective of employees. (Groshen and Hlzer 2019) This is important for

them for two reasons. The first is because it is a reward for their work. The second reason is because it gives them the security of their work in the future. Also, too much effort by management to maximize earnings increases the risk of its future existence. However, investors expect this and it is, therefore, appropriate for companies to set goals other than earnings maximization or high market share.

Earnings are also defined as residual income, which arises as to the difference between the total incomes and expenses of companies. Therefore, we differentiate earnings on accounting and economics. Accounting earnings correspond to the difference between accounting revenues and accounting costs. Economic earnings are reduced by implicit costs. This basis offers the best assessment of the effectiveness of business activity. The source of economic earnings is the reward for taking risk because every business is associated with risk. (Salaga et al. 2015) Also, a reward for innovation and entrepreneurship, where stimulation of the latest scientific knowledge is used.

Each alternative of resource utilization achieves so-called. nominal earnings. With higher use of alternative sources arises extraordinary profit. If companies in the conditions of imperfect competition achieve long-term excessive earnings it is a monopoly earnings.

## 2. Methodology

Factors influencing earnings and its management in commercial companies have been divided into two groups within the scope of this paper. The first group of factors are that it affects earnings from side of State. The second group of factors are that it affects earnings from side companies.

### 2.1. Factors are that affect earnings from State side

Earnings are influenced by several factors that are applicable either from State side or by the companies itself. The State regulates earnings for tax purposes and determines which factors adjust earnings and thereby influence the income tax base.

Factors affecting earnings from side the State include attributable and deductible items. These items affect the basis for calculating income tax and hence earnings. These items are either expense or income. The deductible items reduce the income tax base. Attributable, items on the contrary, reduce it.

The second group of factors is the income tax rate. From the income tax base reduced for non-taxable and other items as is calculated based on the rate. This is then recorded as an expense in the accounting and deducted from the pre-tax earnings or loss. The tax rate is thus explicitly linked to earnings.

The third group of factors is the deduction of losses from previous years. This group can change the tax base and consequently the value of earnings. If a company achieves positive earnings in the current accounting period but a loss in the extraordinary period, it may be offset by deduction.

### 2.2. Factors that affect earnings by the company

Earnings can also have a large impact on the business itself. The first reason is the case, when the equation implies earnings, resp. loss. The second reason is the difference between revenue and cost. However, it is not possible to compare only costs and revenues as such. But also, as subsets that make them up. Therefore, to identify earnings it is necessary to know the variables that contribute to its changes. These are:

- production volume
- price
- costs

There are several approaches to calculate earnings. The following formula takes into account the price per unit of production, the variable, and fixed costs. If revenue exceeds the total cost, earnings were generated. However, the cost and revenue functions are not always linear. In this case, the equation has a different shape from the following case.

$$Z = V - N \tag{1}$$

$$Z = pq - a - bq \quad (2)$$

$$Z = (p - b) \times q - a \quad (3)$$

Where:  $Z$  = earnings  
 $V$  = revenues  
 $N$  = costs  
 $q$  = production volume  
 $a$  = fixed cost companies  
 $p$  = price per unit of production  
 $b$  = variable companies cost per unit of companies

There is an expression in the formula  $(p - b)$  which means a cover contribution or a contribution to the office of fixed costs and earnings. The higher the value of the contribution is, the smaller the amount of production to make earnings is needed. This procedure is typical for manufacturing companies.

#### *Production volume*

Production is the process by which all business activities involve the combination of factors where performance is ultimately generated. On one hand, the production process incurs production costs and on the other hand, the output needs to cover not only these costs but also generate earnings. In summary, the manufacturing process quantifies the break-even point, which is derived from the earnings equation. The break-even point indicates the amount of production that will cover fixed and variable costs. The lower the break-even point, the easier it is to make a earnings. The form of break-even point in production volume is expressed by:

$$q = \frac{a}{p-b} \quad (4)$$

Where:  $q$  = production volume  
 $a$  = fixed cost companies  
 $p$  = price per unit of production  
 $b$  = variable companies cost per unit of companies

#### *Unit costs*

The term costs generally refers to the purposeful consumption of the factors of production. Costs can be in the form of a reduction in assets, incurrence of liabilities or a reduction in cash. In most businesses, costs are analysed as unit costs. Generally referred to as unit cost of production. To the addition up to all costs, it ultimately affects earnings and serves calculation. For the calculation formula to be relevant, it must include all costs actually incurred. The most common error that occurs with the calculation formula is the distinction between direct and indirect costs. Direct costs have an immediate relationship to product. For example, used raw materials, base material, semi-finished products, fuels and the like are included there. Other direct costs include technological fuel, energy, depreciation of tangible fixed assets, etc. Indirect costs are not directly quantified as they are spent on the operation of the whole companies. The most common indirect costs include operating overheads, production overheads, sales overheads and are sometimes referred to as overheads.

#### *Unit price*

Price is the monetary amount for which the customer buys the product. The price must cover not only all costs but also make earnings. At the same time, it may not be higher than the price of competition in terms of trade policy. The fixing of a minimum price is not merely for setting the lower limit of the selling price in order to undertake and to make earnings. It also serves to address the question of how much the price could be reduced or increased in relation to the change in production volume so that the company could make the required earnings. The relationship for this type of calculation is expressed as follows:

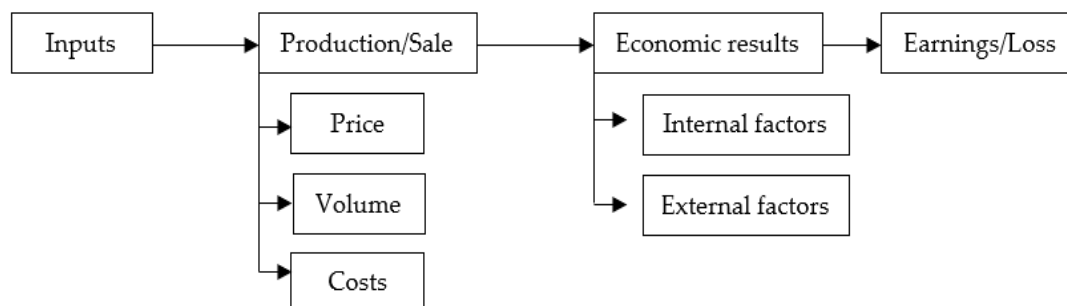
$$c_o = v_j * \frac{FN + Zp}{Qp} \quad (5)$$

Where:  $c_o$  = minimum selling price  
 $v_j$  = average variable cost  
 $FN$  = fixed cost companies  
 $Zp$  = required earnings  
 $Qp$  = expected production volume

On the basis of the above-analysed factors affecting the profit and management of trading companies, the financial results of Slovak trading companies were analysed. In the analysis of financial results, the present article dealt with the analysis of profit/loss of Slovak companies. The analysis of financial results was also carried out an analysis of Slovak trading companies that did not make any profit for the period under review. Also, on the basis of an analysis of factors affecting the profit and management of trading companies, the annual increase in personnel costs of Slovak trading companies was also found. The amount and development of income tax is also an important part of the overall economic result and analysis of financial results. Analysis of the financial results of Slovak trading companies was performed on a sample of 1,531,847 companies. Secondary data were used to analyse financial results. The results of the analysis of financial results are presented in the next chapter of this paper.

### 3. Results

Based on the factors defined above, which affect earnings and its management in commercial companies, we present summarized process in the following figure. 1.



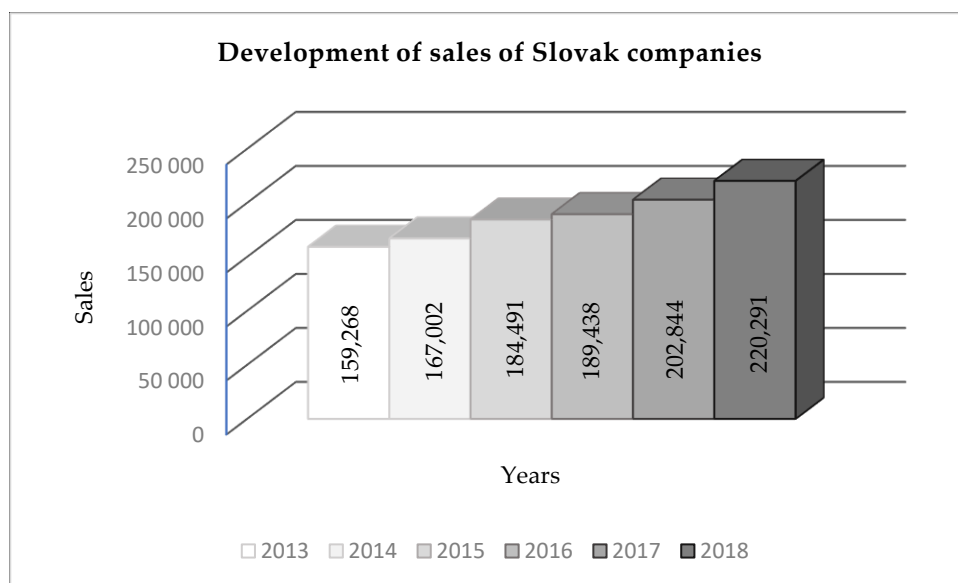
**Figure 1.** Factors affecting earnings and management commercial companies.

From Figure 1, it is clear that the initial input to the company will be converted by production or sale process to economic results. Production or sales are influenced by three factors. The first one is price, the second is cost, and the third is volume. After the sale of a product or service, an economic result arises.

It is determined by internal and external factors. After adding or subtracting the last operations, an earnings/loss arises, which the company can use in various ways. The ways of using earnings will be presented in the paper in a separate category of discussion.

#### 3.1. Results of analysis of earnings of Slovak companies

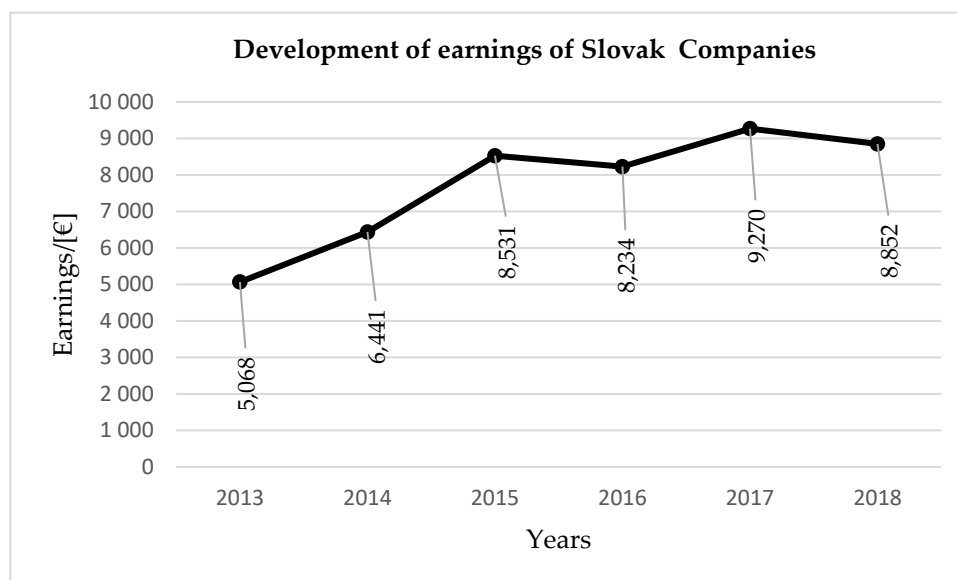
From the above results, the financial results of Slovak companies were analysed based on secondary data. A statistical overview of the development of sales, profit/loss of companies of the Slovak Republic for the last 6 years was performed. Analysis of the overview development of earnings/loss for the last 6 years was examined sample of 1,531,847 Slovak companies. In 2013 and 2014, there were 249,907 and 223,987 companies in the sample. In 2015, there were 235,981 trading companies Subsequently in 2016, there were 298,997 trading companies. The 2017 contained 255,985 trading companies and in 2018 there were 266,990 trading companies. The figure 2 shows the sales overview of Slovak commercial companies for the period 2013 - 2018.



**Figure 2.** Development of sales of Slovak companies, units in millions of €.

Figure 2 shows sales of Slovak commercial companies for the period 2013 - 2018. Revenue was divided into several subcategories. Revenues up to 100,000 € were the case for 697,356 out of the total number of companies. Revenues between 100,000 € and 500,000 of € were reached by 202,803 companies. From 500,000 € up to 2 mil. € in sales, there is naturally a reduced number of 87,786 companies. In the region of over 2 mil. € up to 10 mil. € in sales, there are 36,454 companies. The sales of over 10 mil. € were reached by 12,312 companies.

The development of earnings by Slovak commercial companies for the period 2013 - 2018 is shown in figure 3.



**Figure 3.** Development of earnings of Slovak companies, units in millions of €.

Figure 4 represents the development of earnings in trading companies. Earnings in 2018 decreased compared to 2017 by 4.51%. Sales increased by larger margin of 8.6%. Earnings in 2017 compared to 2016 increased by 13.64% in this kind of companies. The sales also increased by 7.39%. Earnings in 2016 decreased by 8.23% compared to 2015 and sales increased by 2.55%. The 2015 earnings increased by 11% compared to 2014.

Within the total amount of Slovak commercial companies, 395,139 of them were at loss. In 2013, 53,980 companies were in red numbers. In 2014, 59,920 companies were at a loss. Again in 2015, 61,574 companies did not reach profit. In 2016, 66,053 companies were at a loss. The 2017 was more negative with 75,568 companies at loss and the 2018 turned out to be the most negative one with 78,044 at loss.

The analysis of earnings/loss was also carried out on Slovak commercial companies, which achieved neither profit nor loss. They reached the so-called. zero value. The analysis results in percentages are shown in Figure 4.

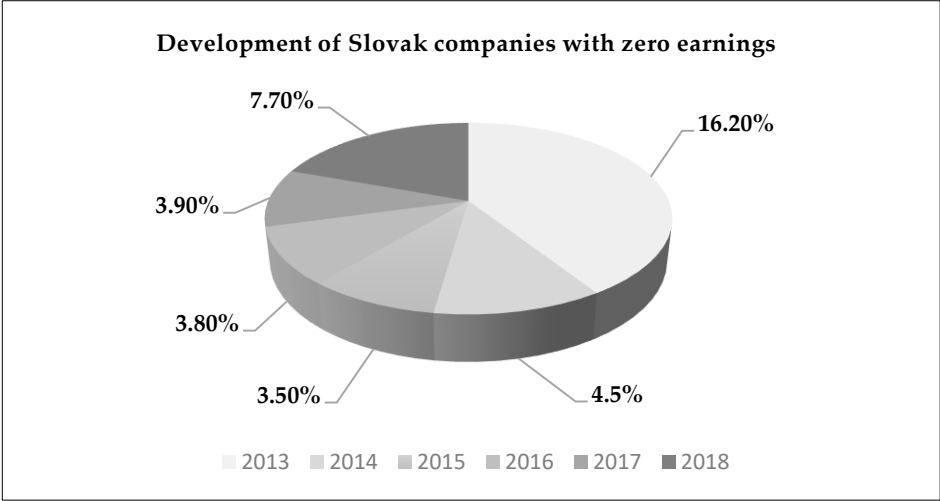


Figure 4. Development of Slovak companies with zero earnings.

Figure 4 represents Slovak commercial companies, which in the reporting period 2013 to 2018 reached the so-called. zero value. In 2013, the largest number of companies ended the year is zero. This represents an increase of 16.20% compared to previous year. In 2014, 2015, 2016 and 2017 the number of companies with zero value was around 4%. In the last analysed year, the number of commercial companies without profit nor loss, rose again up to 7.70%.

While analysing Slovak commercial companies, it was also interesting to find out the results within the personnel costs of companies. In figure 5, the results of the personal costs of companies during reference period between 2013 and 2018, are therefore presented.

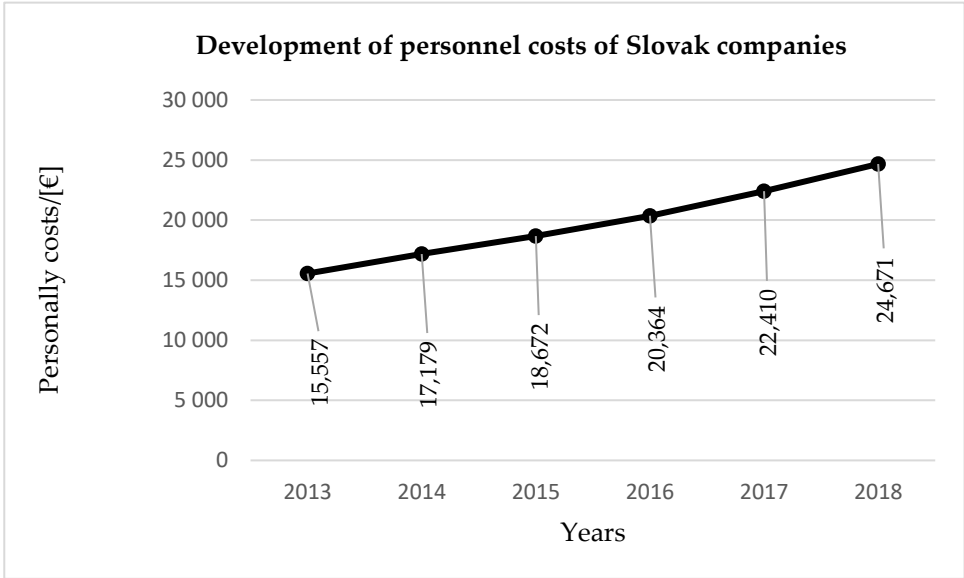


Figure 5. Development of personnel costs of Slovak companies, units in millions of €.

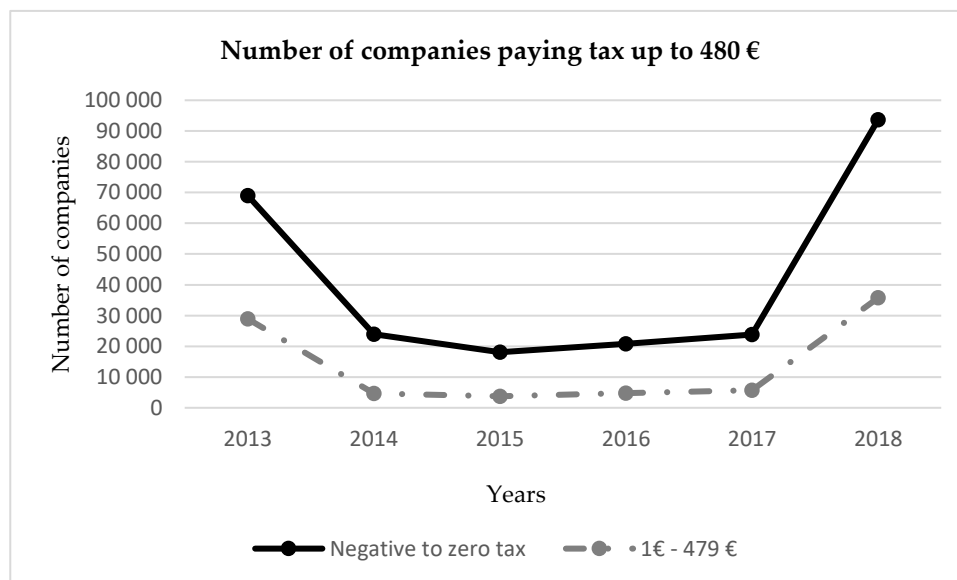
The number of personnel costs of Slovak companies, as shown in Figure 5 compared to other items in the financial statements has been growing significantly since 2013. The change in percentage of year-on-year values between individual years is shown in Table 1.

**Table 1.** The change in percentage of year-on-year values between individual years.

Years	Years over year values [%]
2014	10.42
2015	8.69
2016	9.06
2017	10.04
2017	10.09

In 2014, the volume of personal deposits increased by 10.42% compared to 2013. Subsequently, in the next two years, the number of personal deposits was around 9%. However, in 2017 and 2018 the number of personal deposits was around 10% compared to previous years.

The process of creation and the total amount of profit or loss are significantly influenced by income tax, which is part of the entity's costs. Income tax is a part of expenses and is an expense that is not recognized as an expense for achieving, securing and maintaining an income. Income tax affects the economic result after taxation, earnings/or loss, which is also intended for distribution among owners. Slovak companies paid tax licenses from 2014 to 2017. After 2018, when they were abolished, significant changes are visible. The share of companies with financial statements for the year 2018 paying negative to zero tax increases from 10.3% to 42.8%. The number of companies paying tax more than 2,880 € is about the same level as in previous years. The development of the number of Slovak companies by tax category was divided into three categories. The first category is Slovak companies that pay tax up to 480 €. The results are shown in Figure 6.

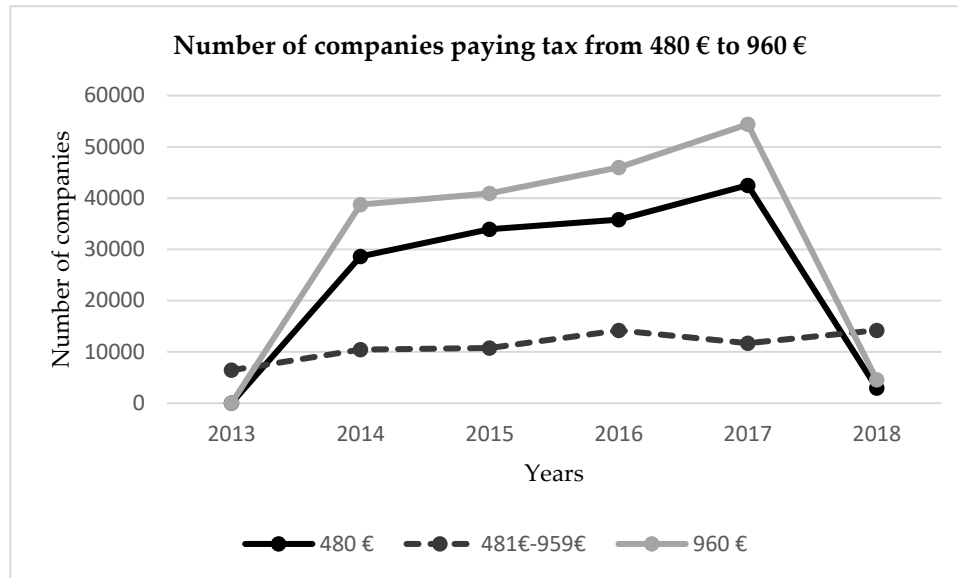


**Figure 6.** Number of Slovak companies paying tax up to 480 €, units thousands of €.

In the monitored period from the above picture no. 6 shows that the largest number of Slovak trading companies is in 2018, which reaches negative to zero tax. It represents 93,670 companies. In previous years, the number of companies that had a negative to zero tax ranged from 18,000 to 24,000. Also, in 2018 there were 35,768 companies that paid tax to 479 €. In previous years, the number of companies that paid tax of up to 480 € ranged from 3,000 to 6,000.



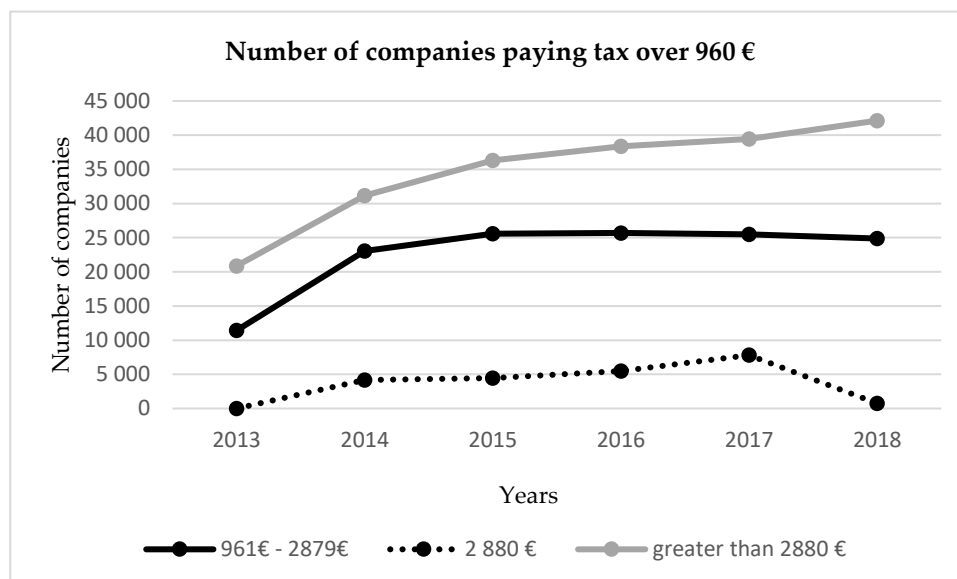
The second category is Slovak companies, which pay tax from 480 € to 960 €. The results are shown in Figure 7. In the second category, Slovak companies are divided into three subcategories. The first is the number of companies that pay 480 € tax. The second subcategory is the number of companies that pay 481 € to 959 € tax. The third subcategory is the number of companies that pay 960 € tax.



**Figure 7.** Number of Slovak companies paying tax up from 480 € to 960 €, units thousands of €.

From the above Figure 7. shows that the largest number of companies in the first subcategory is in 2017. Thus, 42,523 companies pay 480 € tax. In 2018 there were only 2,954 companies paying 480 € tax. In the second subcategory, the largest number of companies paying taxes ranging from 481 € to 959 € in 2018 is represented by 14,219 companies. In the third subcategory, the largest number of companies paid a tax of € 960 in 2017. That was 54,402 companies.

The third category is Slovak companies, which pay tax over 960 €. The results are shown in Figure 8. In the third category, Slovak companies are divided into three subcategories. The first is the number of companies that pay from 961€ to 2,879 € tax. The second subcategory is the number of companies that pay 2,880 € tax. The third under the category is the number of companies paying over 2,880 € tax.



**Figure 8.** Number of Slovak companies paying tax over 960 €, units thousands of €.

From the above Figure 8. it is clear that the largest number of companies in the first subcategory is in 2016. Thus, 25,691 companies pay taxes ranging from 961 € to 2,879 €. In recent years, the number of companies has been almost at the same level. In the second subcategory, the largest number of companies paying a tax of 2,880 € in 2016. In the third subcategory, the largest number of companies paid a tax of over 2,880 € in 2018. This represented 42,123 companies.

#### **4. Discussion**

If revenue for a given period exceeds costs and generates earnings, it is necessary to work with it and use it further. In the presented paper, factors determining the amount of earnings were characterized and categorized. It is also necessary to analyse the possibilities of its use and division.

In the case of a public companies, it is not required by law to create mandatory funds and items. Earnings, respectively. the loss is divided equally among all shareholders. Unless otherwise provided in the memorandum of association, interest on the value of the paid contribution at the agreed amount shall first be paid to the shareholders. Subsequently, the residue is divided equally.

In the case of companies with limited liability, there are several options for distributing earnings. The first option is a share in earnings. This is the portion of the earnings to which members of the Board of Directors and the Supervisory Board are entitled if approved by the General Meeting. (Balcerzak et al. 2017) The second option is a mandatory share in the statutory reserve fund. This option is created because of business risks and is used to cover possible losses. The Commercial Code does not impose an obligation to create a reserve fund for limited liability companies. The third option is to pay a share of the earnings to the silent partner if the company has made earnings. If the company did not make earnings in the previous period, the silent partnership contribution is initially a supplement to the original amount. Unless otherwise specified in the contract, the tacit partner is obliged to share in the loss incurred up to the amount of its deposit. The resulting surplus profit share is paid to the silent companion. The share in the earnings of the silent partner is contingent and determined in the silent partnership agreement. Another possibility is to increase the registered capital by earnings. This is possible if the General Meeting decides to do so and then approve. Last but not least, statutory funds are also included in the distribution of earnings. (Al-Haddad and Whittington 2019) Statutory funds include, for example, social funds or bonus funds. These are called mandatory. Voluntary funds are created based on the decision of the General Meeting and the needs of the company. The allocation to the statutory funds is determined by the company and the company also determines how and where the money will be used. (Anderson and Esenaliev 2019) Another option is to cover losses from previous years. This option can only be used if the company has posted earnings in the current period and a previous loss. Earnings is thus possible under conditions approval by the General Assembly as loss compensation. However, the loss may also be covered in another way. This can be done, for example, through a reduction in equity or a reserve or other fund. The last option includes retained earnings from previous years. It is one of the types of self-financing and serves to develop the needs of the companies. This is the so-called. retained earnings and in the future, it can be used for business development or loss settlement. (Valaskova et al. 2018) However, the distribution of earnings at the end of the match is within the competence of the shareholders. Large number of aspects have to be taken into account in its distribution. Among them, there are visions, business goals, business stability, business environment, etc. It is, therefore, necessary that earnings help to optimize business development. (Kovacova et al. 2017) At the same time, however, stability has to be maintained. Stakeholder satisfaction with usage and profit distribution will always vary. It is, therefore, necessary for companies to set an optimal balance that will meet their needs and invest in the future of the companies themselves. (Sajnog 2017)

#### **5. Conclusions**

If businesses make long-term earnings, it does not just mean that their products or services have a higher selling price than the purchase one, respectively production price. It also means that the company disposes of its assets economically, sensibly invests. It has chosen the right marketing strategy, monitors competition or its activities and constantly makes internal processes more effective.

As part of the analysis of factors affecting earnings in the management of commercial companies, Slovak companies have a fluctuating character of earnings development. However, based on this analysis, Slovak commercial companies also have positive earnings development.

The factors of limitation in the payment of earnings in Slovak commercial companies are also in Act 431/2002 Coll. on Accounting, as amended. If development costs have not been activated, or one of the components of the assets that a company may have is entirely depreciated, a trading company can distribute earnings. This is also possible when the aggregate amount of reserves and other equity is greater than the total amount of unwritten capitalized development costs. According to the Slovak Commercial Code companies with limited liability and joint-stock companies cannot even pay out earnings, if it would cause them to fail – it means to achieve negative equity or insolvency.

When distributing earnings or settling losses, commercial companies should also be careful not to threaten their bankruptcy. Thus, the ratio of equity to liabilities must be below the threshold. If a company is in bankruptcy or threatens to fail, it goes into crisis and is the subject of certain restrictions. Therefore, further research of the presented paper in the future may be a more detailed examination of these constraints and their impact on earnings and management of commercial companies.

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# Cost of Illness of Alzheimer's Disease: Case Study from Selected Region in the Czech Republic

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**Abstract:** Alzheimer's Disease (AD) is an incurable, degenerative, irreversible health condition affecting memory and thinking abilities due to neuron's reduction. These affect the ability to carry out the simplest tasks. AD is a severe health condition bringing burden not only to the patient but to health and social systems and, especially, to families who become informal and, often, the predominant caregivers. Research has shown that care for an AD patient is very costly. The cost increases with the progression of the disease throughout its more progressive phases. The aim of this research article is to calculate the costs of Alzheimer's disease using a framework based on cost-of-illness methodology. The data are based on four main pillars. The first is a caregiver's questionnaire, the second, the patients' case studies selected to represent each stage of the disease, the third is in-depth interviews with the patients and caregivers, while the fourth is data from the Institute of Health Information and Statistics of the Czech Republic (UZIS) which provides data of health care consumption. The results indicate that as the disease progresses, the overall cost of AD increases. The largest share of AD costs is indirect cost at each stage of the disease.

**Keywords:** Alzheimer's disease; cost-of-illness; case study; burden of disease

**JEL Classification:** I10; I11; I13

## 1. Introduction

Alzheimer's Disease is the most common form of dementia and affects up to 25 million people worldwide (Zgola, 2003). According to the 2009 European Collaboration of Dementia, there are around 7.3 million people living with dementia in Europe. In 2018, the Czech Republic's share of dementia patients exceeded 150,000 of which 60% are diagnosed with Alzheimer's Disease (Broulíková 2018). The beginnings of the disease are gradual, inconspicuous. Degradation may proceed smoothly or change randomly. The prognoses are purely individual. Duration of the disease can range from five to twenty years. Many factors influence progression such as combination with other diseases, lifestyle, or the patient's personality and genetics (Raboch et al. 2001). In most cases, combination with other diseases such as Parkinson's disease, vascular dementia, or neurodegenerative dementia with Lewy bodies (Borzová and Jirák 2009) are more the norm.

Clinical symptoms in AD patients vary depending on the stage of the disease in which the person is. There are various stages of Alzheimer's disease. However, the vast majority of authors classify the disease as having three main stages - mild, moderate and severe (Callone 2008; Zvěřová 2017; Huang 2012; Gauthier 2007; Pidrman 2007).

Figure 1 shows the classic progression of the disease. The graph shows the development of primary symptoms through conclusion in death. Schematically, AD is divided into three levels - mild, moderate and severe. The vertical axis describes the value of cognitive functions evaluated using the Mini Mental State Exam (MMSE) which evaluates patient concentration, attention, temporal and spatial orientation, writing, counting, and speech in practice (Molloy et al. 1991). The horizontal axis depicts the time period of disease progression. There is also an overlapping of symptoms of varying intensity and duration. The graph well demonstrates the individuality of the disease and its possible diverse course. Jirák (2008) mentions the link between quality of health care ensuring control over appropriate medication, rehabilitation exercises or preventive measures that struggle with collateral symptoms such as bedsores

and, at the same time, the interaction of social workers who care about hygiene, nutrition and hydration as effective supportive measures. A problem revealed, however, is the non-cooperation of the Czech Republic's health and social sector.

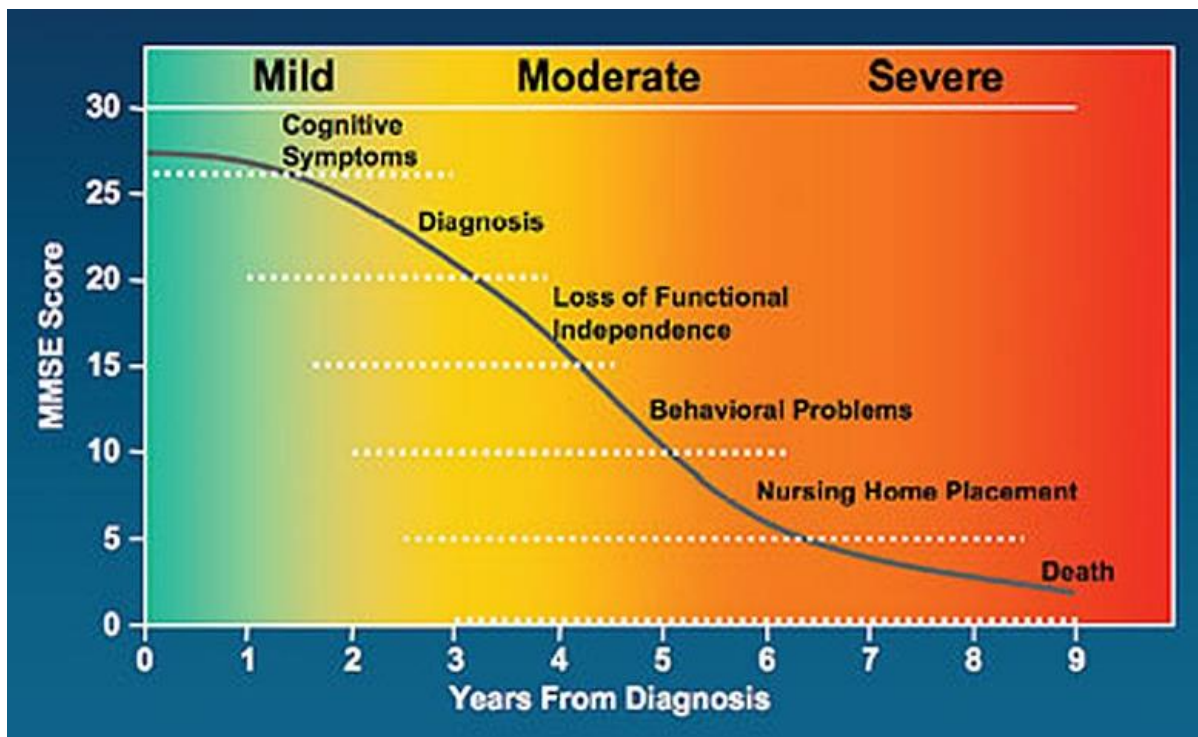


Figure 1. Alzheimer's disease progression. (Dementia and Alzheimer's 2014)

The care provided to AD patients varies in scope and type. Act No. 108/2016 Coll. defines available social services and divides them into three basic types as shown in Figure 2. The sources of funding vary by region. However, funding is on the edge between the health and social sector, and the patient/caregivers themselves.

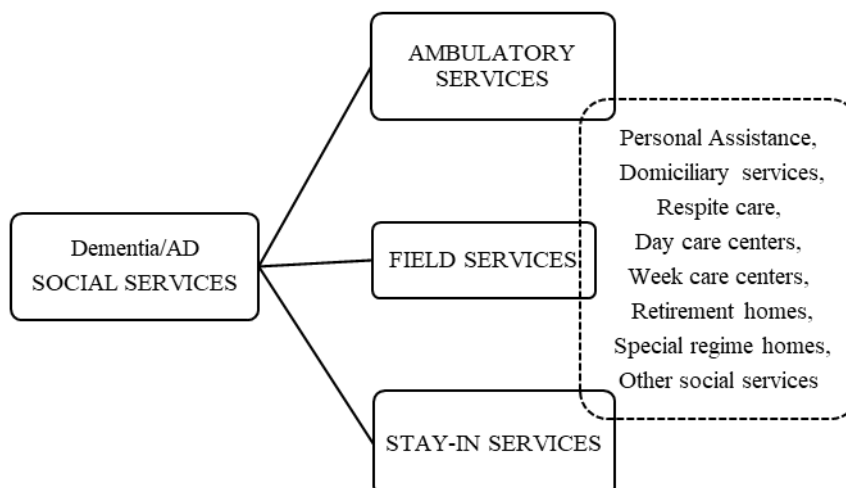


Figure 2. Own processing based on Kandilaki et al. (2019).

It should be noted that, with progression stages of AD, the overall cost of patient care increases. According to Trávníčková (2012), costs range from € 572/month for in mild stages and rises to € 942/month. In terminal stages, there are slight decreases. The most expensive phases are those in the middle with direct costs of € 303 per month and indirect costs of up to € 638. It is, therefore, clear that

indirect costs account for a major proportion of the total cost. These data were based on the 2012 Alzheimer's Disease Cost Analysis in the Czech Republic using the RUD (The Resource Utilization in Dementia) questionnaire.

## 2. Methodology and Data

The framework of this study covers many sources and methodologies. The most important component is the (1) COI methodology. In this particular case, we used the COI methodology to calculate the annual cost arising from AD for three patients. Besides the calculation itself, the main aim is to compare the share of each type of cost on overall costs. The input data are obtained through a (2) questionnaire survey of the informal caregivers represented by, primarily, family members. To get a clear idea of the different stages of the disease, (3) a case study representing each stage was conducted. In order to identify usage of social services (4), in-depth interviews were conducted. Data on the utilization of health services and their financial statements were requested from the (5) Health Information and Statistics Office (UZIS).

### 2.1. COI

COI is a descriptive analysis focusing on the calculation of economic costs of the examined disease focusing on the patient characterized by gender, age and stage. The basic approach is to include direct medical and social costs, direct non-medical costs and indirect costs (Segel 2006). The direct costs include the costs of health care (diagnostic and imaging methods, costs of medicines, rehabilitation, outpatient treatment, hospital stays, transport to a health care facility, treatment of the patient, food for the patient, etc.). Indirect costs arise from lost benefits/profits. Intangible costs are recognized as losses in terms of reduced length and quality of subsequent years of life (Larg 2011).

All costs are, as far as possible, calculated in monetary terms. Data are obtained from UZIS and from questionnaire survey of informal caregivers and in-depth interviews.

**Table 1.** Examples of Costs entering the COI. (Jo 2014)

Direct health care	Direct non-health care	Indirect costs
Home health care	Social services	Loss of productivity
Physicians	Counseling	Morbidity
Physical therapist	Data analysis	Mortality
Capital costs (incl. depreciation)	Repair of property destruction	Impairment
Construction of facilities	Legal costs	Job absenteeism
Relocation expenses	Transportation costs	Foregone leisure time
Device or equipment cost	Time (searching, traveling, waiting)	Time spent by family
Variable costs of utilities	Housekeeping	Visitors attending patient
Medications	etc.	etc.
Drug costs		
Consumable supplies, personnel time, etc.		

### 2.2. Questionnaire

One method used for data collection was a survey questionnaire. The questionnaire used was anonymous and semi-structured designed for caregivers who are, generally, a related family member. The questionnaire consisted of 24 semi-structured questions divided into four areas. The first area was focused on the characteristics of the patient-relative and family. The second, identified direct health and social costs that a relative, caregiver or family incurs in connection with AD. The third area focused on the quantification of direct non-medical expenditures, while the final was devoted to indirect expenditures. This questionnaire was developed for TAČR TL1000300 research project purposes and provided preliminary results only at this stage.

### 2.3. Case studies

Case study is a detailed examination of a given individual or group of subjects (Bredesen 2017). Patients with the similar difficulties were the target, seeking to present a new perspective on identifying the issues or, conversely, confirming issues already established. These studies sought to establish the essence of the cases and subsequently describe the links that individual cases have with one another or how they differ. The assumption was that by carefully examining the phenomenon of AD care, insight might be provided to understand other cases. (Hendl 2005)

### 2.4. In-depth interview

An in-depth interview (IDI) is one of the qualitative methods of data collection employed. Such methods seek a closer and more thorough understanding of the issues and their complexities. Interviews examined one or a small sample of respondents and proved to be an excellent tool for gaining deeper knowledge of the respondent, their feelings, and a clearer understanding of the impact on the subject in question. The results were valuable and rich in information that helped clarify the topic and related hypotheses. The essence of IDI was the use of open questions, their systematic recording and documenting by means of audio recordings supplemented by written notes to include verbal and non-verbal expressions of the respondent, his / her actual feelings, and impressions (Guion et al. 2011).

In this case, IDI were conducted through pre-arranged appointments with the caregivers at home. Steps were taken to maintain anonymity. Interviews lasted about an hour. The structure of interviews was open but guided by a pre-established AD protocol. Interviews were often very emotionally demanding for all respondents. The data provided showcased the seriousness of the issues revealed. The output was, among other things, not only informative about the total monetary costs but also about the indirect costs for which no monetary value can be ascribed.

### 2.5. UZIS

UZIS is a state statistical service under the Ministry of Health of the Czech Republic. The purpose of UZIS is to collect and process data of health care consumption. All data is used in accordance with the relevant regulations, directives and laws, and interest in personal data protection. For this work, UZIS provided data on the consumption of health care of patients diagnosed with AD for the whole Czech Republic. The data are broken down by region, by disease stage, age and gender. Upon request, UZIS provided data on the structure as defined for the year of 2017.

## 3. Results

Case studies are based on the methodological framework (Table 2) in which individual data from the sources are used in conjunction with UZIS (healthcare costs), costs of social care, family cost (ID questionnaire) and IDI (additional information and utilization of social services).

**Table 2.** Methodological framework.

		Source of data	
		Health care	Social care
		UZIS	Region
Direct health and social care	Total health care received per year expressed in monetary terms		Social care provided in the territory of the Region, which falls within the Region's social network, is subsidized by the Region
			In-depth interview
			Family costs
			Questionnaire
			Pharmacy
			Medical equipment
			Outpatient procedures paid by the patient
			Alternative medicine etc.
			Paid household services
			Professional personal assistance



	Clarification of information and usage of social care	Day Care Center Respite residential care Inpatient care Private care
Direct non-health care		Questionnaire Housing adjustment Remote care aids Financial losses (money transfer, unpaid bills...) Scams on the patient Damages and claims Transports to the doctor, day care center, inpatient care, caregiver to the patient home
Indirect costs		Questionnaire Workload reduction Missed hours at work Nursing care allowance Time spent on housework for the patient Personal care and hygiene of the patient Practical patient support Emotional support

### 3.1. Case study I

The first respondent was a daughter caring for her fifty-eight-year-old mother. The caregiver's profession was as a shop assistant in local food store where the average wage was € 880. The respondent's monthly productivity loss was about 4 hours. The patient in her care suffered from the first stage of Alzheimer's disease and still lived alone. The caregiving daughter regularly commuted and took complete care of everything. The first symptoms of the disease began to manifest two years ago in the form of a slight forgetfulness and, rarely, time and space disorientation. The ability of self-care was still possible. The patient responded promptly and could participate in meaningful conversations.

Patient 1    Gender: Female  
                  Age: 58  
                  Stage: Mild  
                  Region: Vysočina

**Table 3.** Case study I.

	Health care cost	Social care cost	Family costs
Direct health and social care	UZIS EUR 336* EUR 534 **		EUR 16/ month
Direct non-health care			EUR 140 *** + EUR 24/month

Indirect costs	Care allowance – EUR 35/ month **** Informal care - 40h/ month Informal care - 4h/ month
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\* Average for given patient characteristics for the Vysočina Region.

\*\*Average for given characteristics of patients for the whole Czech Republic.

\*\*\*Cost from the beginning of the disease.

\*\*\*\*Care allowance from the Ministry of Labor and Social Affairs, which according to the caregiver corresponds to 5 hours of care.

### 3.2. Case study II

The second respondent was a daughter caring for her mother whom she took into her home. The respondent worked in agriculture where the average wage was around € 720. The caregiver had to quit her work duties completely in order to provide needed care. The patient was eighty-eight years old and suffered from second stage Alzheimer's disease. The onset of the disease was dated as four to five years ago. Due to the combination with other diseases, the patient's condition was considered bad and was confined to bed. The manifestations of the disease gradually worsened. The ability to speak and put together meaningful sentences had deteriorated. But she could still provide answers. For most of the time, the patient was confused and disoriented by place and time. There were moments, however, when noticeable short-term improvements were evident. Occasionally, there were so-called "return in time," singing songs from childhood and recalling pictures of youth. More and more confusion became evident with loses of knowing who was near. Self-care ability was considerably impaired although the patient could drink by herself and eat with the assistance of another person. Movement in a walker was assessed as very difficult deteriorating to immobility.

Patient 2 Gender: Female  
Age: 88  
Stage: Moderate  
Region: Vysočina

**Table 4.** Case study II.

	Health care cost	Social care cost	Family costs
Direct health and social care	UZIS EUR 319*		EUR 56 / month
Direct non-health care			EUR 100*** + EUR 40/ month
Indirect costs			Care allowance + EUR 512 / month**** Informal care - 140h/ month Loss of working time - 160h/ month

\* Average for given patient characteristics for the Vysočina Region.

\*\*Average for given characteristics of patients for the whole Czech Republic.

\*\*\*Cost from the beginning of the disease.

\*\*\*\*Care allowance from the Ministry of Labor and Social Affairs, which according to the caregiver corresponds to 60 hours of care.

### 3.3. Case study III

The third respondent was a daughter-in-law who took care of her sixty-six-year-old mother-in-law. The patient was completely dependent on the help of another person. The respondent worked as a hospital orderly in a nearby hospital where the average salary was € 736. The caregiver had to resign from her job in order to provide the level of care required. The patient had almost no reaction to verbal stimuli. Response to physical stimuli, such as, taking blood samples, remained. Occasionally, the patient made meaningless noises. There were involuntary twitches and muscle spasms. The capacity to mix food, feed oneself, self-sufficiency and self-care disappeared. Supervision and care were required throughout the day.

Patient 3 Gender: Female  
Age: 66  
Stage: Severe  
Region: Vysočina

Table 5. Case study III.

	Health care cost	Social care cost	Family costs
Direct health and social care	UZIS EUR 256* EUR 395**		EUR 112/ month
Direct non-health care			EUR 272*** + EUR 32/ month
Indirect costs			Care allowance – EUR 768 /month**** Informal care- 170h/ month Loss of working time - 120h/month

\* Average for given patient characteristics for the Vysočina Region.

\*\*Average for given characteristics of patients for the whole Czech Republic.

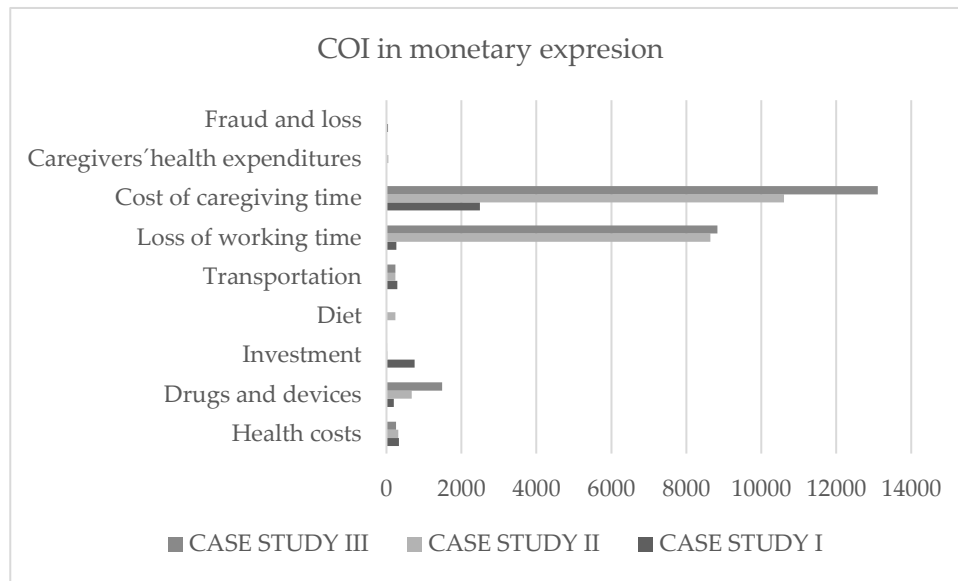
\*\*\*Cost from the beginning of the disease.

\*\*\*\*Care allowance from the Ministry of Labor and Social Affairs, which according to the caregiver corresponds to 150 hours of care.

### 3.4. Results

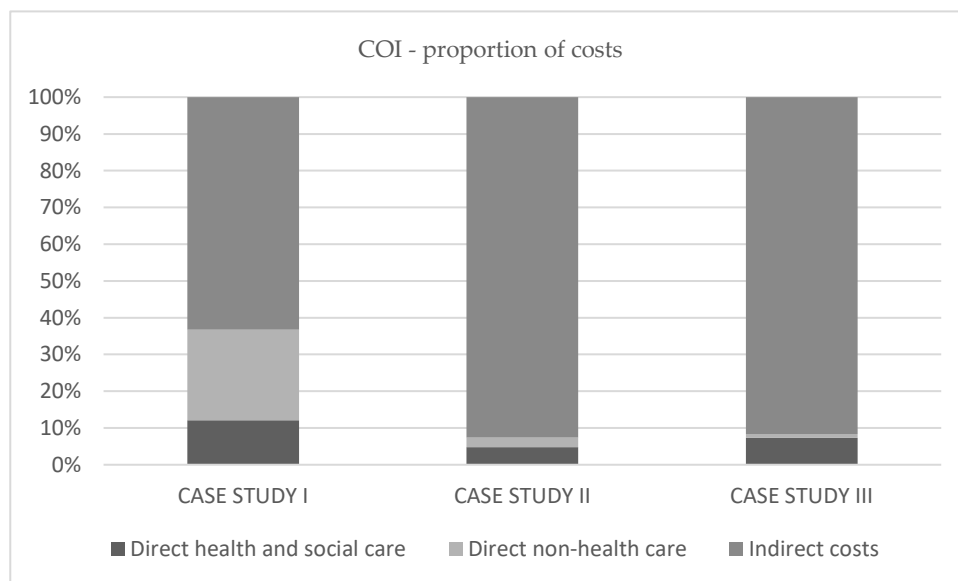
All input data were converted to yearly values. Direct non-medical costs were adjusted for depreciation and, in the case of long-term investment in the amount was reduced to one fifth. In the case of investments in the form of communication technology, the amount was cut in half. The financial expression of the loss of working time was calculated as the average wage in the industry multiplied by the percentage loss of full-time employment. The resulting calculations show that the COI for Case study I was based on EUR 3,646 per year, equivalent to EUR 304 per month. For Case study II, the annual cost was EUR 20,793, equivalent to EUR 1,733 per month. Case study III reported an annual cost of EUR 23,936, which corresponds to a monthly cost of EUR 1,995.

**Figure 3.** Comparison of COI according to the type of costs of each Case study.



The largest share of the cost of the disease was spent on cost of caregiving by the informal caregiver. The value of working time lost by the caregiver as the disease progressed was added in the case study II and III.

**Figure 4.** Comparison of COI according to the type of costs of each Case study.



#### 4. Discussion

The results of our study indicate that as the disease progresses, the overall cost of AD increases. The largest share of AD costs is indirect cost at each stage of the disease. The loss of ability to work and time spent on patient care are the two most important components. These costs arise also due to the fact that the needed care in all selected case studies is not solved with the help of social services.

Further research direction should ensure more researched data. The research should also focus on the whole Czech Republic. Our preliminary results show that the average medical costs for Case studies I and III are significantly lower than the national average. It is also necessary to extend the research area to patients who intensively use social care. An interesting point for further research is

the utilization of care allowance on purchasing social services and the financial burden of patients/caregivers.

#### 4.1. Limitations

The presented study and its conclusions cannot be generalized for the population of the Czech Republic. The small n-size is the primary concern. Additionally, the monitored patients were female from the Vysočina Region and the survey was carried out only in the Vysočina region, which is non-representative of the entire population of the Czech Republic. The results may also have been influenced by the non-random selection of patients used for the case study. This is also evident in the case of social services used, as none of the patients received social services. The final limitation of the article is the fact that data from in-depth interviews and caregiver questionnaires were collected in 2019 while data available on healthcare usage date to 2017.

The exchange rate used was set at CZK 25 for 1 EUR.

#### 4.2. Recommendations

The methodology employed for this study shows promise in an expanded inquiry. The combination of available quantitative data with hard-to-obtain qualitative data provided by interviews, has the potential to develop and increase accuracy for more insightful understanding of Alzheimer's Disease, its true impact on the population of the Czech Republic, and the possible tailoring of services in support of those affected by it.

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# Innovations Leading to Ethical Milk Production in Developed Economies

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**Abstract:** This article investigates the economic implications of ethical issues and considerations thereof with regard to dairy production. The methods combine the review of recent scholarly literature on the topic with analysis of the current media presentation of the studied ethical issues. For the latter, we have conducted a case study of Scottish dairy farming and its coverage in the British newspaper *The Guardian*. Three broad ethical problems are dealt with separately, in particular the living conditions of cattle in tie-stalls, the early separation of calves from their mothers and reduced diversity due to intensive pasture management. There is not much consensus regarding ethics even among farmers, who aim at ethical and environmental processes of production. The degree of ethical approaches is a highly subjective matter, notwithstanding the difficulty of measuring the monetary value of ethical approaches and outweighing it against cost-efficiency.

**Keywords:** biodiversity; dairy production; ethics

**JEL Classification:** K32, M14, Q13

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## 1. Introduction

This paper addresses the possibilities of innovation of milk production in developed economies. Such innovation could lead to the adoption of more ethical ways of milk production. While meat production is often viewed as unethical by some members of the general public, due to the necessity of inducing premature death on animals, the same is not true about the public apprehension of dairy products. However, it has been proven that milk production is linked to more deaths and suffering per calorie than meat production (Kolbe 2018). At the same time, animals can be killed in the process of meat production with minimal suffering, while acquiring milk from cattle has long-term effects on the well-being of animals and their offspring, such as for example mastitis on the side of cows and psychological deprivation on the side of their calves. Therefore, the decision of some consumers to substitute meat with dairy products due to ethical consideration is not rational.

The possible innovations aiming at the adoption of more ethical ways of making dairy products should thus include, apart from dairy-free milk products (such as soy milk or yogurt), the methods of delayed separation of cows and calves.

## 2. Methodology

This article combines literature review with original research based on discourse analysis. The literature review involves literature assessment of recent articles dealing with the economic and ethical factors influencing the choice of ways for dairy farming and milk production. The section on analysis assesses the public discourse on ethical dairy farming, with a particular reference to the media discourse in the United Kingdom, as a specimen of a developed economy, and on the background of the relevant EU legislation pertaining to the ethics of dairy farming.

### 3. Results

#### 3.1. Review of recent research

Recent research on the ethics of dairy farming has been concerned with several factors influencing the ethical acceptability of the methods of production. These factors are weighed out by corresponding economic challenges.

The main ethical considerations include the reduced possibility of movement of bred animals and the early separation of calves from their mothers (Kikou 2015). More generally, ethical milk production should also take biodiversity into account. Grassland management is closely connected to biodiversity (Klimek et al. 2007). Extensive breeding with the use of large grasslands supports biodiversity (Wätzold et al. 2016), while intensively managed pasture contributes to the loss of biodiversity (Plieninger et al. 2012).

Apart from the ethical issues of early separation of calves from cows, other problems include the keeping of animals in tie stalls (Algers et al. 2009). This leads into the reduced possibility of movement and further resulting health problems often leading to premature deaths (Kikou 2015). According to Markova-Nenova and Wätzold (2018), milk farming has been under pressure due to the high demands on ethical standards including animal welfare and biodiversity.

#### 3.2. Analysis - dairy farming in developed economies

Our analysis below is based on black-letter (doctrinal) analysis of current legislation and a socio-legal assessment of the working of such laws in practice, especially the effect of European legislation on domestic laws regulating the systems of milk production upon implementation.

The European Union regulates dairy farming through a dense legislative frame aiming at combining ethical considerations with cost-effectiveness and competitiveness to other world producers. The key legislative instruments pertaining to dairy farming in the EU include:

- EU regulation 1308/2013 on the common organization of the agricultural markets.
- EU implementing regulation 511/2012 on the milk and milk products sector.
- EU regulation 880/2012 on transitional cooperation and contractual negotiations of producer organizations in the milk and milk products sector.
- EU delegated regulation 2016/1612 of 8 September 2016 providing aid for milk production reduction.
- EU delegated regulation 2016/1613 of 8 September 2016 providing for exceptional adjustment aid to milk producers and farmers in other livestock sectors.

The aim of such legislative framework is to provide a feasible system of milk production, which would combine the considerations for ethics and environment with market competitiveness. This is enacted through a number of bodies which monitor the market of milk production, including the European milk market observatory and various committees, such as the Committee for the common organization of the agricultural markets (European Commission n.d.). This is further specified in Table 1 below.

Apart from the basic legislative framework, there are legislative instruments ensuring that milk is produced, distributed and consumed in a way as ethical as possible. These include measures aiming at reducing milk production and consumption and legislation regulating the distribution of aid in order to compensate for the possible loss of income due to the adoption of more ethical procedures for milk production. These are further specified in Table 2 below.

The concern for ethical considerations connected with milk production has been discussed in many developed economies recently. We have selected Scotland as an example of a developed economy, where farming plays an important role and where the trend for and interest in more ethical milk production has recently been in the front of media attention. According to the British newspaper *The Guardian*, the vegan market has significantly aided other ways of ethical milk production, because consumers got used to the idea of paying significantly more for ethically produced milk (Levitt 2019).



**Table 1.** The basic legislative framework of the European Union regarding milk production.

Area of regulation	EU legislating body	Regulation citation
Agricultural markets	European Parliament and Council	Regulation (EU) No 1308/2013 of the European Parliament and of the Council of 17 December 2013 establishing a common organization of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007
Milk sector	Commission	Commission Implementing Regulation (EU) No 511/2012 of 15 June 2012 on notifications concerning producer and interbranch organizations and contractual negotiations and relations provided for in Council Regulation (EC) No 1234/2007 in the milk and milk products sector

**Table 2.** EU legislative framework aiming at reducing unnecessary production and subsidies promoting ethical milk production.

Area of regulation	EU legislating body	Regulation citation
Aid for milk production reduction	Commission delegated regulation	Commission Delegated Regulation (EU) 2016/1612 of 8 September 2016 providing aid for milk production reduction
Exceptional adjustment aid	Commission delegated regulation	Commission Delegated Regulation (EU) 2016/1613 of 8 September 2016 providing for exceptional adjustment aid to milk producers and farmers in other livestock sectors

The alternative ways to the vegan version of milk products, include belated separation of calves from their mothers. Scottish farms on the Dumfries and Galloway coast practice a procedure where the calves are only separated from their mothers after 5 months from birth (instead of days). Until the separation a “calf at foot” system is practiced, which means that a part of the milk is collected from the cows for sale, while their offspring are still fed (*ibid.*). This helps preventing mastitis on the part of the cows and many other health issues on the part of the offspring, including increased mortality. On the other hand, according to the farmer David Finlay of Cream o’ Galloway at Rainton Farm, such procedure leads to about 500 GBP loss in revenue for each cow every year, which has logically to be partly compensated by higher prices of milk products (*ibid.*). Even non-mainstream milk production aiming at ethical correctness can lead to controversiality and the creation of other ethical problems – e.g. early impregnation of cows or later separation of calves and their mothers, which can be more distressing than separation days after birth (Kikou 2015). Later-age first calving, on the other hand, leads to technical inefficiency (Allendorf and Wettemann 2015).

Numerous studies have been conducted regarding the interconnectedness between ethics and cost effectiveness of milk production. According to Allendorf and Wettemann (2015), animal welfare leads to losses in farm efficiency. Similarly, Markova-Nenova and Wätzold (2018) have concluded that higher ethical standards might negatively influence consumer choices, based on their survey as specified in Figure 1 below:

*Please choose one of the three products below. In all eight decision situations you also have the option not to buy milk. Please be honest in your choices and always take into account your financial situation.*

	<b>Milk A</b>	<b>Milk B</b>	<b>Milk C</b>
Animal welfare/ Housing system of dairy cows	free-stall	free-stall + summer pasture	tie-stall
Biodiversity conservation	good for biodiversity conservation	no special biodiversity conservation	no special biodiversity conservation
Support for milk farms	small milk farms with below- average income	no support	no support
Origin of the milk	from your region	from your region	from Germany
Price per litre	1.32 €	0.78 €	0.60 €

I buy milk A     I buy milk B     I buy milk C     I buy no milk

**Figure 1.** Survey carried out by Markova-Nenova and Wätzold (2018), example of a choice card used in the survey.

Similar surveys have been devoted to the willingness of consumers to pay higher prices for ethically produced milk. It has mostly been concluded that while part consumers are willing to pay higher prices for ethically and environmentally friendly milk, this does not significantly contribute to the general consumer population and farmers still have to make choices between being ethical and being cost-efficient.

#### 4. Discussion

The dairy farming market has been recently challenged by a raised awareness of ethical and environmental issues on the side of the general public. This has been further reinvigorated by the milk production crisis in 2014-2016.

As for the literature review, we have gathered sources assessing the ethics of milk production from researchers dealing with the issue mostly in developed economies. The sources and their main findings are listed in Table 3 below.

The ethical problems connected to milk production can be split up into several broader categories: The problem of cows living in tie-stalls and their resulting reduced possibility of movement, the issue of early separation of calves from their mothers and their subsequent feeding with formula milk and the problem of the impact of cow breeding and pasture on biodiversity.

**Table 3.** Literature review – sources and their main findings in several countries with developed economies.

Source	Area	Main ethical issues
Markova-Nenova and Wätzold 2018	Germany	Business led by consumer choices
Algers et al. 2009	European Union	Keeping animals in tie stalls
Kikou 2015	European Union	Lack of access to pasture
Klimek et al 2015	Europe	Plant species diversity
Wätzold et al. 2016	Saxony, Germany	Intensive pasture management
Plieninger et al. 2012	European Union	Decrease in biodiversity
Allendorf and Wettemann 2015	Westphalia, Germany	Correlations of lower-age first calving with technical efficiency

The problem of reduction of movement resulting from tie-stalls is closely connected to cost-effectiveness due to the spatial demands of any alternative arrangement for animal breeding. The same economic challenge applies to the farmers' choice between extensive and intensive management of pastures and thus possible reduction of biodiversity due to cost-efficiency.

The issue of separation of calves from their mothers is immensely complex and is not unequivocal from the ethical point of view. While some farmers in Scotland practice the "calf on foot" system, where the offspring are separated from their mothers as late as 5 months after birth, some believe that this does not contribute to the wellbeing of neither the calves nor the adult cows. Further research would have to be conducted and its results would still be highly subjective if we were to find out whether such system is more sensitive than the mainstream system where the offspring are separated days after birth, before any bond is created between them and their mothers. However, this issue is even more complex as the particular models for the "calf at foot" system vary highly and there are also some alternative procedures adopted at some farms, such as the use of surrogate mothers for feeding the calves separated from their biological mothers.

## 5. Conclusions

Recent research has been devoted to the ethics of dairy production, in contrast to the already traditionally contested ethics of the production of meat. While the general public is increasingly aware of the problematic nature of producing milk, it is not so generally well-known that milk production can lead to more deaths per calorie than meat production. Consumers are generally inclined into spending more on ethically produced dairy foods, but this is still not significant in terms of compensation for the farmers who are less cost-efficient due to their adherence to more ethically

considerate processes. Further research should concern the economic side and equality of possible EU subsidies in terms of compensating farmers for their ethically aware choices.

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# Entrepreneurship in Tourism in Rural Problem Areas. Case Stage of the West Pomeranian Voivodeship

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**Abstract:** Rural areas in many countries are areas with lower levels of development and quality of life. Therefore, efforts to develop entrepreneurship and innovation in these areas are of particular importance. This applies especially to those rural areas, which for many years were areas of special problems related to political changes. The aim of the publication is to present the situation of rural problem areas in the West Pomeranian Voivodeship in Poland, as well as to present innovative examples of developing entrepreneurship in these areas and their effects. The scientific thesis of the publication is that thematic villages in the West Pomeranian region are an important element in stimulating entrepreneurship in rural problem areas. The paper presents the current economic situation of rural areas in the West Pomeranian region, factors affecting the activation of entrepreneurship. Particular attention was paid to showing examples of entrepreneurial solutions in rural areas. The article was created using compact materials, statistical data as well as netographic information. The research method used in the publication is the analysis of existing data and a telephone interview with representatives of thematic villages. Research results positively verify the thesis that thematic villages significantly contribute to stimulating entrepreneurship in rural areas

**Keywords:** development; non-governmental organizations; local community; rural tourism; thematic villages

**JEL Classification:** A10; Q10; R11

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## 1. Introduction

The development of entrepreneurship in non-urban areas is the subject of research of many scientists. The subject matter appeared in publications of such authors as e.g. W. Kamieńska (Kamieńska 2015), K. Krajewski, J. Śliwa (Krajewski and Śliwa 2004), F. Kapusta (Kapusta 2008), D. Knecht (Knecht 2009), J. Sikora (Sikora 2012).

Rural areas are often characterized by a lower level of development, innovation, and thus also quality of life. The concern for equal opportunities and the elimination of rural development disparities in comparison with cities should be an important element of economic policy. It may cause the elimination of many negative phenomena occurring in the countryside, in particular its depopulation.

The aim of the publication is to present the current situation of rural problem areas in the West Pomeranian Voivodeship in Poland, as well as to present interesting examples of developing entrepreneurship in these areas and their consequences.

The scientific thesis of the publication is that thematic villages in the West Pomeranian region are an important element in stimulating entrepreneurship in rural problem areas.

The paper presents the current economic situation of rural areas in the West Pomeranian region, factors affecting the activation of entrepreneurship. Particular attention was devoted to showing examples of entrepreneurial solutions on the example of thematic villages.

## 2. Methodology

The article was created using book materials, statistical data as well as netographic information. The research method used in the publication is the analysis of existing data and a telephone interview with representatives of thematic villages. The studies covered the period from 2013 to 2019. In defining

the nature of rural areas, the OECD definition was used. The theme village was defined as a town whose development is based on the use of a specific idea, constituting a tourist product, enabling the creation of additional income for residents. Research results positively verify the thesis that thematic villages significantly contribute to stimulating entrepreneurship in rural areas.

### 3. Specificity of Rural Areas in the West Pomeranian Region

West Pomeranian Voivodeship is located in the northwest of Poland, on the coast of the Baltic Sea. It covers an area of 22,922,48 km<sup>2</sup>. According to data from June 30, 2019, it had about 1.7 million inhabitants. The seat of the voivodship authorities is Szczecin. West Pomeranian is the westernmost voivodship in Poland (GUS 2019).

Rural areas have a strong impact on the nature of the region in question. In 2016, the share of rural areas in the West Pomeranian Voivodeship was 93.8% and was higher than the national average (93.1%). In contrast, communes below 5000 inhabitants inhabited by rural population constituted 58.3%, which was the third result in Poland, with the national average of 36.7% (GUS 2017).

According to the latest data for 2010, there were 59.6 thous. farms in the West Pomeranian Voivodeship, of which 99.24% were individual. Most often (i.e. 12%) the farm had an area of 5 to 10 ha for arable land. In the West Pomeranian Voivodeship, arable land (78.8%), grassland (20.7%) and orchards (0.5%) predominate in terms of agricultural use. In 2010, the total sown area in the voivodship covered 662.0 thous. ha, of which the most (25.2%) was sown by wheat. The harvest of cereals alone amounted to 1881.0 thous. tons, which accounted for 6.8% of cereal crops from all over Poland (GUS 2010).

The soils of the West Pomeranian Voivodship are characterized by strong typological and bonitic diversity as well as agricultural suitability. Medium quality soils (class IV a and IV b) occupy the most - over 51.2% of the area. The smallest surface is covered by very good and good soils (class I, II). This situation directly affects the profitability of farming, which can be considered average in this case (Mocek 2015).

When discussing the current specificity of rural areas, account should be taken of past events and historical background. The territories of the present West Pomeranian Voivodeship did not enter Poland until after World War II. As a result of hostilities, as well as the robbery policy followed immediately, many villages, farms or houses underwent extensive devastation and looting. The former German private farms were mostly transferred to the state and transformed into state-owned farms. Individual farming was replaced by joint work. This form of agricultural activity changed the image of the West Pomeranian village and the mentality of its inhabitants for many years. Despite the low economic efficiency, state-owned farms operated until the early 1990s. (Pilichowski and Podedworna 2011).

The process of economic changes that have taken place since the beginning of the 1990s has contributed to major changes that have affected the economy and rural communities in the West Pomeranian region. As a result of the economic transformation the unprofitable state-owned farms were gradually liquidated. The negative effects of economic transformation in these areas include the systematic increase in unemployment, the destruction of the former state economic infrastructure, social and living base as well as cultural and educational centers. For many years to come, many rural areas of the West Pomeranian Voivodeship were problem areas and even social exclusion (Jasiulewicz 2011). Many people could not find their place in the new reality, and they were not provided with sufficient support and prospects for new employment from the state.

Taking into account historical conditions, specificity, as well as the problems of rural areas of the West Pomeranian region that have arisen over the years of political changes, creating the right conditions for the development of entrepreneurship in their areas is a very important challenge. The need to counteract negative phenomena occurring in the countryside, such as:

- rural depopulation processes and the escape of young people into cities,
- increase in the level of unemployment, including particularly persistent one,
- progressive degradation and pauperization,
- disappearance of cultural traditions and social ties (Smętkowski et al. 2008).

A serious threat to the rural areas of the West Pomeranian Voivodship are also the prospects of Poles moving and settling in neighboring Germany. Due to the escape of many young people to the western parts of the country, the German self-government authorities have a policy of encouraging Polish citizens to settle in the border towns of their country. Settlers are attracted by competitive property prices or strong support in entrepreneurship creation. The problem particularly concerns young people who are particularly valuable for the development of the Polish countryside (Rudewicz 2017).

#### 4. Development of Entrepreneurship in Rural Areas of the West Pomeranian Voivodship

Among the possible tools to stimulate entrepreneurial activity in rural areas include:

- supporting various forms of economic activity, especially in areas with high unemployment,
- enabling the use of EU aid funds, including from Rural Development programs,
- creating conditions for the full use of existing local potential,
- providing support in innovative activities,
- support for local self-government bodies of various forms of professional activity (Czapiewska 2011).

When considering rural enterprise development programs, local conditions should be taken into account. It becomes necessary to analyze the situation on the local labor market, the level of infrastructure development and natural resources. In addition, efforts should be made to change human mentality through education and training programs (Bański 2017).

Development prospects for rural areas of the West Pomeranian Voivodship are not even. In a privileged position are those villages that are located near large urban centers, as well as those located in the Baltic Sea coastal strip, showing great interest on the part of tourists or those that have extremely favorable conditions for the development of agriculture (e.g. the Pyrzyce region) (Rumiński 2002).

In recent years, many West Pomeranian villages have shown great dynamics of change, and their inhabitants have entrepreneurial abilities. Rural areas and municipalities located on the Baltic Sea coast belt coped efficiently with investments by investing in infrastructure and tourism development (e.g. Mielno, Dziwnów). Some of them became one of the richest communes in Poland (Rewal). Favorable changes in this area are illustrated by the development of local agritourism and rural guest rooms (Table 1).

**Table 1.** The number and number of beds in agritourism farms and guest rooms by regions in Poland in selected years.

<b>Voivodship</b>	<b>2013</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
Lower Silesia	209/4366	194/4097	213/4681	212/4737	272/5733
Kuyavian-Pomeranian	33/632	47/873	54/1027	61/1287	65/1263
Lublin	57/929	71/1280	88/1610	91/1670	116/2209
Lubuskie	38/663	33 / 542	37/638	40/719	45/867
Lodz	44/715	52 / 898	61/1163	51/1079	54/1131
Lesser Poland	540/12819	545/ 13334	545/13658	554/14485	531/14241
Masovian	72/1274	69/1332	75/1547	78/1704	106/2474
Opole	23/364	29/418	29/440	25/426	34/722
Podkarpackie	120/2058	114/1990	124/2321	122/2379	153/3073
Podlasie	81/1197	87/1437	78/1309	79/1377	82/1555
Pomeranian	608/12500	634/13669	671/14503	669/14943	678/15692
Silesian	124/2706	123/2684	126/2814	120/2679	128/2781

Holy Cross	42/616	52/849	49/804	47/830	47/877
Warmia - Masurian	111/1836	129/2060	126/2032	116/1930	117/1986
Greater Poland	101/1632	94/1644	90/1627	88/1585	87/1555
West Pomeranian	420/8943	414/9585	432/10216	476/11409	535/12849
Poland	2623/53230	2687/66068	2679/57594	2829/ 63239	3050/69008

The data contained in Table 1 clearly show that the West Pomeranian Voivodeship is at the forefront of the country in terms of the level of development of the rural accommodation base. In addition, this database has been constantly developing in recent years. It is also worth analyzing the state of use of the rural accommodation base, which is presented in Table 2.

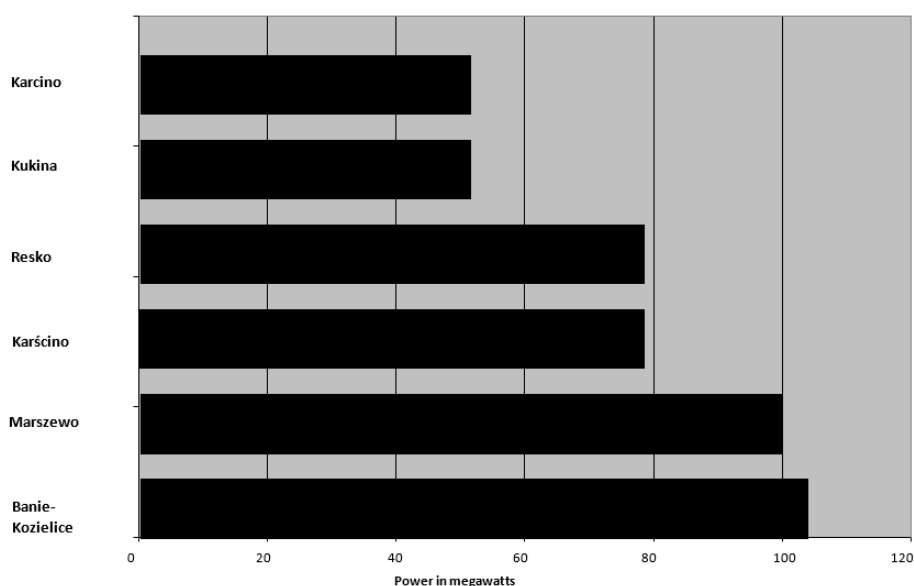
**Table 2.** Number of people using lodging at agritourism farms and foreign guests in selected years.

Voivodeship	2013	2015	2016	2017	2018
Lower Silesia	66329/8560	78 824/2590	86738/4946	101473/6272	117062/3916
Kuyavian-Pomeranian	9001/79	13538/276	15487/215	17581/329	25742/913
Lublin	16152/2051	27370/1789	31984/2520	31339/1551	4085/1870
Lubuskie	9684/1728	9939/653	10585/716	13259/1120	16256/1559
Lodz	19190/3572	18574/2142	18842/1594	14339/562	15193/654
Lesser Poland	144078/43570	164811/17126	210501/26880	245981/35190	263675/43249
Masovian	21614/4380	23395/3091	33155/4172	43695/5439	53490/5321
Opole	3032/1232	4624/474	4343/636	4231/687	3607/423
Podkarpackie	23129/1744	25127/1231	31696/1523	37167/2022	47890/3279
Podlasie	12506/2199	16928/654	17537/860	19591/1138	18801/1185
Pomeranian	106820/12955	125376/3668	141545/4717	160037/8440	182577/9126
Silesian	57029/3590	58387/1463	53933/2062	53016/2537	67985/3256
Holy Cross	4747/-	7786/33	8838/41	10524/525	16454/737
Warmia - Masurian	15296/4747	19385/1701	23754/2447	20851/1840	22384/1273
Greater Poland	16343/1133	19845/669	19745/1009	22135/1856	29354/1521
West Pomeranian	57700/18068	82190/8975	101102/10409	108295/12044	145796/16199
Poland	582350/109590	685139/46535	769793/61248	903514/81552	1067121/94481

The data contained in Table 2 indicate that the rural accommodation base of the West Pomeranian Voivodeship is characterized by high and, moreover, growing interest from tourists and foreign guests.

Some rural communes in the West Pomeranian Region have decided to invest and thus benefit from renewable energy (e.g. Zagórze, Tymień, Jagnitkowo, Karścino). The voivodship in question ranks first in terms of installed capacity of wind farms in Poland, which brings economic benefits (Figure 1).





**Figure 1.** The largest wind farms in the West Pomeranian Voivodeship in 2019.

To complement the picture of the development of rural communes in the West Pomeranian Voivodeship, it should be added that some of them did not cope with economic problems and were liquidated over time (e.g. the Ostrowice commune).

### 5. Ways to Activate Entrepreneurial Activities in Rural Areas of the West Pomeranian Voivodeship

Of the many initiatives to develop entrepreneurship in the rural areas of the region, special attention deserves those little-known and characterized by a high level of innovation. Such ideas should certainly include the creation and operation of thematic villages (Biziuk 2009).

Theme villages are villages with a leitmotif. They focus on one idea and theme. They are an innovative way to revive the rural economy and provide alternative and often significant income to rural residents. Establishing them does not involve high costs, and joint work involves entire rural families (Sala 2016). Thematic villages are places that in the new formula try to adapt to the modern world and at the same time invent a new way of living and earning (Idziak 2008). It is no longer drawing income from typical farming or farming. Thematic villages earn on selling services, symbolic values, emotions, creativity and knowledge (Gangewere 1999).

The West Pomeranian Region was a pioneer in the implementation of this type of projects on a larger scale in Poland (Idziak 2004). Among the first thematic villages in the region we can include:

- Dąbrowa - a village of healthy living,
- Iwięcino - village of the end of the world,
- Paproty - a village of labyrinths and sources,
- Podgórkki - a village of fairy tales and fun,
- Sierakowo Sławieńskie - the village of Hobbits.

All of the above towns are centers which as a result of political changes have been problem areas for many years. They are located near Koszalin, but they do not lie on the Baltic coast and therefore cannot count on income from inbound holiday tourism. Dąbrowa, Iwięcino and Sierakowo Sławieńskie are sołectkie villages in the commune of Sianów. Paproty and Podgórkki are the villages of the Malechowo commune. The number of localities does not exceed 400 inhabitants (GUS 2019).

The mentioned thematic villages were founded in 2000 on the initiative of a sociologist and specialist in the field of rural development, Dr Waclaw Idziak from the Koszalin University of Technology, as a result of the "Thematic villages" project implemented by the "Together" Partnership and co-financed from European Funds (Zielazna 2016).

The offer provided by all thematic villages includes such elements as:

- educational paths,
- field games,
- workshop classes,
- farm visits, including educational holdings.

Evidence of interest in the offer of the discussed villages is the fact that only from May to December 2008, the services of all five thematic villages were used by a total of approximately 16,000 people (Idziak 2009).

In addition to some common elements, each of the thematic villages has a unique tourist offer to offer. The village of Dąbrowa promotes fashion for a healthy culinary offer based on its own traditional food products. It offers its guests honey, syrups, meats and herbs. Iwięcino offers its tourists a unique opportunity to reflect on final matters. The village's theme was taken from the painting of the Last Judgment in the local medieval church. The Paproty village, in turn, focused on organized games based on following or building your own mazes. In contrast, Podgórkki, as part of its theme, invites you to theater, juggling and cycling events.

Sierakowo Sławieńskie deserves special attention among these thematic villages. Sierakowo Sławieńskie, like many other villages in the West Pomeranian Voivodship, particularly suffered the process of political changes in the early 1990s. The liquidation of state-owned farms and other jobs has contributed to the increase in unemployment and long-term economic stagnation. Unfavorable economic situation also negatively affected the level of aesthetics and infrastructure of the village in question.

The situation began to change at the beginning of the 21st century. In 2000, as part of the Sianów Commune Development Strategy, the idea of founding a theme village was born. The village modeled on the previously tested solutions used, among others in Austria, and its key asset was to be a picturesque location close to wooded areas. In addition to residents, in the creation of the village they helped, among others Tolkien prose lovers, students, scouts, artists (Idziak 2009).

The main reason for the investment was to make the local tourist offer more attractive and stimulate the activity of the unemployed. The theme and inspiration that made the village come into being are J.R.R. novels Tolkien - The Lord of the Rings trilogy and The Hobbit. In 2003, the Hobbiton Association was established, which currently has about 40 people. Mieczysław Juszcyk is the president of the association. Its members are mainly residents of the village of Sierakowo Sławieńskie, who are directly or indirectly involved in its service. They constitute a significant percentage of all inhabitants of the village, which numbers about 200 people. Tourists' interest in the village dates back to 2003.

Thanks to the activities of the Hobbiton Association, they built facilities within the village itself (including Bilbo Baggins' House, Elf Tower, Dragon's Chamber, Tavern under a frisky pony or Palantir) as well as facilities outside the village for outdoor games (Dead Swamps, Dwarf Forge, Elf Forest).

About 20 residents of Sieraków Sławieński are directly involved in the functioning of the theme village. They treat their occupation as additional or seasonal work. Another 20 people support the village in various ways (marketing, promotion, running the village website). The theme village and its staff earn a living by organizing field games and workshops for participating in which small fees are charged (Table 3). Employees are also involved in guiding guests, selling souvenirs, preparing meals and playing fairy-tale characters.

**Table 3.** Tourist offer of the Hobbit Village.

Name	Description	Number of participants and duration	Payment with meals in polish zlotys
Dragon Egg Team	Field role-playing game	Above 15 people , 3 h	20 zł
The Hobbit, which is back and forth	Independent field game	Above 20 people , 3,5 h	25 zł

Expedition through the Dark Forest	Bicycle field game	Above 20 people, 4 h	25 zł
Workshops	Manual classes	Above 15 people, 3 h	13 zł

The tourist offer is adapted to various age groups, physical abilities of participants and their interests. According to Grażyna Pelech, a co-founder and employee of the discussed village, their implementation involves 2 to 10 people, with the Hobbit, i.e. back and forth, enjoying the greatest interest. Guests also decide whether or not to use the local gastronomic offer.

However, in order to attract tourists and visitors, the Hobbit Village organizes cyclical events:

- Hobbit run,
- Hobbit fair,
- Sunday picnic.

Since then, "Hobbiton" is an attraction that is visited by thousands of tourists from all over Poland and abroad every year, as shown in Table 4.

**Table 4.** Estimated number of people visiting the Hobbit village in selected years in thousands.

Year	Number of tourists
2003	15 000
2006	10 000
2008	10 000
2010	15 000
2013	10 000
2015	8 000
2019	6 000

Source: Hobbiton Association data.

The data contained in Table 4 indicate the variability in the number of visitors to the theme village. According to the president of the Hobbiton Association Mieczysław Juszczak, the variable number of people visiting the village of Hobbits results from the fact that new thematic villages appear in the area, which of course is somewhat competitive. In addition, the village of Hobbits, which has been operating for almost 20 years, has become a well-known attraction in the area. Mieczysław Juszczak points out that, like every tourist attraction, the Hobbit village also requires revitalization and conservation work. It is also necessary to expand the existing tourist offer in the face of growing competition.

Further plans are proof of the continuous development of this village. Currently, the village is preparing for the implementation of another project called "Sensory Garden". As part of the aforementioned undertaking, another interesting tourist attraction will be created, aimed at making the stay more attractive by providing participants with acoustic and tactile sensations. The new offer means new jobs and sources of earnings.

According to tourists, the biggest advantage of the Hobbit Village is to create fun for both adults and children. In addition, visitors pointed out the possibility of combining both sightseeing and participation in workshops, many of which were completely new to them (the art of decupage, making decorations by the method of quilling). For some visitors, the greatest attraction were educational values, manual classes and agility games.

## 6. Discussion

The functioning of thematic villages in the West Pomeranian Voivodeship, just like in other regions in Poland, is a unique opportunity to stimulate the development of entrepreneurship and activation of local communities without harming the natural environment. The main benefit for the

villagers is the possibility of obtaining income on the spot, using the existing potential and assets. Joint work also contributes to maintaining mutual neighbors and creating new ideas. To this should be added the income increase of entities constituting the immediate environment (transport companies, grocery stores, service outlets). It is also worth mentioning the positive impact on the level of aestheticization of the village, infrastructure and presence in the media and public awareness.

The idea of thematic villages found fertile ground and many other villages follow the example of pioneers. Their further effective development depends on effective management as well as on further extending and making the functioning offer more attractive. Such activities will have a positive impact on the competitiveness of thematic villages and the cyclical nature of visiting them.

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# Evaluation of Climate Change Adaptation in the Energy Sector in China via a Composite Index

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**Abstract:** Climate change will affect the energy sector and the energy sector must take measures to adapt to future climate conditions. Before taking measures, it is necessary to understand the current adaptation of energy sector to climate change. Therefore, this paper is to assess the adaptation of energy sector in China to climate change in 2000-2017 through a comprehensive index. In order to establish a comprehensive index, three sub-indexes are determined first, and the climate change adaptation index (CCAI) is finally obtained through standardization treatment, weight determination and index summary. The results of CCAI show the energy sector in China put forward a reactive adaptation scheme in 2000-2010, which has a high system vulnerability. After 2010, there was an anticipatory adaptation scenario in which vulnerability was average. Although a short leap of planned adaptation was achieved in 2011 and 2013, which greatly reduced the vulnerability of the system, the state is not stable. As a whole, the energy sector in China has made some progress from the reactive adaptation scenario wherein the vulnerability was high to an anticipatory adaptation scenario wherein the vulnerability was average, indicating that the foundations for this sector to build a planned adaptation are currently being laid.

**Keywords:** the energy sector in China; adaptation to climate change; composite index; system vulnerability; climate change adaptation index (CCAI)

**JEL Classification:** Q49; Q54

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## 1. Introduction

Climate change is a major global problem that the international community is generally concerned about. Human beings are experiencing global warming, frequent extreme climate events, increasing disaster intensity and other climate change issues. Climate change is becoming a slow-onset disaster, which has a serious impact on human society, and its potential loss puts forward the requirements of adaptation to climate change to all countries in the world. The issue of global climate change is not only an environmental issue, but also an energy issue. Optimizing energy structure, improving energy efficiency, developing and applying low-carbon technology, changing ideas and enhancing awareness of low-carbon consumption are considered to be important ways to deal with climate change globally. The World Energy Council reports that sea-level rise, extreme weather, drought and flood caused by climate change can wreak havoc on the global energy system. At the same time, energy facilities such as power plants and distribution networks are likely to be affected by accelerated global warming. Christoph Frei, the secretary-general of the World Energy Council, added: "climate change is bound to affect the energy sector. We need a strong and transparent policy framework to unlock the long-term investments we desperately need for the future."

So there is no doubt that the energy sector should take adaptive measures to deal with climate change and avoid serious problems, such as protecting power plants from the threat of water shortages and building power grid restoration systems. The energy sector is a key factor in climate change, as it not only generates GHG, but is also affected by climate change and has to adapt to future climate conditions.

However, according to the current research on the energy sector in China in the context of climate change, it is generally divided into two categories. One is the study of energy law under

climate change. For example, in 2011, Chen Jue focused on the relationship between energy development and climate change, and discussed the necessity and significance of providing legal protection for China to deal with climate change in energy legislation. Focusing on the Renewable Energy Law, Ke Jian (2015) analyzed and reviewed China's renewable energy legislation, and put forward many concrete policies and suggestions. In 2016, Wang Juan studied the development and law of renewable energy in the context of climate change. In the course of exploring the relevant systems of China's energy law, Liu Congcong (2017) found that optimizing the energy law system from the aspects of energy legal system, energy planning system and ecological compensation system can enable China to obtain certain advantages in the field of international climate negotiations. In 2018, Zhai Ruiyan expounded the legal countermeasures or suggestions to deal with climate change from the point of view of energy law. The second is to assess the climate risks of energy in China. For example, Ding Ding (et al. 2015) preliminarily analyzed the climate risk and its characteristics of the energy sector, tried to put forward the framework of climate risk assessment and management system of energy sector, and put forward corresponding suggestions on how to assess and manage the climate risk of energy sector and industry. Based on the influence factors of renewable energy development, Wang Bing (2016) discussed the vulnerability of climate change, quota system and social cognitive risk in its natural risk, and put forward relevant policy suggestions for climate risk aversion of renewable energy in China in the future. Yang Lizhi (et al. 2016) studied the marine environment response in the context of climate change and its possible impact and potential risks on the safety of offshore energy channels to provide decision-making reference for addressing climate change and ensuring the safety of energy channels in China.

At present, China has become the largest energy producer and consumer in the world. All aspects of energy production and utilization are potentially affected by climate change, and even face severe climate challenges. Therefore, while carrying out climate risk assessment and formulating corresponding risk management strategies in the energy sector, China should also understand the current climate change adaptation of the energy sector in China. As far as the existing studies are concerned, there is almost no study on climate change adaptation in the energy sector. The energy sector is one of the sectors most vulnerable to climate change, and its role is far-reaching, which means that the energy sector must take measures to adapt to future climate conditions. Therefore, this paper uses a comprehensive index to evaluate the current adaptation of China's energy sector to climate change, which is not only the first time to directly reflect the adaptability of China's energy sector to climate change through quantitative comprehensive indicators, but also helps decision makers to look at the reality of the energy sector in a more comprehensive perspective, which is conducive to the decision-making in the future. This paper can initially meet the demand for tools, which provide more certainty for assessing the progress of the energy sector in adapting to climate change.

## **2. Methodology**

In order to be able to evaluate the progress of the energy sector in adapting to climate change based on the comprehensive index, this paper is based on the following research steps: conceptual definition, indicator selection, indicator standardization, weighting of indicators, and aggregation of indicators, and finally a comprehensive indicator.

### *2.1 Definition of the conceptual*

Adaptation is the adjustment of natural or human systems to actual or anticipated climate stimuli and their effects, thereby mitigating harm or taking advantage of beneficial opportunities (IPCC 2007). Generally speaking, adaptation can be divided into reactive adaptation and active adaptation. Reactive adaptation refers to the measures taken to deal with climate change after natural events, while the active adaptation includes expected adaptation and planned adaptation, which refers to the adaptation that occurs before the climate impact is observed and requires conscious and planned intervention to reduce its vulnerability (Beermann 2011; Busch 2011). In addition, according to IPCC (2001, 2007, 2014), vulnerability refers to the tendency of human systems to be adversely

affected. According to the IPCC, the concept of vulnerability includes sensitivity or susceptibility to damage, or lack of capacity to respond and adapt to climate impacts. Therefore, vulnerability is understood as the opposite relationship with adaptive ability, that is, the greater the adaptive ability, the smaller the vulnerability of the system.

## 2.2. Indicator selection

According to the availability and correlation of the index, this paper selects five variables (three kinds of sub-indicators) as the object of analysis. The first category is reactive adaptation index, in which thermal energy is used instead of hydraulic energy for evaluation. The second category is the anticipatory adaptation index, measured by the gap between the total power production and the total power consumption. The third category is the planned adaptation index, in which three variables should be taken into account, including climate assistance funds for the energy sector in the area of adaptation, energy law in the context of climate change, and percentage of total installed renewable energy power generation. Based on the previously referenced criteria, Table 1 lists the selected indicators. For the index of "energy law in the context of climate change", this paper combs the relevant legal documents and divides them into different levels (see Table 2). Through the above method, the related index data of five variables under different adaptation types are obtained, and the original index data are summarized in Table 3.

**Table 1.** Index selection based on adaptation type.

<b>Types of adaptation</b>	<b>Indicators selected based on the type of adaptation</b>
Reactive adaptation	X1 :Thermal Generation /Total Generation (Billions of kWh)
Anticipatory adaptation	X2 :Total power production - Total power energy consumption (Billions of kWh)
	X3 :Climate assistance funds for the energy sector in the area of adaptation/All climate assistance funds received in the adaptation area (USD thousand, constant 2016 prices)
Planned adaptation	X4 :The legal level of energy in the context of climate change
	X5 :Total installed renewable energy power generation/Total installed power generation (Ten thousand kilowatts)

**Table 2.** Hierarchical classification of indicators for "energy law in the context of climate change"

<b>Rating</b>	<b>Meaning</b>
1	There is no specialized law on renewable energy.
2	There are specialized laws on renewable energy, but there are no corresponding administrative regulations. (but corresponding government rules, local regulations, etc.)
3	There are specialized laws on renewable energy, and there are corresponding administrative regulations, etc.

**Table 3.** Raw indicator data for different types of adaptation

<b>Years</b>	<b>Planned adaptation</b>				
	<b>Reactive adaptation</b>	<b>Anticipatory adaptation</b>			
	X1	X2	X3	X4	X5
2000	0.8219	83.6	0	1	0.249
2001	0.7947	84.5	0	1	0.246
2002	0.8025	74.5	0	1	0.243
2003	0.8272	74.2	0	1	0.244



2004	0.815	61.7	0	1	0.24
2005	0.8188	62.3	0	2	0.229
2006	0.8269	69.3	0	2	0.212
2007	0.8319	103.7	0	2	0.212
2008	0.7809	127.4	0	2	0.228
2009	0.803	114.3	0	2	0.245
2010	0.792	137.1	0	2	0.254
2011	0.8134	129.3	0.032980738	2	0.265
2012	0.7805	112.9	0.020435864	2	0.28
2013	0.7819	113	0.028920323	3	0.297
2014	0.7594	112.1	0.01874509	3	0.311
2015	0.7368	125.7	9.65763E-05	3	0.323
2016	0.7235	127.8	0.016474977	3	0.346
2017	0.7199	130.4	0.001968504	3	0.366

### 2.3. Indicator standardization

Because the variables are expressed in different units of measurement, in order to convert them into an index, according to the relationship between the indicators and adaptation to climate change, the deviation standardization method is used to convert them to obtain standardized indicators.

Then, if the relationship is positive, the formula used is

$$X'_i = \frac{X_i - m_i}{M_i - m_i} \quad (1)$$

However, when the relationship is negative, the equation used is

$$X'_i = \frac{M_i - X_i}{M_i - m_i} \quad (2)$$

where  $X_i$  is the parameter value of indicator for a given period,  $m$  is the minimum value of the variable for a given period, and  $M$  is the maximum value. Standardized by formulas (1) and (2), the values of each variable fluctuate between 0 and 1.

### 2.4. Weighting of indicators

After standardizing the data, the weight of each variable is determined according to the entropy method, and the following index weights are obtained: Reactive adaptation ( $W_1$ )=7.01%, Anticipatory adaptation( $W_2$ )=10.6%, Planned adaptation( $W_3$ )=82.39%.(Among them, the proportion of climate assistance funds to the energy sector in the field of adaptation is 52.32%, the proportion of the legal level of energy to adapt to climate change is 16.08%, and the proportion of the total installed capacity of renewable energy is 13.99%.)

### 2.5. Aggregation of indicators

When each kind of data is standardized, the data of each variable are obtained. There are three variables under the planning adaptation index. If we want to get the planning adaptation index, we must summarize the data. Therefore, according to the proportion of the three variables in the planned adaptation, the planned adaptation index was obtained by weighted summary of  $X_3'$ 、 $X_4'$ 、 $X_5'$ .

## 2.6. Climate change adaptation index (CCAI)

In order to obtain a comprehensive index for each year, the indices of each variable are multiplied by their respective weights, then the indicators are summarized and the climate change adaptation index (CCAI) is finally calculated. The index calculation formula would be the following:

$$CCAI = \sum_{i=1}^3 W_i * TOA \quad (3)$$

Where  $W_i$  represents the weight of various indicators, TOA represents a different type of adaptation index.

According to the research and collation of Professor Pineda (2019), we obtained the relationship between the comprehensive index of adaptation to climate change and the type of adaptation to climate change and the state of the system (see Table 4).

**Table 4.** General system conditions as a function of the value of CCAI.

CCAI Range	System status	Type of adaptation
$CCAI \leq 0.33$	High vulnerability	Reactive adaptation
$0.33 < CCAI \leq 0.66$	Intermediate vulnerability	Anticipatory adaptation
$CCAI \leq 1$	Low vulnerability	Planned adaptation

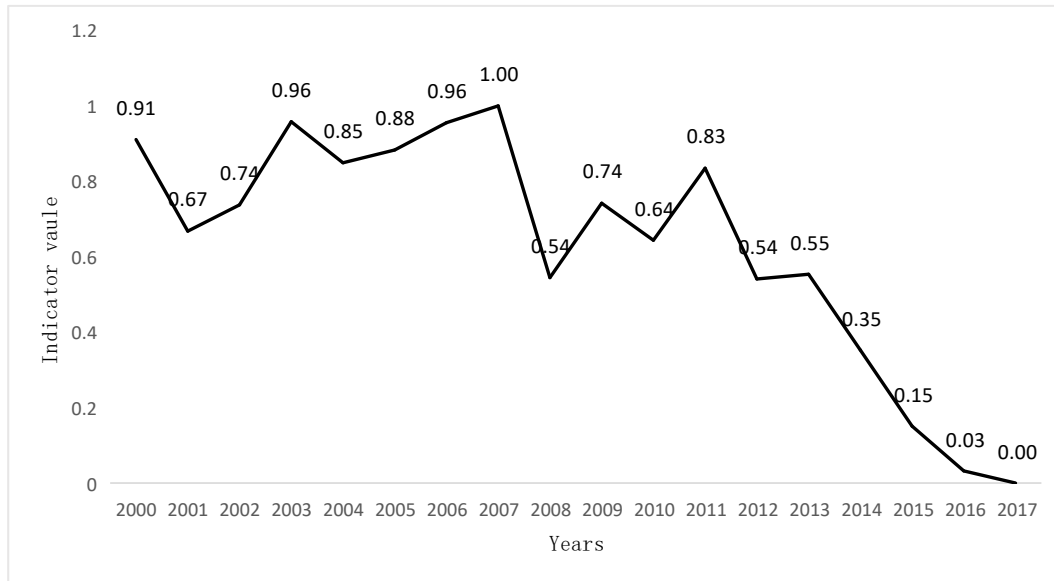
The study of adaptability in China begins with the understanding of vulnerability, so the study of adaptability to China's energy sector cannot be separated from vulnerability. Table 4 shows the relationship between the indicator results and the adaptation type and the system state, where the index value is low when the vulnerability is high, and the index value is high when the vulnerability is low. Therefore, we can say that we pursue planned adaptation, because in this type of adaptation, not only the value of CCAI is higher, but also the value of vulnerability is lower.

## 3. Results

In order to understand the results, a classification index for each adaptation is first given: a reactivity adaptation index, an anticipatory adaptation index, and a planned adaptation index. And then the comprehensive index is analyzed.

### 3.1. Reactive adaptation index

This index (Thermal Generation /Total Generation) can be used to evaluate the substitution of thermal energy for hydraulic energy. When this index is increased, the hydraulic energy used for power generation is reduced. By producing thermal energy, more carbon dioxide is emitted, but the system vulnerability can be prevented from increasing. The relationship between this indicator and adaptation to climate change is therefore positive when the data are standardized (Abraham 2019). So the formula defined in equation (1) was used.



**Fig 1.** Behavior of reactive adaptation in the energy sector of China for 2000–2017.

In 2007, China's hydro-power development was booming, showing a vigorous scene, especially the successful closure of Xiluodu Hydro-power Station on the Jinsha River, indicates that China's hydro-power development has started a new journey. By the end of 2007, the total installed capacity of hydropower in China reached 145 million kilowatts, accounting for about 20.3% of the total capacity, an increase of 11.49% over the same period last year, which is consistent with the decline of thermal power generation in 2007-2008 shown in Fig. 1. In 2008, the natural disaster in China was very serious. In the south of China, 20 provinces (autonomous regions and municipalities directly under the central government) were affected by the severe cold rain, snow and freezing disaster, causing serious damage to water conservancy facilities. The earthquake disaster in Wenchuan, Sichuan Province, has resulted in the damage of a large number of reservoirs and hydro-power stations in 8 provinces (municipalities directly under the Central Government). This is also consistent with the increased reactivity adaptation behavior after 2008. In December 2009, the world climate conference was held in Copenhagen. Representatives from 192 countries discussed the global emission reduction agreement from 2012 to 2020. Since then, countries have begun to gradually control greenhouse gas emissions, including China. After 2011, the thermal power generation started to decline significantly, so the reactive adaptation index of energy sector in China gradually decreased, indicating that energy sector is also in the process of adapting to climate change.

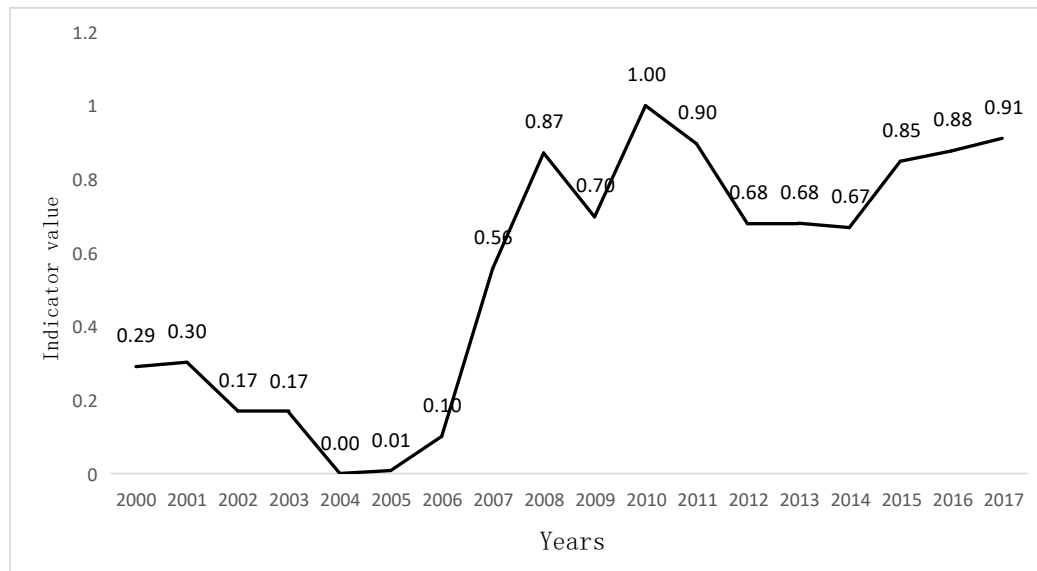
### 3.2. Anticipatory adaptation index

When standardizing the data, the gap between the total power production and the total power consumption has a positive relationship with adaptation to climate change, so the formula defined in equation (1) was used.

**Table 5.** Hydro-power stations put into operation in China.

Name of hydro-power station	Time of completion	Installed capacity (MV)	Annual energy output (TWh)
Longtan Dam	2007	6426	18.7
Three Gorges Dam	2008	22500	98.8
Laxiwa hydro-power station	2010	4200	10.2
Xiaowan Dam	2010	4200	19
Jinping I	2014	3600	17

Nuozhadu hydro-power station	2014	5850	23.9
Jinping II	2014	4800	24.23
Xiangjiaba	2014	6448	30.7
Xiluodu	2014	13860	55.2



**Fig 2.** Behavior of anticipatory adaptation in the energy sector of China for 2000–2017.

From the raw data, the amount of electricity generated during this period is in excess of the demand, which is a good trend for the anticipatory adaptation. Moreover, by comparing the time of completion of the hydro-power station in Table 5 and the year of growth in the anticipatory adaptation index in Fig. 2, it was found that the time of the two was substantially consistent. It is indicated that the construction of the hydro-power station is in a certain degree beneficial to the anticipatory adaptation. Conversely, the good trends in the anticipatory adaptation are mainly due to construction of power plants, hydro-power stations and expansion of installed capacity of reservoirs and dams by predicting the impact of climate change.

### 3.3. Planned adaptation index

Planned adaptation consists of three variables: climate assistance funds for the energy sector in the field of adaptation, energy law in the context of climate change, and the percentage of total renewable energy power generation installations.

First, the data on climate aid funding for the energy sector in the adaptation area are mainly derived from OECD statistics on climate-related financing for development. By analyzing the proportion of energy sector in China in the funds used to adapt to climate change, we can measure the planned adaptation behavior of energy sector.

Secondly, the energy law in the context of climate change is measured according to the degree of perfection of renewable energy laws. At present, there are three levels. Until 2005, there were few specialized laws on renewable energy, even if there were regulations and policies for individual industries and regions. The adoption of the “Renewable Energy Law” in 2005 marks the existence of specialized laws on renewable energy in China, but there are no corresponding administrative regulations (corresponding government regulations, local regulations, etc). In 2013, the State Council issued “Some opinions of the State Council on promoting the healthy Development of Photovoltaic Industry”, and so China has corresponding administrative regulations. Appendix 1 lists the relevant legal documents and hierarchical divisions.

Finally, the percentage of renewable energy power generation installed is increasing year by year from the original data. Among them, for China, the largest installed capacity is hydro-power. China has 678 million kilowatts of hydro-power resources and 5.92 trillion kilowatt hours of annual electricity generation, ranking first in the world and has a bright development prospect. The famous hydro-power stations in China include Three Gorges Hydro-power Station, Gezhouba Hydro-power Station and Xiaolangdi Hydro-power Station. Among them, the Three Gorges Hydro-power Station is the largest hydro-power station in the world, with an installed capacity of 22.5 million kilowatts.

When the data are standardized, the three indices show a positive relationship to adaptation to climate change, so the formula defined in equation (1) is also used. The standardized data are weighted summarized (see 2.5) and the planned adaptation index is obtained (Fig. 3).

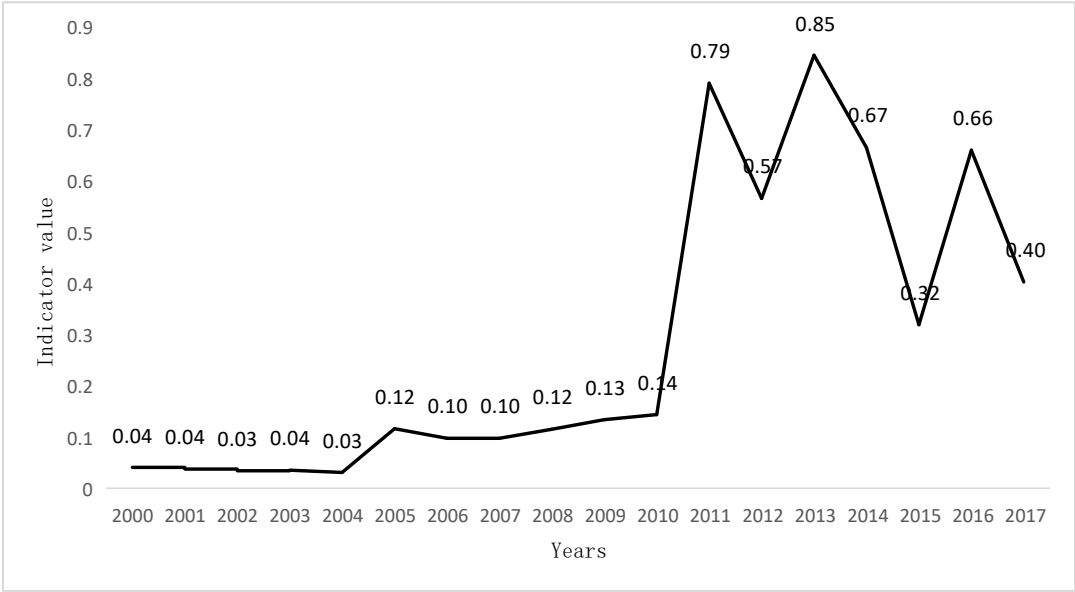


Fig 3. Behavior of planned adaptation in the energy sector of China for 2000–2017.

It is clear from Fig. 3 that there has been a small ladder jump in the planned adaptation index after 2005, mainly due to the adoption of the “Renewable Energy Law” in China. After 2010, the planned adaptation index increased significantly, which is the result of the comprehensive effect of three kinds of data. However, from the perspective of weight and raw data, climate assistance funds to the energy sector in the field of adaptation have played a relatively large role, as evidenced by the sharp drop in the 2015.

3.4. Aggregate adaptation to climate change index

Based on the formula defined in equation (3), the sum of the reactive, anticipatory, and planned adaptation indices results in the CCAI for the energy sector of China in the 2000-2017 period.

Table 6. Behavior of Climate Change Adaptation Index in the energy sector of China for 2000–2017.

Year	CCAI	Types of adaptation	System status
2000	0.128241207	Reactive adaptation	High vulnerability
2001	0.109756849	Reactive adaptation	High vulnerability
2002	0.097855133	Reactive adaptation	High vulnerability
2003	0.113801378	Reactive adaptation	High vulnerability
2004	0.084958774	Reactive adaptation	High vulnerability
2005	0.158587811	Reactive adaptation	High vulnerability
2006	0.158054886	Reactive adaptation	High vulnerability

2007	0.209545093	Reactive adaptation	High vulnerability
2008	0.225477924	Reactive adaptation	High vulnerability
2009	0.236337217	Reactive adaptation	High vulnerability
2010	0.26968142	Reactive adaptation	High vulnerability
2011	0.805302867	Planned adaptation	Low vulnerability
2012	0.576272477	Anticipatory adaptation	Intermediate vulnerability
2013	0.80772862	Planned adaptation	Low vulnerability
2014	0.643681047	Anticipatory adaptation	Intermediate vulnerability
2015	0.363720145	Anticipatory adaptation	Intermediate vulnerability
2016	0.639065936	Anticipatory adaptation	Intermediate vulnerability
2017	0.428508865	Anticipatory adaptation	Intermediate vulnerability

The data in Table 6 show the system status and adaptation types from 2000 to 2017. It can be seen that the reactive adaptation has continued into 2010, indicating the high vulnerability of the energy sector during this period. Between 2011 and 2017, progress was made in active adaptation. Overall, it can be seen that progress has been made in anticipatory adaptation, indicating that the construction of reservoirs, hydro-power stations and power plants in China has enhanced adaptability and mitigated the effects of climate. However, there has not been a real leap forward in planned adaptation, and although a brief leap forward in planned adaptation was achieved in 2011 and 2013, this is not stable and is related to the sudden increase in climate assistance to the energy sector in the area of adaptation that year.

#### 4. Discussion

From the current research results, the energy sector of China has developed from reactive adaptation to active adaptation. However, this does not mean that the state of the system will improve indefinitely, either because of the limitations of the selection of indicators or the impact of special data, such as climate assistance funds for the energy sector in the field of adaptation, or because the method used in weight calculation is single. Although entropy method has high reliability and accuracy, it lacks horizontal comparison among various indexes.

The current warming trend cannot be stopped or reversed, but it can be slowed down, giving the biological system and human society more time to adapt. In addressing climate change, China attaches equal importance to both mitigation and adaptation. Mitigation is a relatively long-term and arduous task, while adaptation is more realistic and urgent. Mitigation and adaptation must be taken into account, coordinated and balanced, with equal emphasis. At present, mitigation and adaptation are difficult to separate, and they are two organic components of climate change (2008). Some scholars believe that long-term adaptation strategies can be regarded as mitigation, for example, the law on renewable energy is not only to adapt to climate change, but also has an impact on mitigation. However, the issue of adaptation is a budding one. At present, the measures and quantification of adaptation to climate change are still limited. So far, the tools used to assess adaptation are vague and controversial in many cases, which need further exploration. More importantly, there is not much research on adaptation to climate change in the energy sector of China.

Therefore, this work is to further explore and try to balance this situation by establishing a comprehensive index to assess the progress of energy sector of China in adapting to climate change. The ideal of the index is planned adaptive behavior, and it is hoped that the subsequent research can further constitute a monitoring tool, so that the government can take action to reduce the vulnerability of the system and transform the government's intervention into improving the adaptability. Unlike most tools that assess climate change adaptation from impact measurement methods and focus on future climate prediction, this work provides tools not only to assess the overall state of the system through the value of CCAI, but also to help determine what happens under each

subsystem. This enables governments to intervene in each of the adaptation indicators that constitute the climate change adaptation index. For example, the current government uses the carbon emission trading right mechanism and other market-based means to achieve emission reduction targets, continues to increase water conservancy construction, and actively improves energy-related laws. All these actions are to improve the adaptability through government intervention. After that, the Chinese government should determine investment policies and priorities based on its own strengths and the realities of the energy sector, and make better decisions to make energy sector of China less vulnerable to climate change (Abraham 2019).

## 5. Conclusions

The results of reactive adaptation show that after the vigorous development of hydropower in China and took the initiative to assume the responsibility of a great country to reduce emissions, thermal power generation is significantly reduced and replaced by other power generation modes. This will not only reduce more greenhouse gases, but also be cheaper in the long run.

The results of anticipatory adaptation show that China maintains a good trend of anticipatory adaptation after 2007 by predicting the influence of climate change, building power plants, hydro-power stations and expanding the installed capacity of reservoirs and dams.

According to the planned adaptation behavior, the adoption of the Renewable Energy Law in 2005 has improved the planned adaptation behavior. After 2010, the climate assistance funds to the energy sector in the field of adaptation began to play a role, which to a great extent affected the planned adaptation behavior.

Based on the overall results of CCAI, a reactive adaptation scheme is proposed to assess the progress of climate change adaptation in energy sector of China from 2000 to 2010. In 2011 and 2013, due to the sudden increase of climate assistance funds to the energy sector in the field of adaptation, a short leap of planned adaptation was achieved, which greatly reduced the vulnerability of the system, but this situation was not stable. Therefore, on the whole, after 2011, there has been an anticipatory adaptation scenario, that is, vulnerability is average. Therefore, at present, the adaptability to climate change of energy sector in China has increased, from reactive adaptation with high system vulnerability to anticipatory adaptation with average vulnerability, and the sector is laying the foundation for planned adaptation scenario.

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# Students and Private Labels: Categories of Private Labels Buying by University Students

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**Abstract:** The traditional perception of private label is that private label is low price and quality. However, this is no longer the case. Over past decades, private labels have grown steadily and have become important direct competitor with other brands. The development of retail chains and creation of private labels brought a new competition to today's market conditions. This article focuses on the categories of private labels buying by university students. Author use an online questionnaire to gain primary data. The sample of the research consists of 305 university students. The author stated several research questions and hypothesis that was tested by mathematical and statistical methods. The author's research revealed that students slightly more prefer branded goods, nevertheless they still buying private label goods. Author used Chi-Square Test for testing stated hypotheses. Based on this test author reject the hypothesis that buying of private label is independent on gender in the segment of university students at the 95% confidence level.

**Keywords:** private label; students; branded goods, non-branded goods

**JEL Classification:** M14, M19

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## 1. Introduction

Today, customers are exposed to a wide range of diverse brands, among which there is strong competition. Private labels gradually began to enter this competitive struggle. Brand itself is one of the most important components of marketing communication of any institution as well as significant part of corporate intangible wealth (Valaskova, Kliestikova, and Krizanova 2018). With the growing competition customer attitudes to private labels have changed tremendously in past decades. Increasing number of customers have been buying private labels. The spread of private labels was significantly increased especially by the competitive pressures (Olbrich, Hundt, and Jansen 2016). That is a reason why many researches have attempted to explain and understand customers buying behavior towards private labels (Shukla, Banerjee, and Phani 2013, Ailawadi, Pauwels, and Steenkamp 2008). Private labels represent a crucial component of retail branding in past decade. Retail branding strategies are based not on manufacturer brands but private label as well. Many researches show that price, quality and perceived risk are important to customers consuming private labels. Fowler (1982) claims that buying low-priced unknown brands represents the highest perceived risk for some customers. Despite of this potential risk the private labels market share has been growing. And for example Walsh and Mitchell (2010) argue in their research that this potential risk connected with buying private label no longer acts as a barrier of purchasing of private labels.

Private labels began to emerge in retail since the mid-1970s. French retail chain Carrefour is considered as the pioneer in creation of private labels. The use of private labels has become an effective way for retailers to increase their profitability. Therefore, nearly all retailers started incorporate private labels in their marketing strategy (Bozhinova 2013). Already in the mid-1990s several authors (e.g. Hoch, Montgomery and Park 1996) began to address the issue of the increase in the share of private labels. Hoch, Montgomery and Park (1996) recorded not only the fact that private labels sales are growing faster than national brands sales, moreover the private labels achieved in mid-1990s higher level of penetration than national brands. The penetration of private labels in the retail market is facilitating by a number of different factors. International retail chains have enough available funds for investing in own private labels. Private labels enable to achieve a greater turnover, cost savings

and higher image. Another factor effecting penetration of private labels is the price and provision of private labels. Private labels are affordable and cheaper for the customer (Bozhinova 2013).

The growth in retail private labels has traditionally been attributed to several crucial causes. First of all, retailers started creating their own private labels to compete to national brands profitably in the price-sensitive segments. Private labels allow retailers to make more profitable agreements with producers and strengthen negotiating position (Boutsouki, Zotos and Masouti 2008, Olbrich and Grewe 2013). The power in relation to branded goods is improving by private labels (Olbrich and Grewe 2013). Moreover, private labels expand the retail product portfolio and help shape a loyal customer base. Retailers are trying not only to increase their profitability by the offering of private labels, but the aim of private labels is an endeavor to improve retailer image perceived by the customers (Olbrich and Jansen 2014). Respectable image of retailer creates store loyalty and attract new potential customers (Bhatt and Bhatt 2014).

Trends show that retail private labels sales have been growing faster than national sales brands (Boutsouki, Zotos and Masouti 2008). Based on the researches of The Nielsen Company, Private Label Manufacturers Association etc. private labels share in consumer basket is growing. Globally, the private labels share in 2016 was 16.7 %. In European countries the share of private labels is 31.4 % and is still growing (The Nielsen Company 2018). The Nielsen Company (2018) states that development of private labels represents a new retail revolution and challenges for brands all over the world.

Based on the statistics of Satista the share of private labels value in European countries is still increasing. Detail information about share of private labels in selected countries follows (for detail see Table 1. Share of private label value in European countries in 2018).

**Table 1.** Share of private label value in European countries in 2018. Source Wunsch, Nils-Gerrith. 2019a

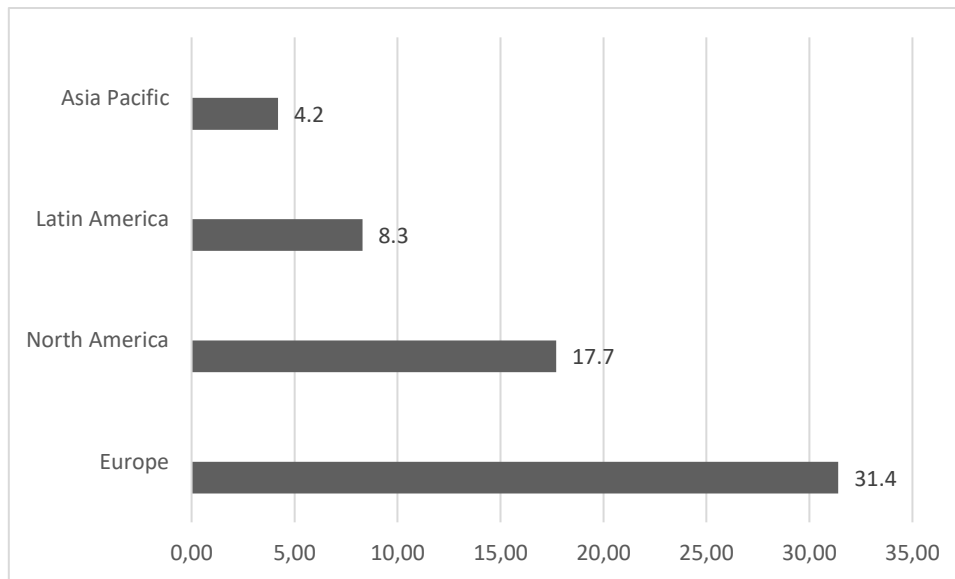
Country	Market share
United Kingdom	52.5%
Spain	42.6%
Germany	40.1%
France	32.9%
Netherlands	29.2%
Italy	18.1%
Greece	16.3%

The statistics of Wunsch, Nils-Gerrith (2019b) shows that the price level of private labels in European countries in 2018 is highest in Italy followed by United Kingdom and Spain. For detail see the following table - Table 2. Price level index of private labels in selected European countries in 2018.

**Table 2.** Price level index of private labels in selected European countries in 2018. Source Wunsch, Nils-Gerrith. 2019b

Country	Price level index
Italy	83.7
United Kingdom	78.1
Spain	74.9
Netherlands	65.9
Germany	63.5
France	61.3

But worldwide the private label share is different in different location and countries. The highest private label share is in Europe, followed by North America. For detail see the Figure 1. Private labels share worldwide in %



**Figure 1.** Private labels share worldwide in %.

The fastest development has been recorded especially in the food sector. The highly competitive environment is the reason for developing of private labels by supermarkets and hypermarkets in the food sector (Cuneo, Milberg, Benavente and Palacios-Fenech 2015). Nevertheless, the private label products can be seen in cosmetics, drugstore, or clothes.

Several retailers sell almost 100% of the goods under own private labels – e.g. IKEA, Marks and Spencer, etc. Private labels are typical not only for large retailers – Carrefour, Lidl, and many others but for smaller discount store too. As stated above, retailers started creating their own private labels to compete to national brands in the price-sensitive segments (Boutsouki, Zotos and Masouti 2008). However, today retailers do not offer only classic and generic private labels for the price-sensitive segments, but the premium private labels for middle and upper price segments (Olbrich, Hundt and Jansen 2016, Schnittka 2015, Ter Braak, Geyskens and Dekimpe 2014).

The Nielsen Company and some other companies focus in their researches on the private labels and their categories, but there are no specific researches focusing on the students' perception of private labels. Therefore, the main aim of this article is to investigate which categories of private labels are buying by the university students. This article presents the results of the first questionnaire that was designed for full-time students. In detail analysis author will investigate if there are any statistically differences between preferences of male and female in the segment of university students.

## 2. Methodology

The main aim of this article is to investigate which categories of private labels are buying by the university students. Author stated following research questions:

1. Do students prefer branded or non-branded goods?
2. Do students buy private labels?
3. Are there any differences between male and female in segment of university students concerning buying private labels?
4. Are there any differences among main categories of private labels buying by male and female in segment of university students?
5. Are there any differences among main categories of private labels buying by male and female preferring branded or non-branded goods in segment of university students?

Author designed a marketing research to achieve objectives of the author's research. As the main research technique author used the questionnaire. Since the target group of respondents were students, author used online questionnaire in order to address the above issues.

For the detail analysis author used primary data gained by the author's questionnaire and for the discussion. Nevertheless, for the support of the author's findings the secondary data published by researchers, academics and institutions (e.g. The Nielsen Company, Statista, etc.) where used, too.

Initially a random sample of 5 students was used for the pilot test of the questionnaire. The aim of the pilot testing was to identify potential shortcomings and avoid misunderstanding of the terms used or individual questions. The pilot testing has shown that there are no shortcomings in the questionnaire could be finalized and distributed. First questionnaire was designed for full-time students and 320 questionnaires were obtained. 15 questionnaires had to be excluded. Total number of 305 questionnaires were used for further analyses.

The questionnaire was divided into several main parts focusing on:

- preferences of students in buying branded or non-branded goods,
- buying private labels, categories of private labels, frequency of buying private labels,
- retail chains where students buying private labels,
- reasons for buying private labels,
- attitude to private labels,
- demographic characteristics.

Author used following mathematical and statistical methods for the analysis of the primary data obtained:

- relative and absolute frequencies,
- chi-square test – for testing independency of data for comparison of observed data with expected to a specific hypothesis. The chi-square test will be used to reveal statistical differences of response of male and female. The formula for calculation of chi-square test follows.

$$\chi^2 = \sum_{i=1}^k \frac{(X_i - N_{Pi})^2}{N_{Pi}} \quad (1)$$

Concretely author stated following hypothesis that will be tested in the segment of university students:

H<sub>10</sub>: Preference of branded or non-branded goods is independent on the gender in the students' segment

H<sub>11</sub>: Preference of branded or non-branded goods is not independent on the gender in the students' segment

H<sub>20</sub>: Buying private labels is independent on the gender in the students' segment

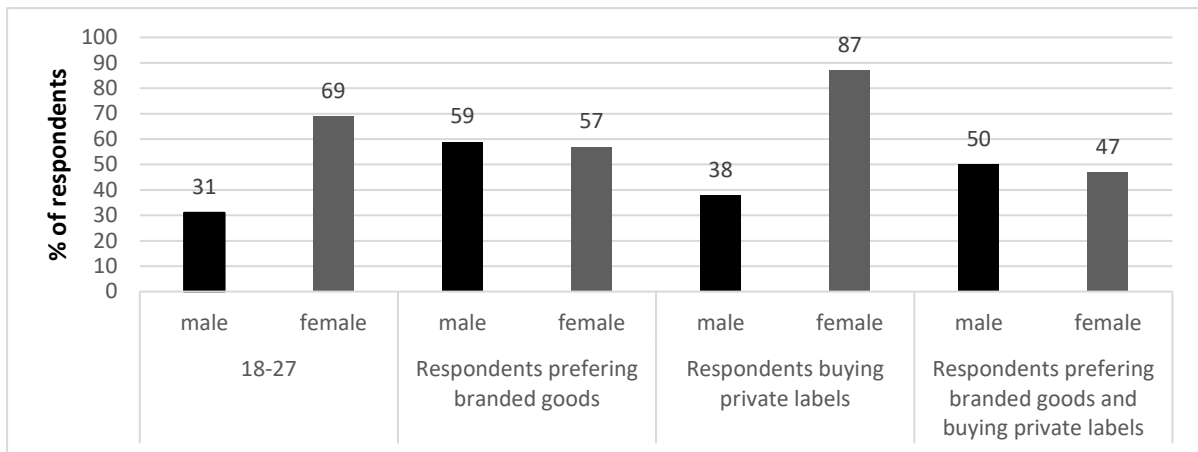
H<sub>21</sub>: Buying private labels is not independent on the gender in the students' segment

### 3. Results and Discussion

This part of the paper summarized the main findings of the first part of the authors research focusing on the buying of private labels by students. Since the respondents were the full-time students all students belong to the age group 18-27 years with secondary education. Most of respondents were female 69%.

#### 3.1. Preferences of branded and nonbranded goods and buying of private labels

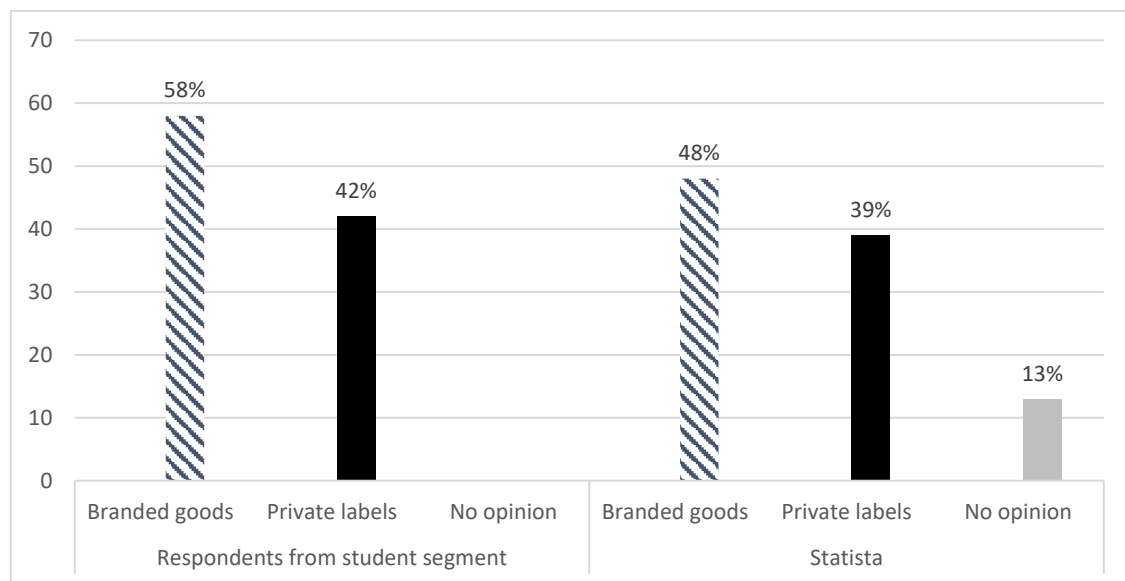
First of all, respondents were asked if they prefer branded and nonbranded goods and if they are buying private labels or not. 66.2 percent of respondents answered that they prefer branded goods, however 88.3% of respondents stated that they are buying private labels. The following Figure 2: Gender structure of respondents, represents the detail analysis of answers of male and female.



**Figure 2.** Gender structure of respondents.

As we can see the number of male and female preferring branded goods is similar as well as the number of male. However, buying private labels seems to be depended on the gender in the students' segment. Therefore, author will be tested stated hypotheses by the chi-square test.

Based on the statistics of Statista (2019b) we can state that in the students' segments generally more students prefer branded goods than in all population. Statista (2019b) claims that 48% of population prefer branded goods. The comparison of author's research and Statista research follows in Figure 3 Comparison of preferences of private labels and branded goods,



**Figure 3.** Comparison of preferences of private labels and branded goods in %.

As we can see in the author's research sample none of the respondents answered that they have no opinion concerning preference of private and branded good. Based on the Statista (2019b) 13% of overall population has no opinion about their preferences. In the author's sample of university students, we can see higher preferences of branded goods than were published by the Statista.

As stated above author will test following hypotheses:

H<sub>0</sub>: Preference of branded or non-branded goods is independent on the gender in the students' segment

H<sub>1</sub>: Preference of branded or non-branded goods is not independent on the gender in the students' segment

H<sub>2</sub><sub>0</sub>: Buying private labels is independent on the gender in the students' segment

H<sub>2</sub><sub>1</sub>: Buying private labels is not independent on the gender in the students' segment

First of all, author tested the null hypothesis: Preference of branded and non-branded goods is independent on the gender in the students' segment at the 99% confidence level.

**Table 3.** Chi-Square Test – first hypothesis.

Chi-Square	Df	P-Value
23.42	1	0.1236

The results of the Chi-Square Test proved that preference of branded or non-branded goods is independent on the gender in the students' segment. Since the P-value of this test is greater than 0.01, we can reject the null hypothesis that Preference of branded or non-branded goods is independent on the gender in the students' segment at the 99% confidence level.

As well as the second hypothesis was tested by the Chi-Square Test. Since the P-value of this test was less than 0.05, we can reject the null hypothesis that buying private labels is independent on the gender in the students' segment at the 95% confidence level.

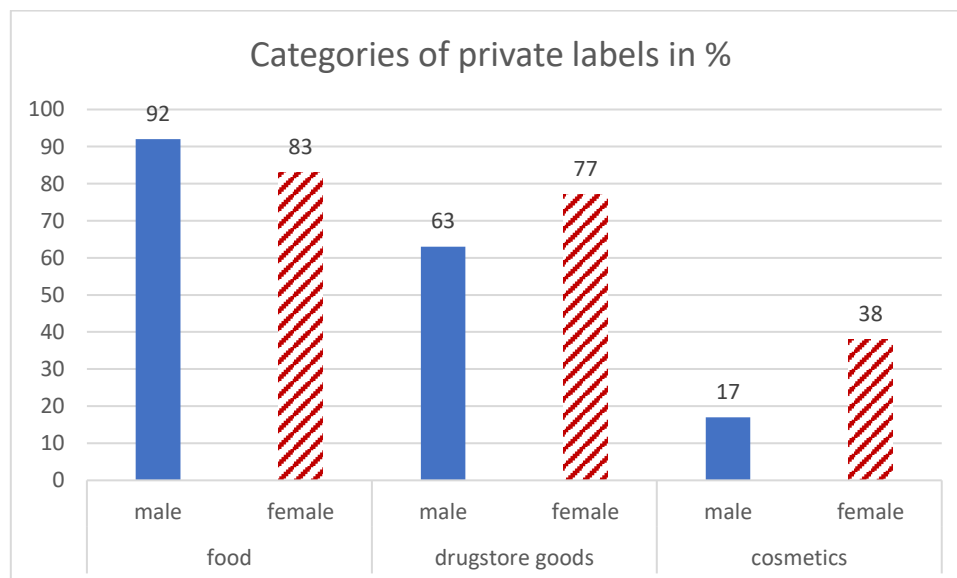
**Table 4.** Chi-Square Test – second hypothesis.

Chi-Square	Df	P-Value
20.89	1	0.0101

Based on the results of the Chi-Square Test we can state that in the segment of the university students the preference of branded or non-branded goods is independent on the gender and private labels is not independent on the gender in this segment at the 95% confidence level.

### 3.2. Categories of buying private label products

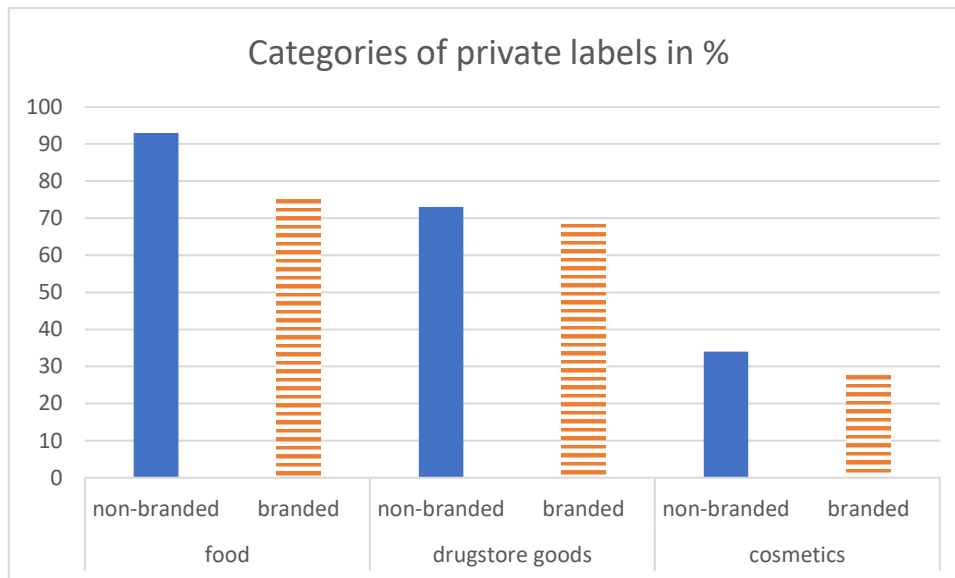
At the second part of the questionnaire author focused on the main categories of private labels that university students buy. Author divided private label based on the literature search into 3 main categories – food, drugstore goods and cosmetics.



**Figure 4.** Main categories of private labels buying by male and female.

As we can see from **Figure 4** Main categories of private labels buying by male and female categories of private labels drugstore goods and cosmetics are buying more by female than male, but 9% more male provide the answer in the questionnaire that they are buying food of the private labels.

In detail author investigate which main categories of private labels buying by students preferring branded and non-branded goods. For the detail see following **Figure 5** Main categories of private labels buying by respondents preferring branded and non-branded goods.



**Figure 5.** Main categories of private labels buying by respondents preferring branded and non-branded goods.

It is obvious that in all categories private labels are buying more by respondents preferring non-branded goods.

## 5. Conclusions

Author is focusing on the private labels in her research. Since there are many demographic characteristics influencing private labels author chose for the first research a segment of university students. The first questionnaire was designed for full-time students. The second one will be designed for part time students and the third one for general public. as the author wants to cover as much of the population as possible with different demographic characteristics.

The result of the first author's research revealed that slightly more of students prefer branded goods. Nevertheless, 50% of male and 47% of female preferring branded goods are buying private labels. Based on the results of the Chi-Square Test we can state that in the segment of the university students the preference of branded or non-branded goods is independent on the gender and buying private labels is not independent on the gender in this segment at the 95% confidence level. Altogether, 87% of female and only 38% of male is buying private labels in the author's research sample. More female is buying cosmetics and drugstore goods and more male is buying food in private labels.

This author research focus only on university students and main categories of private labels. Therefore, author will follow with other researches to cover other demographic groups and in following researches author will focus on more details in categories of private labels.

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# The Model of eSports Ecosystems

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**Abstract:** Electronic sports, widely known as eSports, are presumably the most profound evolutionary movement of the sports industry in the modern history. Despite the business potential, though, the eSports industry remains relatively unexplored in the literature of the management discipline, especially from the network perspective. To fill the gap confirmed in the literature review, the research aimed at answering a question regarding the contents of eSports ecosystems – who the actors are and how do they interact with each other. A multiple case study was carried out, involving content analysis of social media posts published by a selection of eSports-related organizations in order to identify and classify entities comprising the eSports networks. As a result, the authors proposed and described a network model of the eSports ecosystems consisting of distinct roles (stakeholders) and relationships observed in ego-networks of the investigated entities. The model can serve as a foundation for future research on the eSports ecosystems and provide a bird-view on the industry's mode of work for practitioners.

**Keywords:** esports; electronic sports; network analysis; ecosystem; business model; business model innovation

**JEL Classification:** M10; M13

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## 1. Introduction

Electronic sports, widely known as eSports, are presumably the most profound evolutionary movement of the sports industry in the modern history. They break the majority of rules that are conventionally bound to the competition between athletes – the rules of physics and the limitations of human body. In case of the eSports, the only limitations of the game mechanics are the ones introduced by a game developer or a modder (typically an independent developer who modifies a game's source in order to change its look, mechanics, etc.). The liberation has been gaining popularity and fueling the economic activities on an unprecedented scale, reportedly reaching growth of over 40% on a year-to-year basis and generating around \$700 million in revenue with the audience of over 385 million people by the end of 2017 (Newzoo 2017). Two years later, in a new report the same company estimated that the eSports industry would generate \$1.1 billion in revenue, growing at a still magnificent pace of +26.7% year-to-year with the audience of over 453 million people (Newzoo 2019). Furthermore, the eSports are progressively considered to be merged into the major traditional sport events like the Olympics (IOC 2018) and Asian Games (BBC 2017) as one of the contested disciplines.

Despite the business potential the eSports industry remains relatively unexplored in the literature of the management discipline, especially from the network perspective. A review of currently available business and management articles resulted in their abstract-based classification presented in **Chyba! Nenalezen zdroj odkazu..** A list of the literature positions was extracted from the Scopus database by querying it with two keywords – “eSports” and “electronic sports” – and subsequently narrowing the search scope to the “Business, Management and Accounting” subject area. Subsequently, they were classified to a specific theme based on their title, abstract and keywords. The goal of the review was to identify the existing literature describing the eSports business networks so only articles from the “network analysis” theme was subject to further content analysis.

**Table 1.** Classification of the eSports studies from the “Business, Management and Accounting” subject area, listed in the Scopus database.

Theme	Description	No. identified articles
Player and consumer behavior	Studies researching motives, behavior, etc. of players, spectators and other eSports consumers.	14
General discussion	Studies touching upon miscellaneous eSports aspects (e.g. eSports statistics, differences between sports and eSports, etc.).	8
Network analysis	Studies describing the eSports industry from the network perspective, particularly analyzing the eSports business networks and phenomena occurring within them.	3
Law	Studies dedicated to various legal challenges of the eSports industry.	2

The recent book by Scholz (2019) summarized the current state of knowledge from the strategic management’s perspective on the eSports industry. The author used the stakeholder journey approach in order to identify and characterize the eSports industry’s stakeholders, dividing them into two groups in accordance to the division proposed by Darnall et al. (2010):

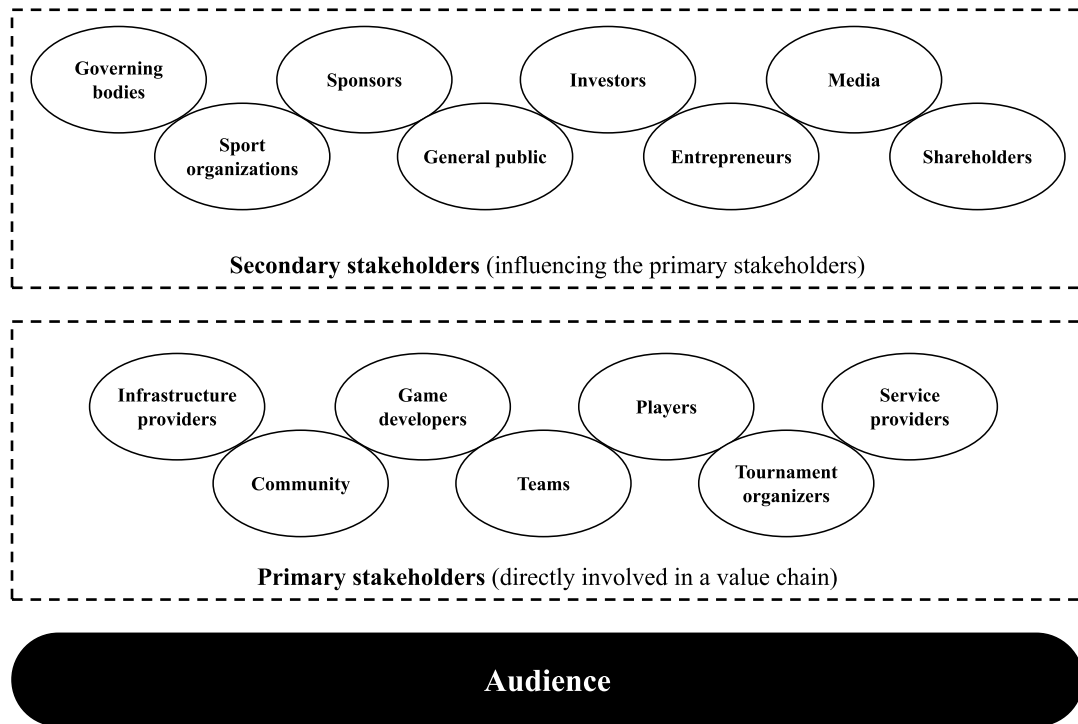
- *primary stakeholders* directly involved in the value chain – game developers, tournament organizers, professional players and teams, infrastructure and service providers, community,
- *secondary stakeholders* who have an indirect influence on the primary stakeholders, serving as their environment – governing bodies, sports organizations, sponsors, the general public, investors, entrepreneurs, media and others (Scholz 2019).

The author also elaborated on governing principles and business models observed in the eSports industry, concluding with the sector’s forecasted roadmap. Although it provided a clear, bird’s eye view that can be used as a substantial entry point by practitioners, it is hypothesized that the model of the eSports industry proposed in the book is incomplete and can be extended with additional roles, noticeable in the industry.

A work published prior to Scholz’s book, attempting to describe the logics of relationships in an eSports network was an exploratory study carried out by Zhou and Huang (2015) who had employed the e3-value methodology to analyze the business network built around the StarCraft 2 game. The authors examined data from multiple sources (e.g. threads on Reddit, Liquipedia, articles from the Internet, etc.) which allowed them to discern the network’s actors (noteworthy, Scholz’s classification was consistent with theirs) and translate their value offerings and revenue streams into the proposed model of the e3-value network. This perspective shed light on the general mechanics of the individual ecosystem built around the single game title, visualized its actors and explained how they contributed to and profit from the participation. Similarly, the actor model assumed by the authors was hypothesized to be subject to further extensions.

The third work categorized in the “network analysis” theme was a case study of the marketing strategy of the Paris Saint-Germain sports club by Chanavat (2017). The author carried out a number of interviews with a number of the company’s insiders which allowed him to examine the interesting case of the entity’s transformation into an “omnisports brand” – both traditional-sports and eSports. Nonetheless, the research did not satisfy the review’s search objective as it did not touch upon the overall perspective on the eSports industry.

The literature review underpinned a formulated research question: what are the actors of the eSports industry and how do they interact with each other? To answer it, the research was drawn upon the industry’s model proposed by Zhou and Huang and later by Scholz (see: Figure 1).



**Figure 1.** Categorization of an eSports network's participants proposed by Scholz based on Scholz (2019).

## 2. Methodology

The research used a multiple case study approach of analyzing social media content of a selection of eSports-related organizations (see Table 2). They were chosen to be distinguishable in terms of a self-assumed role. Thanks to the common practice of expressiveness in the social media space, observable in many electronic industries including eSports, it was not necessary to additionally filter candidates in terms of availability of data. In order to optimize further analysis of data by unifying the interface to data sources, the social media were limited only to Facebook profiles.

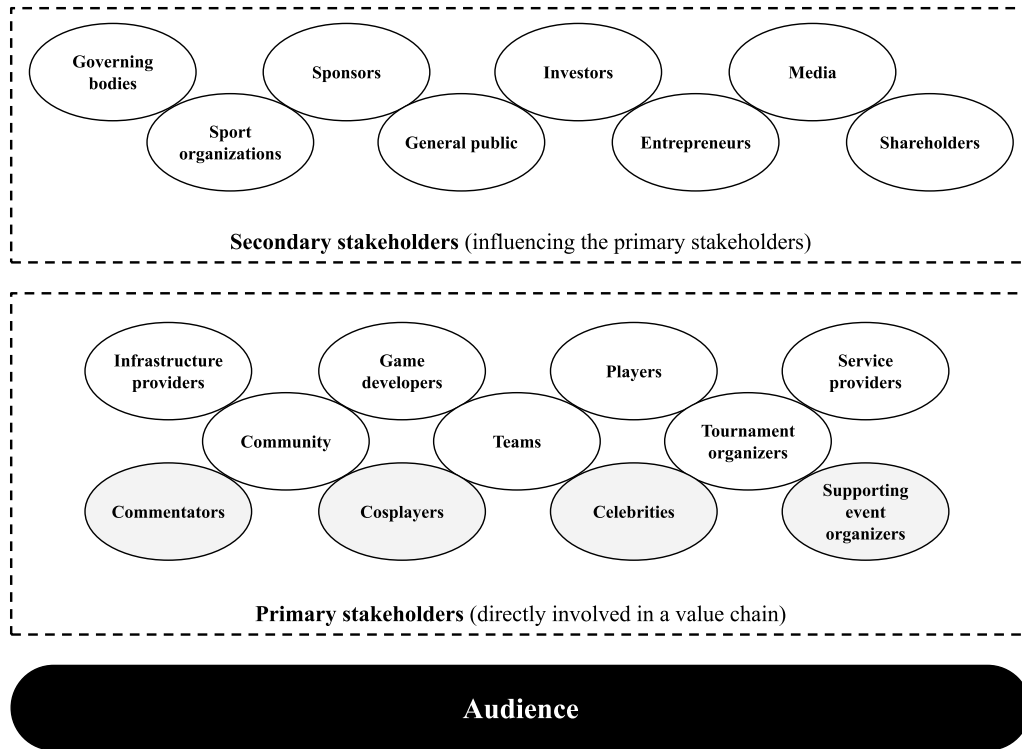
**Table 2.** The entities selected for the multiple case study. The descriptions were extracted from their own social media.

Facebook profile name	Self-description
FantasyExpo	"The largest Polish gaming agency offering creative strategic consulting for brands, unique marketing sales campaigns, as well as product and event campaigns" (Fantasyexpo 2019).
WEST (Wrocław E-Sports Tournament)	"An eSports project co-created by a group of young people from IKSS – an academic organization at Wrocław University of Economics and Business" (WEST 2019)
ASE (Akademickie Stowarzyszenie E-Sportowe)	"League of Legends team representing Wrocław University of Technology" (ASE 2019)

Posts from two-year period following the beginning were analyzed in search for all references and mentions about other entities and descriptions of their relationships. The posts often contained links to external sources (other website's, social media, images, and videos) which were recurrently scrutinized to obtain auxiliary insights on investigated events and actors. Altogether, the research covered over 500 posts and 100 additional items.

### 3. Results

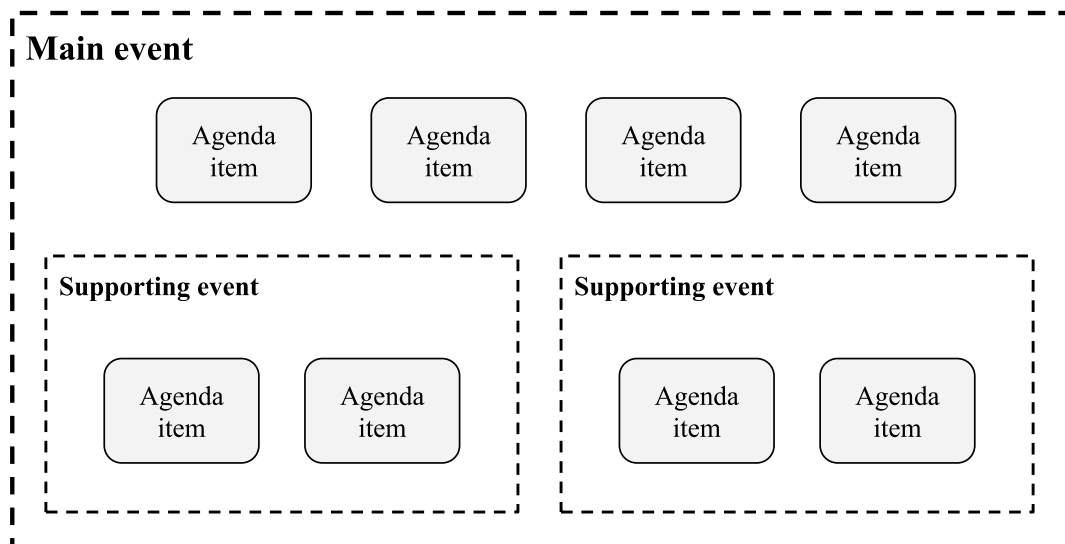
The data analysis confirmed Scholz's model as the authors were able to identify all the roles. However, it became evident on the course of the research that a part of the classified entities did not fall precisely under any category or could be labelled with a few of them. Consequently, the authors propose an extension to the model: four new roles and an alteration to the antecedent role of event organizer which, arguably, could be divided into two related but separate roles – main and supporting event organizer. The extended model is presented in Figure 2.



**Figure 2.** The extended model of the eSports industry proposed by the authors. The gray ellipses depict the roles additional to Scholz's model.

#### 3.1. Supporting event organizer

The observed form of cooperation between event organizers in which there is one entity organizing the main event and a number of entities contributing to the event's agenda with their own performances paved a way to the proposed discrimination between the roles of the main event organizer and the supporting event organizer (see Figure 3).



**Figure 3.** The cooperation scheme between the roles of main and supporting event organizers found by the research. Each event contained an agenda comprising individual items (e.g. different tournaments, an exhibition, a show, etc.) whereas the main event’s agenda occasionally included a whole supporting event.

The supporting entities played a particularly significant part in young eSports networks, presumably due to scarcity of resources that could help to create an event by a single actor. Therefore, the organizers were observed to leverage the mutual benefits of the main and supporting event organizers. The main event organizer achieved its goal of expanding the core value stream whereas the supporting event organizer exploited the network effect of the event and gained access to potential customers and/or partners. In return, the supporting event organizers run individual agendas on their dedicated areas at the main event, contributed to the agenda with their speeches and presentations, or simply enriched the event with their brand stand. Moreover, their engagement usually meant broadcasting and advertising this fact in their own ego networks which further broadened the main event’s outreach.

### 3.2. *Celebrity*

Celebrities play an important role in many events, not only eSports-themed. It was found that many traditional-sports spectators looked for famous players and their attendance at live events provides a way to fulfill this motive (Watanabe 2013). Similarly, a significant part of eSports spectators declared a motive for their interest in a specific player (Pizzo 2018). It was observed during the research that the event organizers often invited recognizable parties to enrich the overall experience, hereafter called the eSports celebrities. The figures sometimes contributed to the value stream with their stage performances or, in case of streamers (people recognized for their posted live videos) with their live streams of the event published on their official channels. Noteworthy, it was found that the celebrities cooperating with the event organizers to boost value proposition not necessarily limited to individual people. In the examined case, an event organizer (FantasyExpo) advertised a forthcoming event emphasizing the presence of a game developer (CD Projekt RED) widely recognizable by the target audience of game players for their flagship title (The Witcher). The event’s participants were assured to be given a chance to interact with the organization during a Questions And Answers session constituting a part of the happening. This could be interpreted as one of the organization’s inputs to the event’s value stream.

### 3.3. *Cosplayer*

Cosplayers are described in the literature as people “role-playing with their costumes” or, in other words, dressing up as characters from games, comics, cartoons, anime, and other fictional universes

(Winge 2006). As Winge pointed out, the “costumes” often included much more than mere clothes. Cosplayers modified their body (hair, piercings, etc.) and their character to maximize a non-verbal description of a roles they played which, for the time of the event, became their alter ego. Also, the clothes were rarely straightforward pieces of fabric but subject to extravagant creativity. They sometimes required a lot of resources and innovative tools (e.g. 3D printing, holograms, etc.) from their creators to be developed. For example, there were instances of cosplayers role-playing robotic characters (i.e. Transformers) which led to a costume being basically a state-of-the-art human-driven robot.

Cosplayers were observed to contribute significantly to the core value stream of eSports events, primarily by building the atmosphere and broadening the range of entertainment activities during the events. Certainly, cosplay is not only a supporting element of eSports but also an individual industry, featuring its own events and devoted audiences. In the context of this research, however, the “cosplay” role was only analyzed from the eSports-centric perspective and therefore it was not investigated individually. Nonetheless, it was found that entities participating in the eSports network as the “cosplay” actors went beyond Schultz’s classification of the network’s stakeholders and deserved their own, unique category.

### 3.4. Commentators

Another role interestingly rarely described in the literature, yet having a significant, direct impact on the core value stream of eSports events are commentators. They are – similarly to the traditional sports – highly fluent in the rules of a commented game individuals who comment tournament gameplays, making them more comprehensible by an average observer. It is rather evident that their competences in gameplay narration are paramount to the final reception of the gameplay. A highly skilled commentator can not only make complex, fast-moving gameplays easier to ingest by the audience but also provide insight on the current state of teams and players, their statistics, probable outcomes of the matches and the overall view on a tournament. On the other hand, an incompetent commentator may obfuscate reception of gameplay, confuse the audience with invalid insights on a tournament’s state and, if not sufficiently fluent in common delicacy, may damage the event’s image in the audience’s eyes.

Commentators observed during the research were often well-known personas in the eSports and game communities. They usually represented their own brands of popular streamers, players, journalists, and other industry experts. Therefore, the events they commented could benefit from their recognizability and channels to their follower and partner networks. Such a cooperation between the main event organizer and the entity could be described with a dual role in the extended Scholz’s classification of both *commentator* and *celebrity* and occasionally extended to a combination of *commentator*, *celebrity* and *media* in case the individual shared information about the event with own media channels.

A proper selection of commentators appears to be an important process that requires due diligence from the main event organizer, specifically with respect to their relations with certain parts of the public. There were numerous cases of public affronts by recognizable people from the game- and eSports-related communities which led to an outrage in some groups (Mitchell 2014) (Frank 2018). Admittedly, the caution should likewise apply to the selection of all celebrities branding an event with their own names.

## 4. Discussion

The study’s findings provide an insight on the current state of the eSports industry from the network perspective. It leveraged expressiveness of modern IT-related organizations in the Internet and examined social media of a selection of eSports entities investigating their eSports-related environment. This allowed to identify and classify eSports actors operating in the network and led to a confirmation of the eSports industry’s model previously proposed by Scholz. Additionally, the authors suggested an extension to Scholz’s model (three additional roles: *celebrity*, *cosplayer* and *commentator*) along with division of the *event organizer* role into two separate ones: *main* and *supporting*

event organizer. Lastly, the additional roles were characterized in accordance to the studied instances and related to the existing body of knowledge.

An obvious limitation of the research was its methodological scope. Expansion to more cases could result in a greater detail of the roles' descriptions and, presumably, lead to even greater complexity of the model. Another limitation was the data source which encompassed posts published by the entities (and their environment) on their own social media profiles. It means that they could miss (accidentally or purposefully) certain intelligence that the entities had not consciously decided to inform the publicity about. Although this issue was partly addressed with the recurrent scrutiny of external, linked sources, interviews with insiders of the studied entities could bring added value.

The findings can help practitioners to understand and build network strategies in the emerging eSports industry as well as provide academics with a base model for future research. The authors intend to continue investigating the subject of eSports networks, strategies and business models and welcome fellow scientists and practitioners to join or provide a critical feedback.

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# Consumer Credit other than for House Purchase Regulation in the Czech Republic and Selected EU Countries

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**Abstract:** A transposition of 2014/17/EU changed consumer credit markets throughout the EU. In the Czech Republic the transposition by the act 257/2016 Coll. was taken as an opportunity to unify regulatory framework for all consumer credit regardless of a purchase purpose. At the same time this regulatory framework extension was motivated by adverse phenomena in a non-bank consumer credit sector such as predatory and usurious practices (regulatory arbitration, abuse of the social distress of debtors, credit cost obfuscation, pre-contract payments, insufficient or even none creditworthiness assessment and more). These issues were addressed by the market entry public regulation including employee's professional qualification requirements. The paper compares professional qualification regulation approach in the Czech Republic and eleven selected EU countries. In the Czech Republic, Hungary, Greece was adopted the public regulation approach which combines national regulator supervisory with accredited institutions examination. On the other hand, in Germany and the Netherlands was an approach closer to a private regulation. Croatia and Portugal still did not completely transposed 2014/17/EU and are facing a legal procedure from the Court of Justice of the EU. In the Czech Republic a new regulation significantly decreased a number of non-bank consumer credit providers and their market share is diminishing since the last economic crisis. Yet, a new option of regulatory arbitrage for predatory creditors appeared although with a very limited impact on the market.

**Keywords:** consumer credit; regulation; Czech Republic; MCD

**JEL Classification:** G28; G23

## 1. Introduction

The financial sector is one of the most regulated sectors in an economy since it can be and was in the past a source of systematic economic failures that can lead to a global economic crisis. Retail credit provision is a fundamental service offered in this sector and therefore significantly regulated. Directive 2014/17/EU (European Parliament and Council, 2014) (frequently referred to as MCD) introduced several unifying concepts for EU economic area mortgage provision. Except for other features, it differed from previous consumer credit regulation because it also included the institutional component of regulation such as the market entrance. However, its transposition was in some countries with a greater range than just mortgage market and there were set rules applicable to any consumer credit including non-bank financial companies providing consumer credit other than for house purchase.

In general, there are two basic principles of consumer protection by EU consumer law – information and fairness. However, MCD established two more principles of affordability and responsible lending (Méndez-Pinedo, 2015). Any non-bank credit provider is subjected to a duty to assess a consumer's creditworthiness. Explicitly it has to be done by reliable, sufficient and direct information provided by the consumer, and if necessary from a credit registers (bank, non-bank).

There was also introduced standardization of pre-contractual information facilitates comparison (Rona-Tas and Guseva, 2013). In light of the last global financial crisis, neither of these two principles were respected. It is true that this concerns mostly other markets than Czech Republic, i.e. USA and in EU Mediterranean economies – foremostly Spain. Regardless of a territory, confidence in the financial sector had to be restored or strengthened, ultimately leading to MCD.

However, in the Czech Republic, there were no trust issues with the bank sector unlike non-bank one due to three credit union bankruptcies in the last decade. Moreover, there were present adverse phenomena such as predatory and usurious practices in a non-bank consumer credit sector. These practices led to the more frequent seizure of property among mainly sub-average and low-income households. Czech parliament came to a conclusion to protect such vulnerable borrowers from predatory lending and also from making uninformed decisions that they will later regret. The situation with many borrowers unable to pay is both adverse for the industry and for the whole society. Achieving this goal without risk of fair competition and market balance negative interference was the main concern. However, the situation was a killing two birds with one stone scenario since unifying the regulatory framework for all types of consumer credit with MCD transposition would solve mentioned adverse phenomena. One of the regulatory rules was related to an issue of employees involved in the provision and intermediation of a consumer credit professional qualification. It is not uncommon that non-bank providers bear a lack of professional qualification as a competitive disadvantage compared to bank ones (Da Silva et al., 2017) but there were tens of thousands of credit providers as a tied sole trade suggesting a substantial share of unprofessional providers performing among other things predatory and usurious practices.

## **2. Regulatory approaches in Non-bank Financial Market**

As any financial intermediation, non-bank consumer credit provision carries a systemic risk which creates the need for regulation. As (Anagnostopoulos, 2018) mentions concerning non-bank financial companies, any regulation density and policy options should be proportionate to: size, liability volumes, geographical expansion, scope, and business models.

A regulatory strategy of consumer credit provision is following general open-ended standards principles which are typical for EU legal environment. In such mandatory rules leave space for even private rule-making, giving rise to typical co-regulatory arrangements where public law-maker defines mandatory minimum standards or general principles, the private one specifies them or raise standards (Cafaggi, 2009). Therefore, there can be found several regulatory approaches that can be sorted accordingly the space for private rule-making.

Regulation is commonly viewed as affecting lender behavior by e.g. risk weightings, capital buffers (entity-based regulation) and by e.g. loan-to-value caps, debt-to-income ratios, interest coverage (borrower-dependent regulation) (Anagnostopoulos, 2018). The regulatory tools of proving a professional qualification of all employees involved in the provision and intermediation of a consumer credit belong into the entity-based category.

The Consumer Credit Directive and MCD are given by (Cherednychenko, 2016) as a good illustration of the involvement of private actors in standard-setting within the EU principles-based regulatory framework that implicitly leaves room for co-regulation can be found in the area of consumer credit. This directive allows Member States considerable leeway in implementing this obligation of EU origin in transposition.

Another possibility is for a public regulator to rely upon the senior management of financial institutions to put in place appropriate systems and oversight mechanisms. This management-based regulation stimulates modes of self-organisation within financial institutions so as to achieve certain public goals (Baldwin et al., 2010). However, this approach is present in other parts of the financial market such as investment firms where they define, approve and oversee a policy as to such products in accordance with the firms' risk tolerance (Cherednychenko, 2016).

The last option is a strictly public regulation that is proposed, set and performed by a national or specialized regulatory institution. However, completely neglecting an opinion private sector and their rightful interest may result in inefficient regulation in terms of industry performance. Also, on a

financial market, (Stringham, 2015) warns that a substitution of private regulation in the financial services field by hardcore public regulation and/or public soft law produced by regulators is not without risk. For example, too restrictive rules on responsible lending may prevent consumers from gaining credit from licensed creditors and force them to seek other less safe and more costly ways how to obtain a credit. Therefore, a possible inconsistency in regulatory concepts regarding sectors and products has to be considered since they raise the risk of regulatory arbitrage.

### 3. Regulation Implementation

#### 3.1. Czech Republic

There were several reasons for a regulation extension from the range set by (European Parliament and Council, 2014). At first, inconsistent regulatory concepts regarding sectors and products raise both the risk of regulatory arbitrage and also cause additional costs for businesses to ensure compliance of their activities with individual and different regulatory environments. Consumers also incur the cost of learning about different rules for different products and sectors (learning costs). Inconsistent legislation may also complicate the effective exercise of integrated supervision. To be more specific, there were credit providers completely out of national regulator reach such as sole traders providing or intermediating consumer credit. Parliament and Ministry of Finance predatory and usurious practices in the non-bank lenders market are a very serious negative socio-economic phenomenon (Chamber of Deputies, 2014). Especially such practices included:

- too easy market entry causing lack of professional qualification
- regulatory arbitrage with the artificially divided principal is several credits in order to remain below regulation requisite (being over 5.000 CZK)
- abuse of the social distress of debtors when lender speculates on the debtor's default followed by strong contractual sanctions or pre-contract payments
- obscuring of credit cost
- insufficient or even none creditworthiness assessment
- predatory use of a bill of exchange in case of a default

From several proposals, such as APR ceilings, there was like the most appropriate solution chosen market entrance regulation by a national regulator. After consultation in parliament and at Ministry of Finance, Czech Republic received a positive opinion from European Central Bank (European Central Bank, 2015) stating that these sole traders were only lightly regulated and supervised by the Czech Trade Inspection Authority. This was the argument in favor of incorporating sole traders into the regulatory framework of the national regulator which was so far hesitating to accept such wide regulatory extension.

The regulatory framework was approved and set in act No. 257/2016 Coll. (Parliament of the Czech Republic, 2016) however, professional qualification requirements were further specified in following Czech National Bank regulatory decrees and supervisory benchmarks. Non-bank consumer credit providers have to state in their organization rules which functions are performed by employees and thus can be performed only by persons who meet the requirement of professional qualification by § 60 of the Act of (Parliament of the Czech Republic, 2016), including the definition whether they are directly involved or responsible for it. Qualification requirements and examination process are set accordingly:

- accreditation for professional examinations organizing (Czech National Bank, 2016a)
- details of the essential elements of an application for authorization to pursue the business of non-bank consumer credit including professional qualification (Czech National Bank, 2016a)
- The manner of generating tests when organizing professional examinations, categories of qualification, types and number of test questions, score requirements, the scope of professional expertise and competence for the provision or intermediation of consumer credit (Czech National Bank, 2016b)

- only an indirect relation mentioning the duty of managing and controlling the quality of intermediary distribution network internal regulations accordingly external and internal regulation (Czech National Bank, 2016b)

The national regulator provides a set of questions covering areas of:

- minimum expert knowledge of the financial market
- the structure, entities and functioning of the market for consumer credit other than for house purchase
- regulation of the market for consumer credit other than for house purchase
- lending and the products of consumer credit other than for house purchase
- complementary services related to consumer credit other than for house purchase
- the principles of the process for assessing a consumer's creditworthiness

Every single test is unique in terms of the order of the correct answers. The accredited institution examiner creates individual test variants on the day of the examination. Each test contains single-answer questions, questions with more correct answers and case studies with sub-questions (Czech National Bank, 2017) The test has to be completed within two hours.

Professional qualification requirements are complemented by other rules related to improving the standard on the market. The national regulator imposed a general duty on creditors to assess whether the consumer is creditworthy before the conclusion of the credit agreement, so as to prevent consumer overindebtedness. These two capital requirements, firstly a market entry regulation which is based on minimal start level of capital of at least 20 million CZK (800,000 EUR). Secondly, capital related rules state that non-bank provider maintains capital at least at the level of 5% of the volume of outstanding loans. Removing tied sole trade creditor option. These and the rest of the rules were supposed to diminish negative phenomena that emerged over the last decade on the consumer credit market.

However, long before the regulation could be observed a downtrend of non-bank providers market share. Since the last economic crisis stroke the economy, the volume of consumer credit other than for house purchase provided by non-bank financial companies is decreasing from 216 million EUR in 2008 to less than 120 million EUR in 2016. These figures cover the members of the Czech Leasing and Financial Association. On the other hand, consumer credit volume of bank providers rose from 300 million EUR in 2008 to 420 million EUR in 2016 (Mejstrik and Dzmuran, 2018). However, non-bank provider consumer credit regarding companies in the Czech Leasing and Financial Association showed a year-on-year increase in the volume 1.8% and a slight decrease of number of contracts (Czech Leasing and Financial Association, 2018). In a similar manner, before the regulation took place one of the most cited negative effects of mis-providing of consumer credit other than for house purchase – natural entity insolvency and seizure of property, was declining.

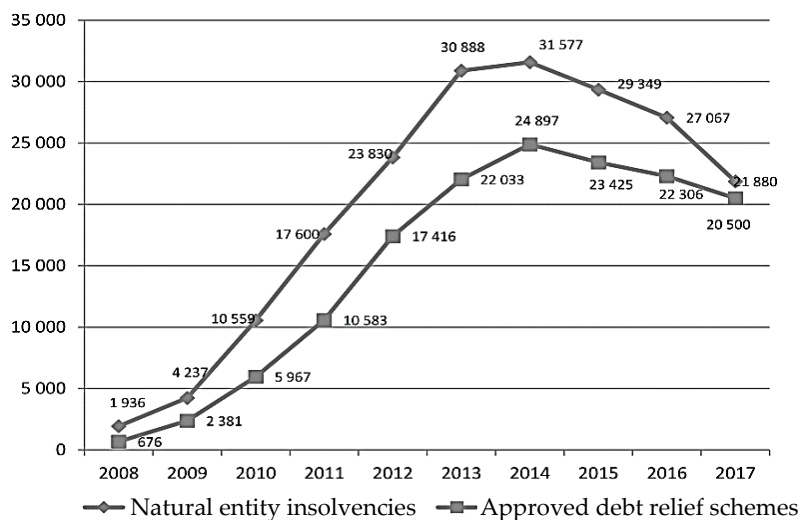


Figure 1. Number of natural entity solvencies and debt reliefs (Mejstrik and Dzmuran 2018).

Nevertheless, the main impact of the regulation was a sharp decrease in consumer credit other than for house purchase providers and intermediaries. From an estimation of 55,000 providers and intermediaries (including tied sole traders) is now registered approximately 17,500 tied agents and intermediaries of tied consumer credit and 86 non-bank consumer credit providers (Czech National Bank, 2019; Mejstrik and Dzmuran, 2018) with a decreasing trend regarding the first group and stable trend regarding the latter one. Due to a capital requirement, a number of employees that have to declare professional qualification, etc. it took approximately one year before these providers were approved by the national regulator and registered.

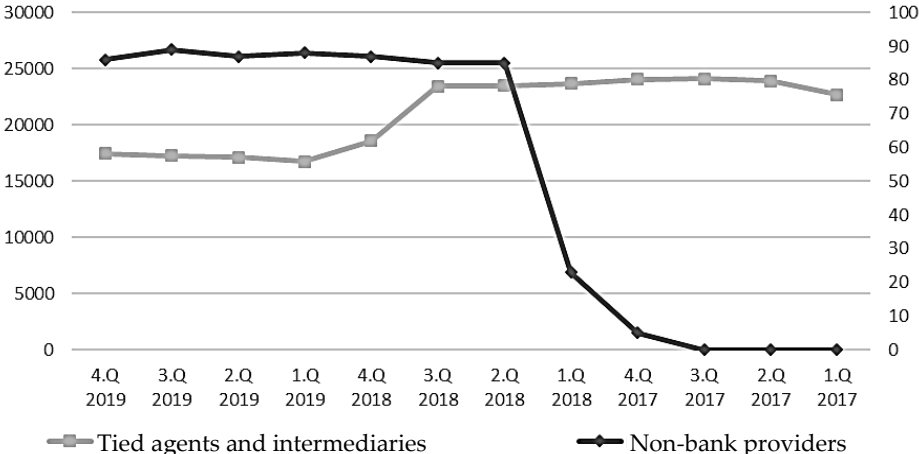


Figure 2. Number of registered agents and institutions (Czech National Bank 2019).

Although tied sole trader creditors cannot operate any more on the market of consumer credit, there is another option how to avoid regulation in form of a credit to entrepreneurs. An option of regulatory arbitrage is based on persuading a natural entity borrower to apply for the easiest form of sole trade with a very easy market entry. Then they will provide a credit but, in this case, it is not a consumer credit anymore and a borrower protection is completely lifted.

We did not address a question of whether the consumer protection is needed in this manner when the number of property seizures is diminishing. This question relates to not just an economic cycle, legal environment but also to financial literacy. Even though this issue is a part of obligatory education scheme e.g. study (Hedvicakova et al. 2017) showed that less than 50% of pupils in the sample did not reach a required score. If such results are present in a sample of those who had an opportunity to receive a financial literacy lessons, the situation among those who had not won't be better, on a contrary worse result can be expected. In such environment mainly, professional staff and creditworthiness assessment are beneficial for a society.

3.2. Selected EU countries

The majority of EU countries did not assign specific tasks of this nature to their national regulators, i.e. supervision over accredited persons professional qualification examination and an obligatory duty for consumer credit other than for house purchase providers or intermediators.

In Austria the Banking Act (Austrian Financial Market Authority, 2019) there are stated appropriate knowledge and skills in the areas concerned and they are to be refreshed and updated on a regular basis. It contains knowledge of credit products, of the legal provisions, comprehension of the procedures relating to the acquisition, credit products, ethical standards in business dealings, procedure of assessing the creditworthiness, financial and economic competence.

In the Bulgarian legislation, the Law on Consumer Credit (Bulgarian National Assembly, 2018) prescribes the requirements with regards to consumer credit agreements. Neither this law nor the applicable Bulgarian legislation contains professional qualification requirements for the distribution of consumer credit.

As a part of MCD transposition, Croatian National Bank issues an outline of the process for training sales staff and a certificate of adequate knowledge and expertise. A credit institution is also obliged to prepare a training program and submit it to the Croatian national regulator no later than 31 January of each year. However, the transposition was not finished and so the European Commission has decided to refer Croatia to the Court of Justice of the EU for not enacting the MCD in their national legal system.

In German law, credit intermediaries are inter alia regulated by the Gewerbeordnung (Parliamentary Council of the Federal Republic of Germany, 2019), which states that credit intermediaries require an authorization. Such authorization can only be granted in cases where an examination passed before the Chamber of Industry and Commerce is presented as evidence that the applicant has the grounding in carrying out of credit intermediation activities, legal matters and customer services.

Greek national regulator (Bank of Greece) is assigned a number of tasks in relation to the certification process, including the eligibility assessment procedure and handling of the relevant documentation. The conditions for participating in the certification examinations, the examination syllabus, issues relating to the organization of the courses, the examinations procedure, the conditions and procedure for the renewal and withdrawal of the certificate. The fees are paid by the candidates. The examinations and relevant courses may be carried out by various entities, following an assessment of their capability by the national regulator stated in MCD transposition (Parliament and the president of the Hellenic Republic, 2016) and other national regulator related acts.

The central bank of Hungary duty is, concerning professional qualification, set by the Decree (Ministry of National economy, 2015) related to financial, insurance and capital markets service providers' agents. The national regulator supervises that the requirements for official examinations and examiners' activity comply with the decree. The financial education of financial, insurance and capital markets service providers' agents may be carried out by an official trainer firm registered with the Central bank of Hungary. The national regulator organizes the official exams and ensures the examiners.

In Ireland, the base for professional qualification is based on two Codes (Central Bank of Ireland, 2017a, 2017b). The aim is to ensure at least a minimum acceptable level of competence from individuals acting for and on behalf of regulated firms in the provision of advice and information and associated activities in connection with retail financial products. The standards apply to persons exercising a controlled function on a professional basis, the exercise of providing advice to consumers on retail financial products, arranging or offering to arrange retail financial products for consumers or exercise of a specified function. The Central Bank of Ireland does not take part in course design or examinations and credit intermediaries are not authorized by the Central Bank. A person who holds qualifications other than those recognized for the purposes of the MCC may seek an exemption from part of the recognized qualifications from the professional educational bodies providing those qualifications such as the Institute of Banking and The Insurance Institute.

In Netherland, every employee who gives advice with regard to financial products is required to have specific and standardized diplomas. In this case, the diplomas on *Wet op het financieel toezicht* basis (Queen of the Netherlands, 2017) and *'Wft Consumptief krediet'* are mandatory. Aside from this, every financial service provider is obligated to have business procedures and processes with regard to the permanent professional competence of every single person in direct contact with customers, with regard to financial products. Even if these persons do not give advice.

In Poland, by (Polish sejm, 2019) a responsible institution is the Polish Financial Supervision Authority which exercises supervision of the banking and financial market in Poland and also takes part in the process of drafting legal acts related to financial market supervision. Consumer credit intermediaries are not subject to financial supervision. There are also no legal requirements for certain professional qualifications to provide such business. Consumer credit providers are fully responsible for the actions of their intermediaries.

Portuguese decree-law (Bank of Portugal, 2017) states that credit institutions will have to comply with regulatory requirements where, for instance, their employees hold a certificate of professional competence. Credit intermediaries must also conform to specific requirements of knowledge and

competence. Under the Credit Intermediaries Law, the national regulator (Bank of Portugal) assesses compliance with the relevant requirements throughout the authorization procedure. Compliance with the requirement for staff to have an appropriate level of knowledge and competence can only be ascertained by a certificate of professional competence. According to decree-law (Bank of Portugal, 2017) and the Credit Intermediaries Law, certificates of professional competence may only be issued by entities certified by the Bank of Portugal. Under the relevant provisions, the Banco de Portugal is also responsible for monitoring those entities and may revoke its certification if it concludes that the conditions required have ceased to exist. The fulfillment of these tasks is financed by the national regulator.

Slovenian national regulator (Bank of Slovenia) is responsible for supervising compliance with the Consumer Credit Act of credit institutions, leasing companies and certain credit intermediaries. All these institutions are required to employ properly qualified staff as in provision and intermediation. Their national supervisor has the authority extended to supervise compliance with the provisions of the Consumer Credit Act that regulates education. These tasks of Bank of Slovenia are financed by the subjects of its supervision.

#### **4. Discussion and Conclusion**

Non-bank market performance might be connected to a type of Czech financial system. In categorization by a capital structure of (Allen and Gale, 2001) the Czech financial market is an example of B-market (Mejstrik et al., 2009) as almost all European continental countries. A different point of view provides (Walter, 2012) claiming that most of the countries have universal banking model and are dependent on it. Although conventional bank power slightly eroded on the consumer credit segment maybe because of the system non-bank financial companies did not disrupt a credit business as they did in typical M-system countries or Asia. There the share of assets held by banks and insurance companies has fallen thanks to funds and non-bank financial firms. Hence, traditional intermediaries have declined in importance even as the sector itself has been expanding (Allen and Santomero, 1997) and, in general, banks face increased competition from non-banks financial intermediaries (Melnik and Shy, 2015). There can be argued that the Czech financial market is less mature than M-system countries are, however, the French one, which is a typical B-system example, cannot be considered as less mature. Therefore, an increase of bank consumer credit share would be natural outcome of dominant bank position in B-system countries.

Another explanation dominant bank position in a consumer credit sector suggests a theory of bank and non-bank lending by (Thakor and Merton, 2018). Their banks have an endogenous advantage over non-bank lenders when it comes to being trusted to make good loans. Study (Begley and Srinivasan, 2019) provides empirical evidence that this trust advantage of banks matters to borrowers confirming that their unique access to low-cost deposit funding increases trust. However, e.g. model in the study (Boot and Thakor, 2000), later supported by findings (Degryse and Ongena, 2007), suggests that banks facing an increased non-bank competition react by loyalty strengthening counter-activity such as relationship loans.

There can be observed that in spite of an obligatory duty of MCD transposition an environment regarding professional qualification differs in both a regulatory approach at the level of a national regulator as well as on the level of requirements. Czech and Hungarian approaches are very close to public regulation with very little co-regulation. Central bank sets requirements, provides accreditation and supervises the professional examination process. The only difference is that in Czech Republic examination is not organized by the central bank. A similar system but with a wider range of authorized institutions for professional examining is adopted in Greece, Slovenia, and Portugal. Signs of co-regulation can be found in Croatia where credit institution is obliged to prepare a training program and submit it to Croatian national regulator for assessment. However, due to an uncompleted MCD transposition changes can be expected. In Germany and the Netherlands, the standards are based on minimum standards and trade code which are not provided or authorized by the central bank. Private regulation is also a case of Poland where credit providers are fully responsible for the actions of their intermediaries.

Professional qualification, capital and other requirements lead to cleaning the market of the most obvious usurious and predatory form of consumer credits provision since it was mostly caused by tied sole trader creditors. However, although the regulation in the Czech Republic did clear the market of most doubtful non-bank financial companies and tied of sole trader creditors cannot participate on the market of consumer credit anymore, the problem was not treated completely. There is still one arbitrage option and this type of sole trader arbitrage is obviously detrimental and with strong possible negative consequences for consumers who decide to take this way to credit. However, the question is if it can be ever solved by a regulatory means since a decision to start a sole trader business cannot be limited when requisites are met. Still, time and other costs of such arbitrage efficiently prevent its mass misuse.

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# Innovativeness as Well as Research and Development in Selected Countries of Central Europe

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**Abstract:** The article contains synthetic characteristics of activities related to the implementation of innovation, and the basic research problem was to present the dynamics of changes in the area of research and development activities, with particular emphasis on the expenditure and expenses for the above-mentioned activities in the Czech Republic, Poland and Slovakia. The situation in these countries was related to the conditions in the European Union. In addition, the state of R&D staff and the number of obtained intellectual property rights were analyzed. This allowed us to identify the strengths and weaknesses of national innovation systems and to identify areas to which attention should be paid to improving the innovation indicators of individual countries. Research shows that the most innovative country among the three analyzed is the Czech Republic. Subsequently, Slovakia and Poland proved to be the least innovative country. However, in all countries in the last decade there has been a dynamic growth of individual indicators that are significant when measuring the innovativeness of a given country. Although the Czech Republic is leading the way in innovation, in most cases they differ from the EU average indicators.

**Keywords:** innovation; innovativeness; innovative processes; research and development activities; research staff

**JEL Classification:** O30; O31; O34

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## 1. Introduction

Science, technology and innovation play a key role in implementing the development of the economy and society in order to maintain and increase the country's competitiveness, and development is one of the EU's main tasks. Innovations are the driving force of the modern economy, transforming ideas and knowledge into products and services (Robinson 2004). They help solve many critical problems, including social threats, and increase society's ability to act. The consequence of innovation is economic growth, improvement of well-being and communication, access to education and environmental sustainability. Practically, innovations are implemented in every branch and area of life. This happens in IT, medicine, agriculture, electrical engineering, energy, mechanics or logistics. Modern technologies are also used in the everyday functioning of cities and villages.

However, for innovations to be implemented, they must be created. And innovative technologies and solutions arise as a result of research and development activity, cooperation between enterprises and public administration, business environment institutions and research units. All developed economies are shifting their structures towards knowledge-based industries and services. This, in turn, involves spending huge amounts of money and economic and social maturity. Therefore, the development of technology, new products and services in individual countries is not even. Innovations in developing countries will grow much faster and more intensively. In turn, in less prosperous countries, the speed of implementing innovations will be lower. Despite this, each country should strive to create conditions aimed at implementing a pro-innovation policy. This was also noticed by the European Union, which in one of the five main goals of the Europe 2020 strategy adopted the improvement of research and development conditions, and in particular the raising of the general level of public and private investment in this sector to 3% of EU GDP (European Commission 2010). This is followed by all

Community countries, which try to pursue their policies to varying degrees, in order to gradually increase their country's position in innovative as well as research and development activities.

The article contains synthetic characteristics of activities related to the implementation of innovation, and the basic research problem was to present the dynamics of changes in the area of research and development activities, with particular emphasis on the expenditure and expenses for the above-mentioned activities in the Czech Republic, Poland and Slovakia. The situation in these countries was referred to the conditions in the European Union. In addition, the state of R&D staff and the number of obtained intellectual property rights were analyzed. This allowed to identify the strengths and weaknesses of national innovation systems and indicate areas that should be noted to improve the innovation indicators of individual countries.

## 2. Methodology

The wide scope of research covers three countries of Central Europe: the Czech Republic, Poland and Slovakia, i.e. countries which in many scientific studies are analysed in terms of socio-economic indicators. These are Slavic states, belonging to the Visegrad Group since 1991, and since 2004 to the European Union. Despite significant similarities in location, level of development and economic history, these countries present significant differences in many respects. Poland has the largest population of around 38 million. Four times less people live in the Czech Republic and eight times in Slovakia. But only Slovakia joined the eurozone in 2009. Each of these countries differs in macroeconomic indicators, however, most economic indicators are still below average factors for the entire European Union. The time range of the research covers the last decade and applies to the years 2008 - 2018. The analyzes were conducted based on the literature studies of the subject, analysis of previous studies and mass statistics data made available by the national statistical offices, national patent offices and EUROSTAT, OECD and the European Commission. The methodology of research in the field of innovation was based on the textbooks of international organizations (Frascati Manual for R&D Statistics, Oslo Innovation Statistics Manual). In the case of the analysis of the ratio of gross domestic expenditure on R&D to GDP, analysis of the share of budget funds for research and development (GBAORD) and the number of patents and protection rights granted to domestic entities for utility models per one employed in R&D, the forecast of the trend for the to 2025 was made year to determine further lines of action in the field of innovation for the countries concerned.

The work uses methods for processing and interpreting optional knowledge using the descriptive method, the method of tabular-descriptive analysis and graphic presentation, as well as literature studies. The analyzes used numerical data for business entities conducting innovative activities, the involved research and development personnel, the number of intellectual property rights obtained and the involvement of financial capital for research and development. The comparative interpretation also uses the methodology developed by the European Commission for assessing the innovativeness of countries on the basis of an innovation indicator allowing the development of the European Innovation Scoreboard, which has been published since 2011. To determine such an indicator, an assessment of 27 elements from the following groups is used: involvement of human resources in innovative activities, functioning research systems, R&D environment, financial support, investments, connections between entities, investors, intellectual property (European Commission 2019). Trend forecasts for selected indicators were made using the linear function method, taking into account historical data based on time, assuming a 95% confidence level.

## 3. Results

### 3.1. *Innovativeness as well as research and development in the light of theoretical considerations*

The term 'innovation' comes from the Latin "innovatis", meaning renewal, creating something new. Innovation, also known as change, means the introduction of new products, processes or management models, more effective and cheaper than those previously used (Janasz and Koziol 2007). The term "innovation" was introduced by Joseph A. Schumpeter in 1911. He said that innovation is the commercial or industrial use of something new: a product, a process, a production method, a new

market or supply sources, a new form of doing business (Schumpeter 1960). It is a broad frame of the concept of innovation, including the introduction of a new production method, a new good, opening a new market, discovery of a new source of raw materials, and introduction of a new industry organization. In the second half of the 20th century, many definitions appeared in the literature on the subject representing a narrow or broad approach to conceptualizing the term "innovation". And so in 1980 to the concept of innovation M.E. Porter includes technological improvements, better methods and ways of doing a given thing or product. This can be done by changing the product, process, new marketing approaches, new forms of distribution (Porter 1992). Innovations in its definition are treated as a series of technical and organizational changes, including ordinary modifications to existing ones, as well as the development of completely new products and processes. Creating and implementing innovations involves a whole range of scientific, technological, organizational, financial and commercial activities. In turn, P. Drucker in 1992 presented his view on innovation in the context of the organization's activities, because he stated that innovation is: "a special tool of entrepreneurs, through which changes make an opportunity to start a new business or provide new services. Innovation is a specific entrepreneurial tool - an activity that gives resources new opportunities for creating wealth" (Drucker 1991). Another point of looking at innovation was presented by P. Kotler (1994), who pointed out that innovations are ideas that have already existed for a long time, but for a given person it is new (Kotler 1994). Currently, the most popular and commonly used definition is the one specified in the Oslo Manual (2005), where innovation means the implementation of a new or significantly improved product (good or service) or process, a new marketing method or a new business organization or external relations. Innovative activities are of a scientific, technological, organizational, financial or commercial nature and are intended to lead or lead to the implementation of innovations (OECD 2018). Therefore, product, process, organizational and marketing innovations can be specified. Often functional and ecological innovations are also identified in the literature (Penc 1999). Product innovation, often referred to as subject innovation, is the placing on the market of a product or service that is new or significantly improved in terms of its characteristics or applications. In turn, process (technological) innovations point to the implementation of new or significantly improved existing methods of production, distribution and support of activities in the field of products and services. Technological changes often condition the emergence of functional innovations that meet new, previously undisclosed social needs. As a result of the occurrence of process innovations, there is a desire among the society to use new technologies. In the case of organizational innovations, a new organizational method is implemented in the operating principles adopted by the entity, in the organization of the workplace or in relations with the environment, which has not been used in the unit before. However, we will meet with marketing innovation when a new concept or marketing strategy is implemented that is significantly different from the marketing methods previously used in the unit (OECD 2018). Ecological innovation contributes to reducing or eliminating the negative effects of economic entities on the environment (Krzepicka and Tarapata 2012).

Beside the innovation term, there exist also innovativeness term. Innovativeness occurs when a process that takes place in a determined or undetermined time, which is not an event but a set of activities that begins from a concept and ends with practical application, which in turn leads to an increase in of value of the entity. Therefore, it is a specific way of operating of entities, based on innovations, i.e. making innovative decisions and implementing them into business activity (Poznańska 1998).

Entities involved in implementing innovations, called innovators, conduct innovative activities, i.e. a process constituting all scientific, technical, organizational, financial and commercial activities that leads to the implementation of innovations (OECD 2018). Innovative activity includes research and development (R&D) activity, characterized by creative work, carried out in a methodical way, undertaken to increase knowledge resources and to create new applications for existing knowledge that leads to the implementation of innovation (Bukowski et al. 2012). In addition, as part of the innovation activity of a given entity, there can be distinguished activities related to the purchase of knowledge from external sources, the purchase of software or fixed assets, staff training, marketing and other (Stępiak-Kucharska 2012).

Conducting R&D activity allows measuring the innovation and innovativeness of the economy of country, region, industry, sector or given entity.

The following groups of indicators are used for the most frequently performed measurements of innovation [GUS 2019b]:

1. cash expenditure on research and development,
2. the number of people employed in the R&D sphere,
3. the number of patents and rights granted for utility models,
4. number of innovation active entities.

The above indicators inform about how intensively innovative activity is conducted. On an economic scale, the Frascati Methodology is most often used to measure innovation in financial expenditure on R&D, and the measure used is GERD - gross expenditures on research and development, i.e. the sum of internal expenditure incurred in a given year on R&D by all units conducting this activity in a given country. The Frascati methodology enables multidimensional analyses and comparisons. Frascati expenditure on R&D is classified according to the distance for the economic application of the conducted research, divided into basic research, applied research and development works, as well as into other classes (according to the criteria: sector in which research is conducted - business, government, higher education, private non-profit; by source of funds: domestic and foreign; according to socio-economic goals; according to research areas, etc.) (Bał 2016). In turn, people employed in the R&D sphere play a key role, because they constitute the greatest intellectual value and through a creative commitment to creating innovation significantly affect the overall result of measuring innovation. The following three groups of employees can be distinguished in R&D: research and development employees, technicians and equivalent employees as well as other auxiliary staff connected with R&D. These groups of employees differ in their level of education, scope and content of activities (OECD 2015).

A key measure of innovation results are patents and rights for utility models. Patent indicators reflect the inventive results of countries, regions, technologies, enterprises and scientific institutions. They are also used to observe the level of spreading of knowledge in various areas of technology, country, industry, field, etc. An important role in measuring innovation are innovation active entities, i.e. enterprises that have implemented at least one product or process innovation or have conducted discontinued or unfinished innovation activities (including research and development activity that is not directly related to the creation of a specific innovation). The measurement of this indicator shows what percentage of units conduct innovation activity in a given year (GUS 2019a). In recent years, the fourth industrial revolution (Industry 4.0) has become widespread in the world. However, numerous studies show that entrepreneurs approach the implementation of the Industry 4.0 concept with caution. Changes in this area are being introduced slowly, as financial factors are a barrier for many entrepreneurs. Therefore, the concept of industry 4.0 has a relatively small impact on improving the innovation indicators in individual countries (MPiT 2018).

In order to encourage entrepreneurs to increase innovation activity, governments of individual countries introduce the possibility of applying tax reliefs on R&D activities. For comparative purposes between countries, indicators of suggested rates of R&D tax relief determined by OECD are used. The tax subsidy rate is defined as 1 minus the B-index, a measure of the before-tax income needed by a "representative" firm to break even on USD 1 of R&D outlays. As tax component of the user cost of R&D, the B-Index is directly linked to measures of effective marginal tax rates (OECD 2019).

### *3.2. Innovativeness as well as research and development in the Czech Republic, Poland and Slovakia*

Innovation and innovativeness in the enterprise is one of the elements of competitive advantage in the daily activities of business entities. According to data from 2016, it appears that about 80% of enterprises in EU countries introduced innovations or have conducted innovative activities (fig. 1). In the analyzed countries, the most innovative enterprises were in the Czech Republic - over 72%, and the least in Poland - about 59%. This is less than average across the EU. A similar situation occurred in the case of implementing product and / or process innovations as well as organizational and / or

marketing innovations. In the EU, several innovations use more than 54% in total, and in the subject countries from 37% in Poland to 49% in the Czech Republic. A similar trend is noticeable in the case of enterprises producing innovative products or using only organizational or marketing innovations. Here the leader is again the Czech Republic, followed by Slovakia and finally Poland. The situation is the opposite if the entities implement process or product innovations. It was Poland where the most enterprises implemented this type of innovation (16.7%) and it was 3% more than on average in the entire EU. It can be seen from all statistical analyzes that not all economic entities implement innovations. The largest number of enterprises that cannot be innovative was in Poland - 41.2%, and the least in the Czech Republic - 27.6%. These data indicate that these countries diverge from the EU average, in which the number of enterprises without implementing innovation is 20.3%.

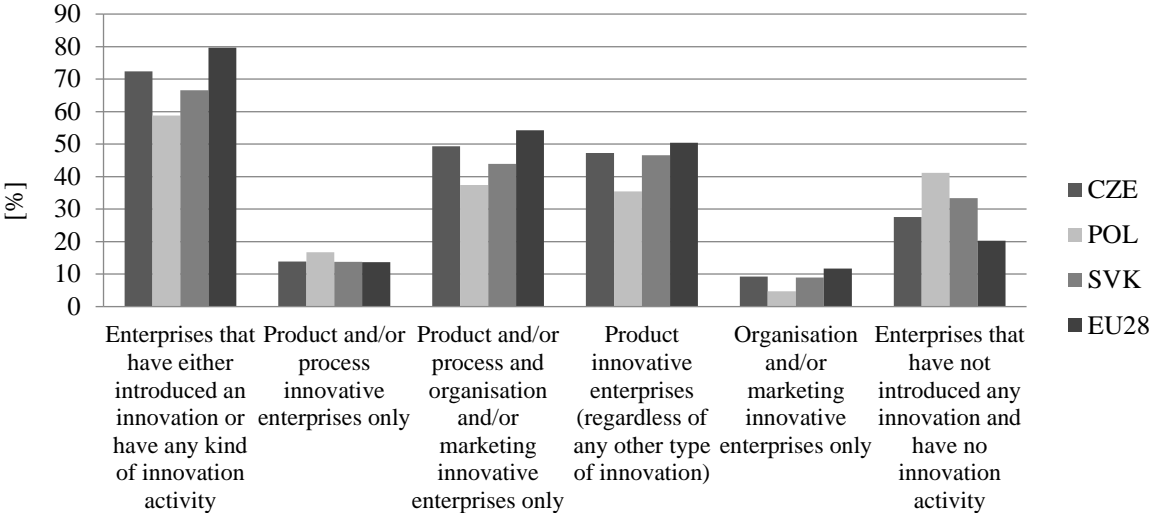
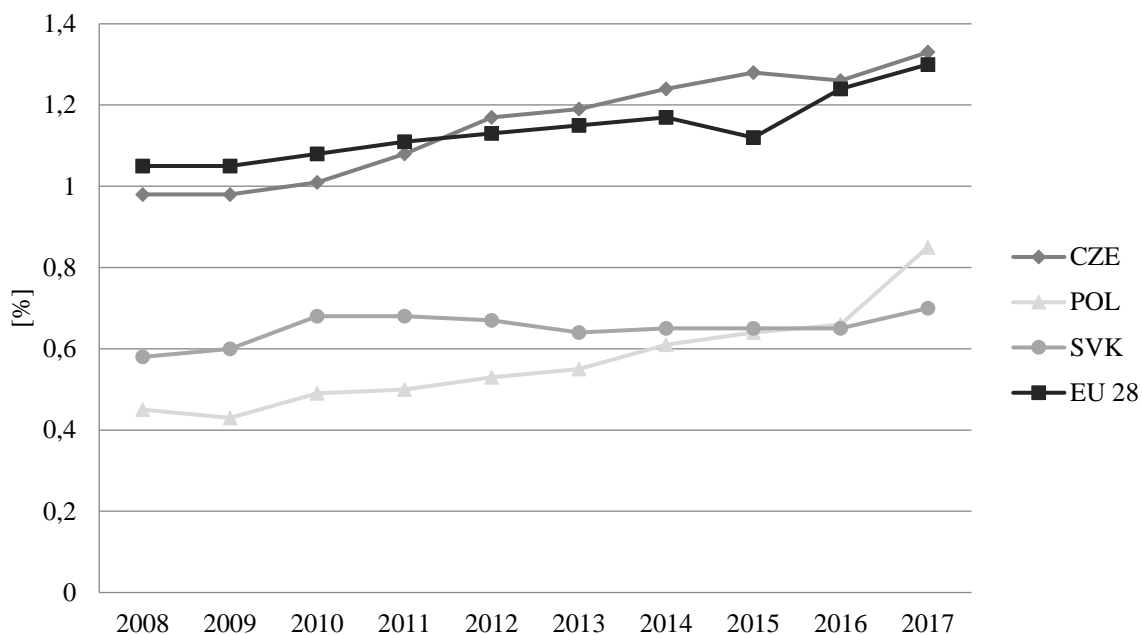


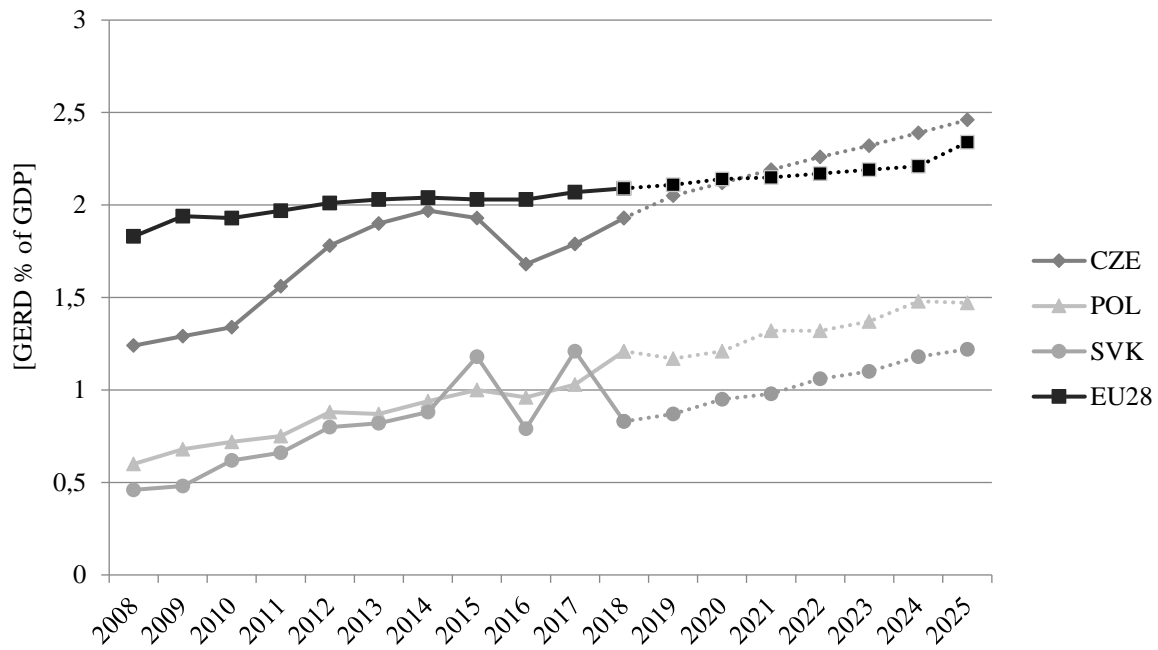
Figure 1. Share of innovation-active enterprises by implemented types of innovations.

The last decade has shown a systematic increase in staff involved in research and development (fig. 2). The largest share of researchers and creators is in the Czech Republic. In 2017, they accounted for 1.33% of the total labor force and it was more by 0.03% than in the EU. A much smaller share of scientists among the total workforce was recorded in Poland and Slovakia - 0.85% and 0.7% respectively. It is worth noting, however, that until 2014 the share of R&D staff in the total workforce was higher in Slovakia than in Poland, and in 2015-2016 was the same. Despite this, both Poland and Slovakia must definitely intensify their activities in the field of increasing R&D staff to match the EU average and the Czech Republic. Therefore, a challenge awaits the governments of these countries to create conditions for acquiring new staff, as well as to open development opportunities for young scientists.



**Figure 2.** Total R&D staff as a% of total workforce and total employment.

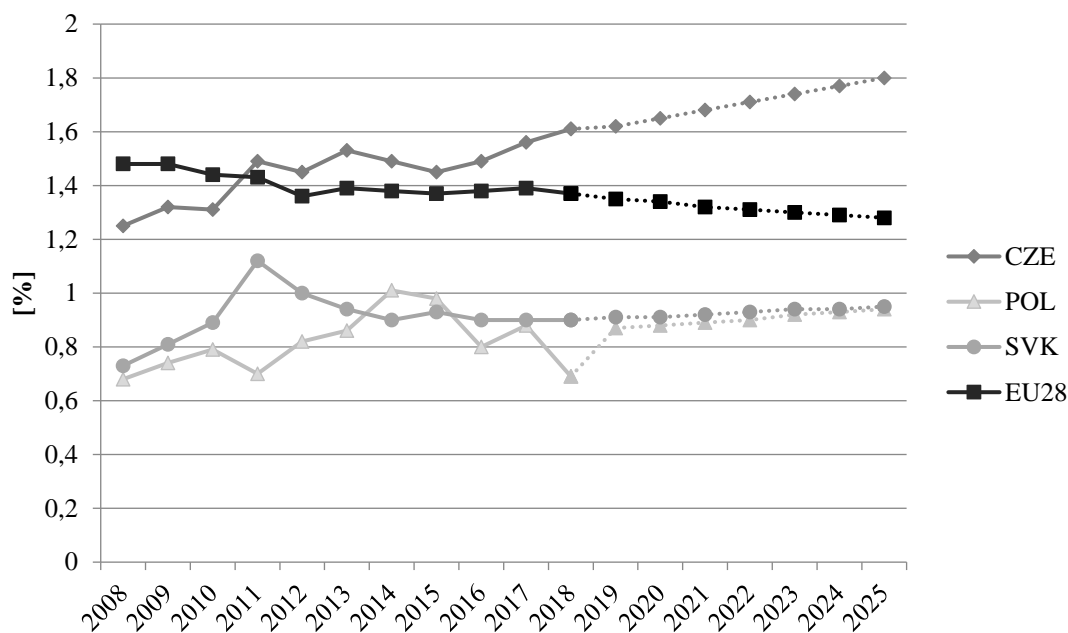
As indicated in the previous chapter, one way to measure the innovation of a given country is by researching expenditure on research and development. The graphical analysis below (fig. 3) shows the relation of gross domestic expenditure on R&D, which is distributed similarly to the structure of innovation-active enterprises, as well as the number of employed R&D personnel. In the period 2008 - 2018, these expenditures are steadily increasing, and the highest are in the Czech Republic. In 2008, 1.24% of GDP was allocated to R&D. After a decade, these expenses increased to 1.93% of GDP. In the case of the Czech Republic, there was a slight decrease in these expenses in 2015-2017. In Poland, these expenses have doubled over the decade from 0.6 to 1.21% of GDP and are 0.4% higher than in Slovakia. However, since 2015 quite significant fluctuations of these expenses have been noticed by about 0.4%. Despite this, expenses in the countries surveyed are lower than the EU average, which in 2018 was 2.09% of GDP. Based on the results to date, a forecast has been made of the ratio of gross domestic expenditure on R&D (GERD) to GDP by 2025. As can be seen from the chart below, in these countries these expenses will increase successively. However, only in the Czech Republic these expenses will exceed the average of 28 EU countries. Despite this, in both the countries surveyed and the EU, forecasts until 2025 do not predict that R&D expenditure will reach at least 3% of GDP. Therefore, further actions of all interested parties (enterprises, scientific units, government and EU) are needed to achieve the planned minimum expenditure on R&D.



**Figure 3.** Relation of gross domestic expenditure on R&D (GERD) to GDP in% in 2008-2018 together with the forecast for 2019-2025.

To increase the country's innovativeness, governments of individual countries allocate budgetary resources to R&D activities (fig. 4). The most funds for innovative activities are transferred by the Czech government, as in 2018 1.8% of the budget was allocated to research and development. This result was better of over 0.4% than the EU average and as much as twice higher than the share of budget funds for this activity in Poland. The least amount was allocated to financing innovative activities in Slovakia - 0.69%. It is worth noting that in the Czech Republic and Poland the share of budget funds for R&D has been systematically increasing in the last decade. In Slovakia, by contrast, it increased until 2013, and has been steadily decreasing since 2014. On the other hand, averaging the data for all EU countries, a systematic decrease of budget expenditure for this type of activity is noted. It caused that the Czech authorities spend more funds on R&D than on average 28 EU countries. On the basis of the presented data, expenditure forecasts in individual countries until 2025 have been made. According to the forecast, expenditure on R&D in the Czech Republic will systematically increase, and thus will be significantly higher than the average expenditure in the EU, as it will systematically decrease. Similarly, R&D expenditure is forecast to increase at least until 2025 in Poland and Slovakia, which will bring the indicator closer to the EU average.





**Figure 4.** Share of budget funds for research and development (GBAORD) in the years 2008 - 2018 together with the forecast for the years 2019 – 2025.

In order to increase innovation as quickly as possible, the governments of individual countries use incentives for entrepreneurs to increase expenditure on innovation activities. Entrepreneurs can apply tax reliefs in the form of deductions for R&D expenses, employment of research staff, purchase of modern technologies, patents, computer programs, etc. It was the Czech government which has provided entrepreneurs with the opportunity to apply tax reliefs as a first one and for the longest time. In this country, the alleged tax relief rate is between 0.20 and 0.23 (table 1). In Poland, on the other hand, the possibility of applying tax breaks on expenditure on innovation exists only since 2017. Initially, the supposed relief rate was at level of 0.10, and in 2018 it increased to 0.22. In Slovakia, in turn, entrepreneurs can apply R&D tax reliefs from 2015. At that time, the supposed relief rate was at the level of 0.11. In 2018, a discount of 0.28 was allowed. The authorities of all countries declare that similar concessions in this respect will be maintained in the following years, thanks to which it will be possible to accelerate the growth of innovativeness of a given country and get closer to the most developed EU countries.

**Table 1.** Alleged rates of tax relief on R&D expenses.

State	Company size	2008	2010	2015	2017	2018
Czechia	MŚP	0,23	0,20	0,21	0,21	0,21
	DP	0,23	0,20	0,21	0,21	0,21
Poland	MŚP	-	-	-	0,10	0,22
	DP	-	-	-	0,10	0,22
Slovakia	MŚP	-	-	0,11	0,10	0,28
	DP	-	-	0,11	0,10	0,28

By analyzing the number of ownership rights granted for patents and utility models, we can determine the dynamics of growth or decrease in innovation in a given country. In case of the Czech Republic and Poland, the number of granted rights has increased in the last decade (table 2). In case of Slovakia, only the number of allocated rights for utility models increased. In case of patents, in 2018, five times less rights were granted than in 2008. It is also worth noting that in the Czech Republic there

are definitely more rights granted for utility models than patents. A similar phenomenon began to occur in 2011 in Slovakia. In Poland, the number of patents granted invariably exceeds the number of granted utility models.

**Table 2.** Patents and protection rights granted for utility models.

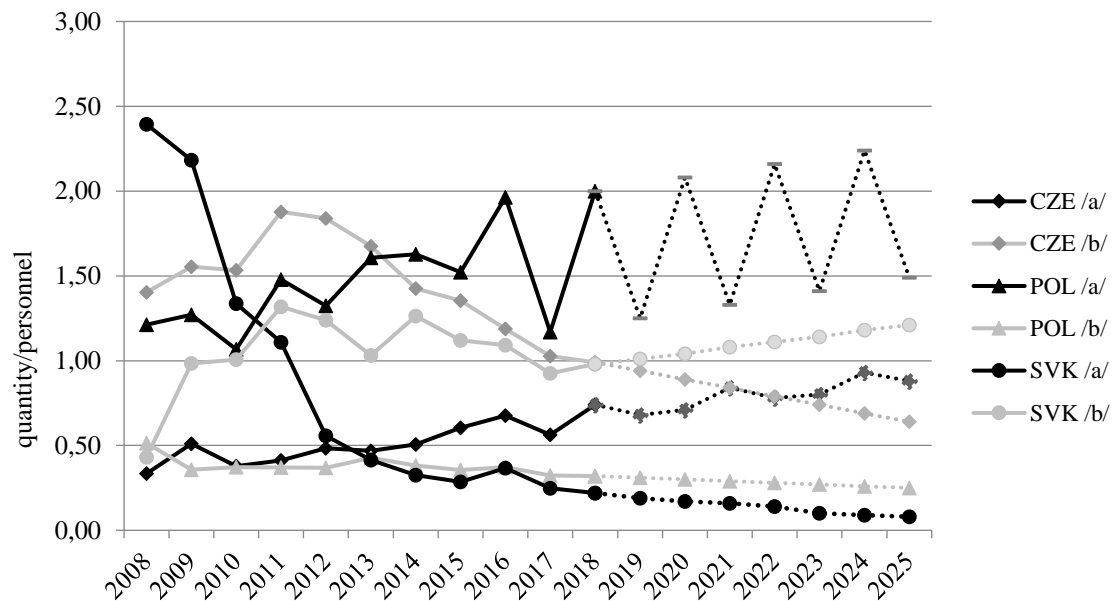
State/ year	Czechia		Poland		Slovakia	
	/a/	/b/	/a/	/b/	/a/	/b/
2008	249	1046	1451	616	566	102
2009	387	1178	1536	431	554	250
2010	295	1194	1385	484	376	283
2011	339	1545	1989	498	317	377
2012	423	1609	1848	514	161	358
2013	435	1552	2339	621	115	287
2014	493	1388	2497	586	94	364
2015	605	1356	2404	562	82	322
2016	676	1187	3370	638	122	363
2017	606	1107	2795	776	82	307
2018	507	1130	2906	769	109	337

a - patents

b - protection rights for utility models

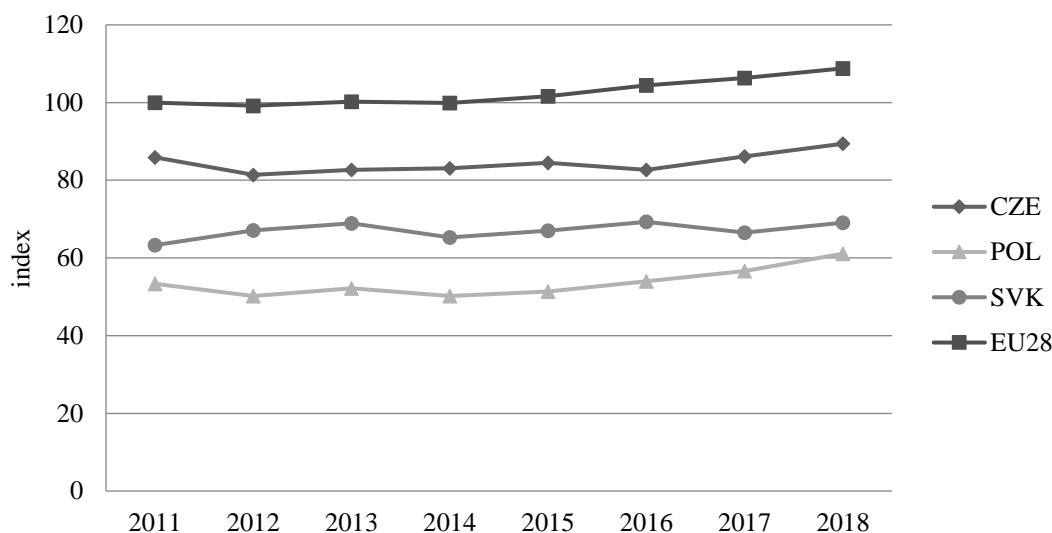
In order to compare the level of innovation between given countries on the basis of the number of ownership rights granted, we should refer to the selected variable, which will allow to illustrate these relationships. Figure 5 shows the number of patents and utility models granted per employee employed in R&D. In the context of patents, the largest decrease was recorded in Slovakia. In 2008, 2.4 patents were granted for one employed in R&D. At the time, it was the highest number of rights granted per researcher in the examined countries. During the decade, the number of patents granted per researcher fell to 0.25, which put Slovakia in last place. However, in the case of utility models, the statistics look slightly better, because in ten years the number of utility models granted has been doubled from 0.43 to 0.92 per researcher. In the Czech Republic, the number of patents obtained per employee employed in R&D in the last decade has increased from 0.33 to 0.56. Although the number of utility models obtained exceeds the number of patents obtained, a slow decrease of the number of utility models obtained per person has been recorded since 2008. This is probably due to the increase in the number of employees in research. In turn, in Poland, in the case of patents, the upward trend continued in the years 2008 - 2016. The number of patents granted per person increased from 1.21 to 2. Unfortunately, in 2017 there was a significant decrease of this indicator to the level from the beginning of the analysis. A smaller number of obtained patents contributed to this, as well as an increased number of employees in R&D. In the case of rights obtained for utility models, a downward trend can be observed. Therefore, comparing the examined countries, the most patents were granted per person in Poland, followed by the Czech Republic and the least in Slovakia. In the case of utility models, the Czech Republic is the leader, followed by Slovakia and Poland.

Based on the above data, forecasts of the trend of obtained patents and utility models in the analysed countries were created. The best forecast is in terms of obtaining patents by R&D staff in Poland and the Czech Republic. Despite the annual fluctuations, in Poland in 2024-2025 one scientist should be granted about 2 patents a year, while in the Czech Republic less than one. It will be different in Slovakia, as the number of patents granted will be systematically decreasing. However, the number of utility models will grow steadily, and in 2025 one scientist can be expected to average 1.2 designs a year.



**Figure 5.** The number of patents and protection rights granted to domestic entities for utility models per one employed in R&D in the years 2008 - 2018, together with the forecast for 2019 - 2025.  
a - patents  
b - protection rights for utility models

Based on the methodology for assessing the innovativeness of countries developed by the European Commission, it is possible to compare innovation indicators presented in the European Innovation Scoreboard (fig. 6). The highest innovation rate in the analyzed period was recorded in the Czech Republic. An upward trend in the overall ratio can also be seen from 85.9 in 2008 to 89.4 in 2018. Slovakia is second in terms of innovation, which also has an upward trend. In 2008 this indicator was at the level of 63.3 and increased over the decade to the level of 69.1. Poland is the least innovative country. Despite the upward trend, Poland failed to achieve even the lowest innovation rate of Slovakia in earlier years. In 2018, this ratio was 61.1. All three countries have significantly lower indicators than those specified for the EU average. In EU countries, this indicator also has an upward trend and in 2018 amounted to 108.8. This state of affairs is probably due to the fact that the vast majority of the EU are countries with longer membership years, and thus more economically developed. In these countries, the authorities allocated much more funds to innovation than in the Czech Republic, Poland and Slovakia. However, the decisive inflow of EU funds, which is, among other things, to support entities to increase R&D activities will contribute to reducing disparities between the surveyed countries and the entire EU. In addition, further reforms in higher education, research and development, as well as maintaining a favorable innovation policy should be made. Poland faces a special challenge, which stands out not only from the EU average indicators, but also from the countries studied in the publication.



**Figure 6.** Innovation indicators of the European Innovation Scoreboard of the surveyed countries against the background of the EU.

## 5. Conclusions

In the last decade, the R&D sphere in the Czech Republic, Poland and Slovakia as well as the entire European Union has undergone significant transformations. The presented data indicate an increase of the level of innovation of individual countries. The number of employed R&D staff is systematically increasing. The biggest number of these people are in the Czech Republic and the least in Slovakia. Financial expenses on research and development is rising similarly. An analysis of financial expenditure on R&D per GDP has shown that the most is spent in the Czech Republic, and it is not much less than average expenditure in the entire EU. Nearly half the expenditure is spent on research in Poland and Slovakia. As EU expenses are above 2% of GDP, many more steps still need to be taken to achieve the planned minimum R&D expenditure of 3% of GDP. One of such activities is the possibility of applying reliefs on innovative activities. The Czech government introduced the relief at the earliest, and the Polish government the latest. The number of acquired property rights for patents and utility models is increasing successively. However, the dynamics of this growth is definitely too low, because the increasing number of R&D personnel means that the number of patents and utility models obtained per one employed in R&D slowly decreases. Based on the European Innovation Scoreboard, the average innovation indicator calculated on the basis of 27 components indicates that the Czech Republic is the most innovative country. Next, Slovakia and Poland were the worst, which can be said to be the least innovative country. Despite the fact that the Czech Republic exceeds Poland and Slovakia in practically all innovation indicators, this country is still less innovative than the European Union.

Forecasts made regarding the ratio of gross domestic expenditure on R&D to GDP, the share of budget funds for research and development (GBAORD) and the number of patents and protection rights granted to domestic entities for utility models per one employed in R&D showed that the indicators in most cases they will have an upward trend. However, these increases will be so small that by 2025 the assumed indicators will not be achieved at a satisfactory level. The 4.0 industry concept is also important, as it has a significant impact on the use of modern technologies. However, entrepreneurs approach this topic with great caution, changes in this area are implemented slowly, which is why the concept of industry 4.0 has a relatively small impact on improving the indicators of innovation in individual countries.

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# Verification of Earnings Management in Slovak Enterprises using Teoh, Welch and Wong model

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**Abstract:** Earnings management involves management's ability to influence whether to manipulate reported earnings through accounting methods. Earnings is a profit for businesses and are, therefore, a major indicator for both internal and external users of financial information. Using reported earnings, internal and external entities can assess the financial health of a particular business. The main reason why companies use earnings management, i.e. earnings manipulation, is to achieve predetermined earnings values and thus to present the positive financial situation of businesses to the outside. This paper focuses on the verification of the existence of earnings management in the Slovak Republic in 2015-2017 by applying the model of the authors Teoh, Welch, and Wong. We apply the model to a set of Slovak companies in three ways, using the discretionary accrual and its estimation, assessing the occurrence of earnings management and determining the direction, degree or extent of earnings management. Our goal is to find out whether earnings management occurs in companies in the Slovak Republic and whether Slovak companies manipulate their earnings downwards or upwards. In our research, we use the modeling method, comparison method, and statistical analysis.

**Keywords:** discretionary accrual; earnings; earnings management; earnings management detection

**JEL Classification:** M4

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## 1. Introduction

Earnings management is a much-debated topic in the world of finance, which is influenced by many factors and circumstances. In the literature, many authors address various topics related to earnings management that are related to the current market situation, such as why managers influence earnings, which factors can influence the managerial decision to choose earnings management, how they effectively measure manipulation or how the concept is defined.

Earnings is a profit for businesses and are, therefore, a major indicator for both internal and external users of financial information. Earnings is a topical issue in today's business world and provide a specific perspective on the company's financial situation. (Jakoubek and Brabenec 2012) Using reported earnings, internal and external entities can assess the financial health of a particular enterprise. (Valaskova et al. 2018a) Many entrepreneurs are still very cautious in predicting the future financial health of the enterprise. (Siekelova et al. 2015) The ability to accurately predict business failure is a very important problem in financial decision-making, (Šuleř 2017) while inaccurate forecasts can be misleading by external entities and weaken their credibility in the business. (Wawryszuk-Misztal 2017) At the same time, earnings are an important item of financial statements designed to present a true and fair view of a company's financial performance. (Weissova et al. 2015) Businesses with higher earnings are therefore more attractive to external entities than businesses with lower earnings. The main reason why companies use earnings management, ie earnings manipulation, is to achieve predetermined earnings values and thus to present the positive financial situation of businesses to the outside.

### *1.1. Definition of earnings management*

There are different perspectives on earnings management in the literature. By Siregar and Utama (2008) earnings management represents a complex process involving the accounting judgment that underlies not only the income statement but also the other financial statements and related disclosures. Earnings management signals managers' motivation to increase company value. (Di and Marciukaityte 2015) According to Callao, Jarne, and Wróblewski (2014), earnings management is a purposeful intervention in external financial reporting, to reach earnings targets, by varying the accounting practices. This activity is realized without violating accounting regulations, and it can, but won't necessarily, mislead stakeholders into believing certain financial information. Earnings management refers to companies' strong incentives to use judgment in financial reporting and in structuring transactions to alter financial reports". (Burgstahler and Dichev 1997) Linck et al. (2013) explain that reducing the company's financial limitations may be the aim of the earnings management, because of obtaining higher external capital. (Sosnowski 2017) Another author describes earnings management as the manipulation of accounting numbers within the scope of generally accepted accounting principles (GAAP). (Dechow 1994)

### *1.2. Detection of earnings management*

Earnings management detection is based on accruals. Dechow and Skinner (2000) submits that the accrual is used to reduce irregularity in the undertaking that was recognized at another time. Beneish (1999) explains that the use of accrual techniques is less visible in businesses and therefore the difficulty of detecting them or comparing them to the actual transactions in the business is higher.

In the literature related to earnings management, we distinguish between discretionary and non-discretionary accruals. Non-discretionary accrual is proposed on management by GAAP/IFRS and in the discretionary accrual, managers can manage earnings because they have flexibility in making accounting choices. (Shahzad 2016) The estimated value of discretionary accruals can achieve positive or negative numbers because the manipulation of financial statements can be directed towards achieving the desired management objectives. (Bešlić et al. 2015) Another of the authors explain that discretionary accruals are mainly conducted in the interval between the end of an exercise and the period of publication of the financial statements. (Cupertino et al. 2015) Another author explains that the discretionary accrual represents a reserve of non-compulsory expenditure that has not yet been incurred but is nevertheless recorded in the books while the non-discretionary accrual represents pre-booking of an obligatory expense that has yet to be realized, but is already recorded in the enterprise's accounting records. (Chang et al. 2019)

There are several various earnings models focused on the measurement and detection of earnings management. (Valaskova et al. 2018b) In our analysis, we focused on verifying the existence of earnings management in Slovak companies using the model of authors Teoh, Welch, and Wong, which we found out from the previous analysis as the most suitable earnings model in the Slovak Republic.

## **2. Methodology**

We use the Amadeus financial database to obtain the data needed to carry out our research. The total number of businesses generated by the Amadeus financial database is 21,084,937 businesses. A total of 260,429 businesses were generated within the Slovak Republic. The initial selection of Slovak companies is based on criteria related to defining the range of values for financial items such as sales, total assets, and profit. After applying these criteria, the scope of Slovak enterprises decreased to 2,769 companies. Subsequently, we select Slovak enterprises according to whether they are still existing or canceled enterprises and also according to their ownership, where we include private domestic enterprises, private international enterprises, and private foreign enterprises. In this selection, we also exclude Slovak companies with missing data from the analysis. The result of this selection is to reduce the size of enterprises to 2,330 Slovak enterprises. Lastly, we apply extreme values reporting when selecting a sample of Slovak companies. We test extreme values by applying a Z-score method that takes into account two parameters, the standard deviation, and the mean. Extreme values are those

which exceeded the value 3. After applying all the above criteria, the total set of 2,155 Slovak enterprises in the period of three years 2015-2017.

To verify the existence of earnings management in the conditions of the Slovak Republic, we apply a modeling method using which we propose the application of Teoh, Welch and Wong model in Slovak companies. Using statistical analysis, we estimate the discretionary parts of accruals of a selected set of Slovak enterprises. To assess the existence of earnings management in Slovak companies, we use a comparison of the values of the discretionary accrual of the fictitious file with the values of the discretionary accruals of the file we selected with the Slovak companies. We used a nonparametric Mann - Whitney test to compare both sets. To determine the direction, degree, and extent of earnings management in the Slovak Republic, we use the method of comparing percentages and average values of discretionary accruals.

### 3. Results and Discussion

Our analysis includes the discretionary accrual and its estimate, the assessment of the existence of earnings management of Slovak companies and the direction, determination of the degree or extent of earnings management.

#### 3.1. Discretionary accrual and its estimation in the Slovak Republic

As the first method of applying the model of the authors Teoh, Welch, and Wong, to the group of companies we selected, we chose the estimate of the discretionary accrual. Based on the regression analysis, we estimated the discretionary parts of accruals for each Slovak enterprise in our selected set of enterprises, through which we can interpret the prediction error of the model. We then proceeded to the quantified descriptive characteristics of the estimated individual discretionary parts of the accruals, which are summarized in Table 1 below.

**Table 1.** Discretionary parts of total accruals and their descriptive characteristics.

<b>Descriptive characteristics</b>	<b>Discretionary accrual in 2015</b>	<b>Discretionary accrual in 2016</b>	<b>Discretionary accrual in 2017</b>
Average	-0.078290	-0.045852	-0.046536
Standard deviation	0.342316	0.165296	0.163556
Median	-0.036272	-0.031271	-0.031938

In 2016, the average value was -0.045852. In 2017 there was a slight change and the average value fell to -0.046536. In 2015, the average value was the lowest at -0.078290. Based on the above data, we can see that the average values in 2015-2017 are negative. These negative values are an indicator of the downward management of earnings by our selected set, which means that they are trying to manage earnings by reducing it. The highest standard deviation was recorded in 2015 at approximately 0.342316. In the following years, the value of the standard deviation decreased. In 2016, the standard deviation was 0.165296 and in 2017 it reached 0.163556. In 2015, the median value was -0.036272. In 2016 the median value reached -0.031271 and in 2017 the median value was -0.031938.

#### 3.2. Verification of the existence of earnings management in the Slovak Republic

The second way of applying the model of authors Teoh, Welch and Wong is to assess the existence of earnings management within Slovak companies. To assess the existence of earnings management, we have created a fictitious file. We created this fictitious set in the absence of earnings management (the values of discretionary accruals are equal to mule or close to zero). Creating a fictitious file serves us to assess the differentiation of the values of the discretionary accruals of the fictitious file with the values of the discretionary accruals chosen by the file with Slovak companies. If this differentiation is high, then the companies in the Slovak Republic in our sample tend to manipulate earnings. However, if the differentiation is low or zero, earnings manipulation by Slovak companies in our sample does



not occur. We applied the Mann - Whitney test to compare both sets. This is a non-parametric test that does not assume a normal distribution of characters in the file. In hypothesis testing, we chose the null hypothesis (H0) and the alternative hypothesis (H1). The null hypothesis (H0) assumes that companies in the Slovak Republic do not manipulate earnings. The alternative hypothesis (H1) assumes that companies in the Slovak Republic manipulate earnings. Which of the two set hypotheses we accept and which we reject by comparing the p-value and the significance level ( $\alpha = 0.05$ ). The following table provides an overview of the results of the Mann Whitney non-parametric test over three years.

**Table 2.** Overview of Mann-Whitney test results.

Parameter	Period		
	2015	2016	2017
Significance level	0.05	0.05	0.05
p-value	< 0.0001	< 0.0001	< 0.0001
Hypothesis accepted	H1	H1	H1
Decision	Earnings manipulation	Earnings manipulation	Earnings manipulation

Based on the data in the table, we can see that in the reporting period 2015-2017 the level of significance is higher than the p-value, indicating that in the reporting period 2015-2017 our analyzed set of companies has detected the existence of earnings management, that we have adopted an alternative hypothesis (H1) that shows that businesses are manipulating earnings.

### 3.2. Determination of the direction, degree, and extent of earnings management in the Slovak Republic

Verifying the existence of earnings management, although we found that businesses in the Slovak Republic manipulate earnings in 2015-2017, but based on these results we can not say with certainty whether earnings is manipulated by decreasing or increasing it, so we are the third way to apply the model Teoh, Welch and Wong chose to determine the direction, degree, and extent of earnings management. So, to determine the direction, degree, and extent of earnings management, we proceeded as follows. First, we calculated the percentage of discretionary accruals, positive and negative, because the discretionary accrual represents the manipulation of earnings by increasing and the non-discretionary accrual by decreasing. We have calculated the percentage over all three years and table 3 provides a brief overview.

**Table 3.** Expressing the percentage of discretionary accruals.

Discretionary accrual	Period			Average
	2015	2016	2017	
Positive DA	36.15%	36.01%	35.13%	35.76%
Negative DA	63.85%	63.99%	64.87%	64.24%

Based on the percentage of discretionary accruals, we can say that in the reporting period 2015-2017, when the existence of earnings management was found in all three years, the percentage of non-discretionary (negative) accruals is higher compared to the percentage of discretionary (positive) accruals. The percentage of non-discretionary accrual increased in individual years. In 2015, the percentage was 63.85%. In 2016, the percentage increased to 63.99%. In 2017, the percentage increased to 64.24%. Unlike the non-discretionary accrual, the percentage of the discretionary accrual developed in the opposite direction. In 2015, we recorded a percentage of 36.15%. In 2016, the percentage fell to 36.01%. In 2017, we recorded the lowest percentage of discretionary accrual at 35.13%. Comparing the percentage of discretionary accruals achieved, we can say that more than half of businesses in the Slovak Republic tend to manipulate earnings by reducing it because the percentage of non-discretionary (negative) accruals in each year is higher than the percentage of discretionary (positive)

accruals. Once we have determined which direction earnings are being manipulated, we determine the degree of earnings management, using the average value of discretionary accruals. The average values, expressed as a coefficient, are given in table 4 below.

**Table 4.** Average values of discretionary accruals.

Discretionary accruals	Period			Average
	2015	2016	2017	
Average value +DA	0.100930	0.095027	0.088535	0.094831
Average value -DA	0.179752	0.125129	0.119675	0.141519
The difference value	-0.078823	-0.030102	-0.031140	-0.046688

From table 4, we can see that the average value of the discretionary (negative) accrual in 2015 is higher than the average value of the discretionary (positive) accrual. When we compare the average values of discretionary accruals in 2016, we see that the average value of the discretionary (negative) accrual is again higher than the average value of the discretionary (positive) accrual. There was no change in 2017, which suggests that in each year the manipulation of earnings by decreasing it is more obvious than manipulating earnings by increasing it. Once we have determined the direction and degree, we can determine the extent of earnings management. To determine the extent of earnings management, we use average values and percentages of individual discretionary accruals. The results are presented in Table 5 below, where the individual coefficient values were calculated by multiplying the average value of the discretionary accruals and the percentage of these discretionary accruals.

**Table 5.** Discretionary accrual as an indicator of the extent of earnings management

Scope of discretionary accrual	Period			Average
	2015	2016	2017	
Scope of positive DA	0.036485	0.034218	0.031100	0.033934
Scope of negative DA	0.114775	0.080071	0.077636	0.090827

Based on the data from table 5, we can see that the range of positive discretionary accrual in 2015 is lower than that recorded in 2016. In 2017, the range of positive discretionary accrual changed slightly to 0.031100. The extent of discretionary negative accrual has changed in the individual years 2015 - 2017, but in all three years, it reached a higher level than the scope of discretionary positive accrual and therefore, according to the scope of earnings management, companies manipulate their earnings by reducing it. Taking into account the average range of discretionary accruals, we can see that the range of non-discretionary negative accruals is higher than the average range of discretionary accruals, with the result that businesses in our analyzed sample in 2015-2017 manipulate earnings by reducing it.

#### 4. Conclusions

This paper was focused on verifying the existence of earnings management in the Slovak Republic by applying the model of Teoh, Welch, and Wong. We used the discretionary accrual and its estimation as the first way to apply this model, we further verified the existence of earnings management using the non-parametric Mann Whitney test and finally, we determined the direction, level and extent of earnings management in the Slovak Republic. The final finding was that the companies in our analyzed sample in the conditions of the Slovak Republic manipulate the earnings downwards, ie by decreasing it in all three years of the monitored period 2015 -2017. The aim of our research was fulfilled, as the results of the research confirmed the existence of earnings management in Slovak companies, which further enabled us to find out the extent, degree and direction of earnings management in the Slovak Republic. The reasons for the implementation of earnings management and their impacts on companies in the Slovak Republic are the subject of future research.

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# Stress Load of University Students in Terms of Health Economics

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**Abstract:** The aim of the study is to clarify the causes and consequences of stress factors of the young people's current lifestyle in the period of adolescence. The authors proceed from the theoretical background of the fields of health economics, psychology of health, psycho hygiene, psychosomatic and behavioural medicine. The research part is based on the evaluation of their own research conducted in 2011 - 2018 among more than eighteen hundreds of university students. The methodology of the research was based on the questionnaire survey in which the rate of ability to cope with stress-load situations was being found out. We focused on three ways of handling stress factors, malcoping practices evoking negative emotions (33.6%), health damaging ways of behaviour (24.9%) and coping strategies which represent a healthy management of stress stimuli (58.5%). The research has shown that the differences between individual stress handling techniques are statistically significant. In the vast majority of cases, the measured values of healthy stress management methods outweighed the values of other less suitable methods of dealing with stress. Thus, positive coping strategies of behaviour in stressful situations prevailed significantly over negative malcoping strategies in the surveyed sample of respondents. The research thus confirmed a considerable increase in students' adaptation skills throughout their university studies.

**Keywords:** health economics; psychosomatic medicine; university students; stress factors; coping and malcoping strategies

**JEL Classification:** I120; I110; I150

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## 1. Introduction

The studied areas, that are the subject of our empirical research, belong to the field of health economics, psychohygiene, psychosomatic medicine, behavioural medicine and psychology of health. When we consider the differences between these fields, health economics deals with the objective determinants of health relating to lifestyle and the quality of life, while psychohygiene deals with the principles of mental health. Psychosomatic medicine is based on the assumption of the psychogenic origin of diseases and was influenced significantly by psychoanalytic solutions and the theory of stress findings. Behavioural medicine emphasizes the use of behavioural analysis in the way of diagnostics, treatment, prevention and rehabilitation of diseases. In contrast to the aforementioned fields, psychology of health, despite the interdisciplinary nature of its focus, remains a psychological discipline that seeks to apply the results of psychological knowledge in relation to health (Kebza 2005).

One of many studies has focused on individuals that are the most resistant to stress and do not show signs of emotional or physical weakness even in severe stress situations (Kobasa 1979; Maddi 2006). This attribute is referred to as *hardiness*. Hardiness has two components: the determination to *engage* in the struggle against difficulties, the ability to perceive difficulties as a *challenge* and the ability to see *possibilities* how to influence the development of situations. Highly committed individuals believe that it is important to be interested in events and people, no matter how demanding and stressful the circumstances are. People determined to manage the course of their lives do not give up the conviction that they can influence the situation despite obstacles. Individuals who consider obstacles to be challenging perceive stress as a normal part of their life and as an *opportunity to learn, develop and gain wisdom*. Hardiness is therefore one of the prerequisites for better physical and mental

health. The personality of resilient individuals resistant to stress, is characterized by determination, control and challenge. These properties are linked to the factors that affect the perceived intensity of stressors. For example the feeling that a person is in control of his/her life reflects the trust in his/her own abilities and also affects the evaluation of stress events. The challenge also includes cognitive assessment and the opinion that the change is a common part of life and that it must not be seen as a threat but as an opportunity for growth.

Emotions and psychological activation caused by stressful situations are very uncomfortable and one is motivated to do something to alleviate this inconvenience. The process by which a person tries to cope with stress states is called *coping*. It has two basic forms. The first option is to focus on a specific problem or situation and try to find a way of changing it or avoiding it in the future. This is called *problem-oriented coping*. Another option is to focus on relieving the emotions associated with the stressful situation, even if the situation itself cannot be changed. This procedure is called *emotion-oriented coping* (Lazarus and Folkman 1984). Most people use both approaches to manage situations with increased stress load.

## 2. Theoretical Background

### 2.1. Economics of health

The subject of study in the field of health economics are objective determinants, which can affect positively, but also negatively, the person's health or illness (Barták 2005). Beaglehole (in Detels et al. 2005, p. 83) presents four ways of looking at these determinants. He distinguishes a *biomedical* perspective, a *lifestyle-based* approach, a broad *socio-economic* approach and a *public-health* perspective.

In addition to basic biological characteristics, health is a social and cultural concept and, according to Beaglehole, there are three basic sources of differences in human health. These are innate prerequisites, socio-economic life conditions and lifestyle, thus behaviour-related factors. These three areas concern gender differences as well as cultural and economic factors which also play an important role in determining the health of the population. Individual determinants are summarized by Beaglehole as follows:

- genetic determinants affecting approximately 20-25% of our health,
- social and economic determinants that include an individual's labour market position, working conditions and safety at work, education, housing and family conditions
- lifestyle and other behavioural determinants – they include eating habits (high or low fruit and vegetable consumption), smoking, alcohol consumption, self-care, social contacts and style of work
- male or female gender
- cultural determinants (e.g. in relation to older people)
- political determinants, which include the social and economic environment and health system
- global factors, especially environmental, which are related to the state of the environment and can affect human health

According to this concept we can see that a good health condition of a person is not only an individual matter but also a society-wide one. Health is a vital prerequisite for an individual's participation in social activities, enabling them to realize primary and secondary needs and thus to develop human and social potential.

### 2.2. Concept of health in psychological fields

The scientific discipline of *psychohygiene* is closely related to human health and, in particular, to disease prevention. It provides important principles that help to achieve mental health and mental balance. According to Křivohlavý (2001) mental hygiene means the care for optimal functioning of mental activity. In this sense, also the World Federation for Mental Health headquartered in Geneva defines its main role. It is the successor to the International Mental Hygiene Committee created by the extension of the Connecticut Society for Mental Health, founded as early as in 1908. Attention is paid

to interpersonal relationships, environmental regulation, changes in study and work conditions and principles of healthy living. One of the main areas of psychohygiene is *the art of relaxation*. There are various ways of easing mental or physical tension. Nowadays, anti-stress exercises are gaining in importance, combining the perception of movement with the perception of breath such as in yoga practices and Asian exercises. Psychohygiene also places great emphasis on interpersonal interaction, realistic perception of others and interpersonal relationships. Various *methods of mental health diagnostics* can also be included in this field. They focus on the quality of life of an individual, life satisfaction and the state of vitality – the overall feeling of health. On the other hand, experiencing anxiety and depression states in connection with serious life problems can be mentioned. As Kebza states (2005) in the 20th century *psychosomatic medicine* brought a change in the view of the patient – looking at the patient as a mental and physical unity in the context of the environment. It implemented the basics of multicausal view of the relation between health and disease in medicine. Apart from other things, it introduced into medicine and psychology the research of personality profiles for particular nosological groups, description of intrapsychic conflicts and further developed the theory of stress.

*Behavioural medicine*, on the other hand, emphasizes the interaction of biological and behavioural factors. The basic methodological starting point here is a behavioural analysis, i.e. the detection of deviations from health which are related to human behaviour. This tradition of the comprehensive vision of the relationship between physical, mental and social factors in relation to health is now followed by *psychology of health*, understood as a systematic application of psychological knowledge into the area of health, disease and health care system (Kebza and Šolcová 2000).

### 2.3. Lifestyle-related stress

Current research shows that human behavioural patterns and the level of social conditions can significantly increase susceptibility to mental disorders or physical illnesses. For example, if a university student prepares for tomorrow's very difficult exam till late night, in fact, due to the lack of sleep, they endanger their performance during the exam itself (Wolfson 2002). In people who already suffer from cancer or cardiovascular disease, stress conditions can reduce the motivation to behave in a way that is beneficial for their recovery or survival (Schneiderman et al. 2005). Many people, for example, do not go to the doctor for medical checks or do not follow prescribed medication.

They ignore the diets that are vital for their health – e.g. some diabetics do not watch their sugar intake. Studies of people infected with HIV indicate that stressed patients are more likely to indulge themselves in unprotected sexual activities or use drugs intravenously (Fishbein et al. 1998). On the other hand, people with a healthy lifestyle – who have a low-fat diet, drink alcohol moderately, have enough sleep and exercise and have created a safe family background – they often report that they can handle even very difficult stress situations and have their lives under control (Ingledeu and McDonagh 1998). These approaches suggest that healthy behaviour patterns can alleviate the feelings of everyday stress and reduce the risk of a number of serious diseases.

Strong emotional movements affect human health, which has been shown by the closer examination of negative emotions – *anger, anxiety and depression* in connection with experiencing stress. The tendency to anger as a personality trait may hasten death at younger age more accurately than the presence of other risk factors such as smoking, hypertension or high blood cholesterol. Occasional manifestation of negative emotions does not represent any danger to human health. The problem arises only when animosity and anger last long enough to become the part of the character – then people are often cynical and distrustful, prone to sarcastic remarks and criticism, they are moody and have fits of rage. When it comes to unpleasant situations, it is necessary to learn to understand things also from other peoples' perspective – to learn *empathy*. The best remedy for enmity is to bring more trust in others into your heart. All we need is the right motivation. When people understand that their anger can lead to premature death, they are willing to try (Goleman 1997). Another negative emotion – anxiety – is an emotional response to excessive demands of current hectic lifestyle. The connection between this emotion and the onset of a disease is supported by very convincing scientific evidence. Repeated anxiety attacks are the manifestation of intense stress. The harmful effects of stress on human health are so damaging that *relaxation techniques* are beginning to be used to alleviate the symptoms of

a wide range of chronic diseases. It turns out that in melancholic seriously ill patients would be worthwhile to treat not only their physical disease but also their depression – pathological states of sadness. Depressed patients show unhealthy behaviour – they much less adhere to medical procedures and violate the prescribed diet.

The accumulating evidence of adverse effects of anger, anxiety and depression on human health is very serious. While negative emotions are harmful in many ways, positive emotions, on the other hand, can strengthen us. The favourable effect of positive emotions is very subtle, but through studies conducted on large numbers of people, this effect can be seen against the background of many other factors that affect the course of a disease. These are mainly positive emotions of *mutual trust, emotional support, understanding, consolation and hope awakening*. They are applied between a teacher and a student, between a doctor and a patient, between a coach and an athlete, between friends or close family members. Social isolation, i.e. knowing that you have no one to share your inner feelings with is doubling the probability of illness. The quality of our relationships and their number are therefore important factors for stress relief. A study of university students living together in one room at dormitory showed that the less they get on with each other the more susceptible they were to infectious diseases and more often they visited a doctor (Goleman 1997).

### 3. Methodology of Research

#### 3.1. Questionnaire survey

The method of our research was a questionnaire survey concerning the treatment of stress conditions in higher education. The research was adjusted to the needs of student population according to the previous survey among students of Faculty of Informatics and Management, University of Hradec Králové (FIM UHK) in accordance with the manual by Micková et al. (2004). The choice of research methods was professionally consulted with researchers from the Institute of Psychology of Masaryk University in Brno. The items of distributed questionnaire forms are listed below.

- SMA – Procedures evoking negative emotions (malcoping)
- SMB – Harmful (malcoping) ways of behaviour
- SMC – Coping strategies (healthy coping)

#### 3.2. Sample of respondents

A total of 1848 university students participated in the research in 2011–2018. The file consists of 2572 questionnaires (some respondents answered repeatedly). There were 910 men, 919 women and in 19 questionnaires the gender box was left blank. The average age of respondents was 20.11 years, with full-time students aged 20 on average and part-time (distant) students aged 26.57.

#### 3.3. Methods of statistical processing

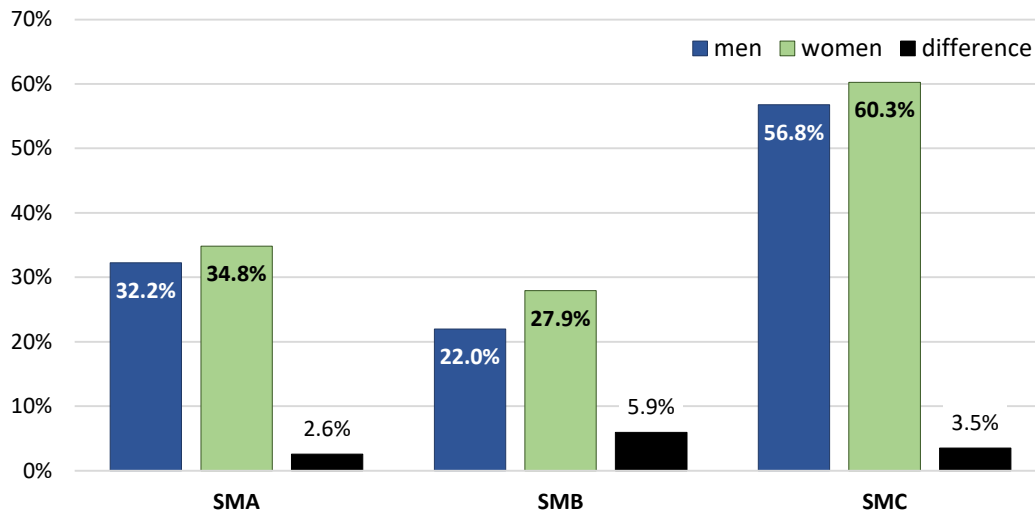
The differences in individual scales were tested by Mann-Whitney test. The result which did not exceed the significance level of 5% ( $\alpha < 0.05$ ) in this test was considered a statistically significant difference between two compared groups.

## 4. Research Results

#### 4.1. Differences from gender perspective

A statistically significant difference between men and women (Fig. 1) was seen in all three ways of dealing with stress situations. In harmful malcoping behaviours (SMB) women show less than 6% higher frequency of use than men. Nevertheless, coping strategies for healthy management of stress (SMC) predominate significantly in both genders, 56.8% in men and even 60.3% in women. Practices evoking negative emotions (SMA) have a similar representation in both genders, 32.3% in men and 34.8% in women.

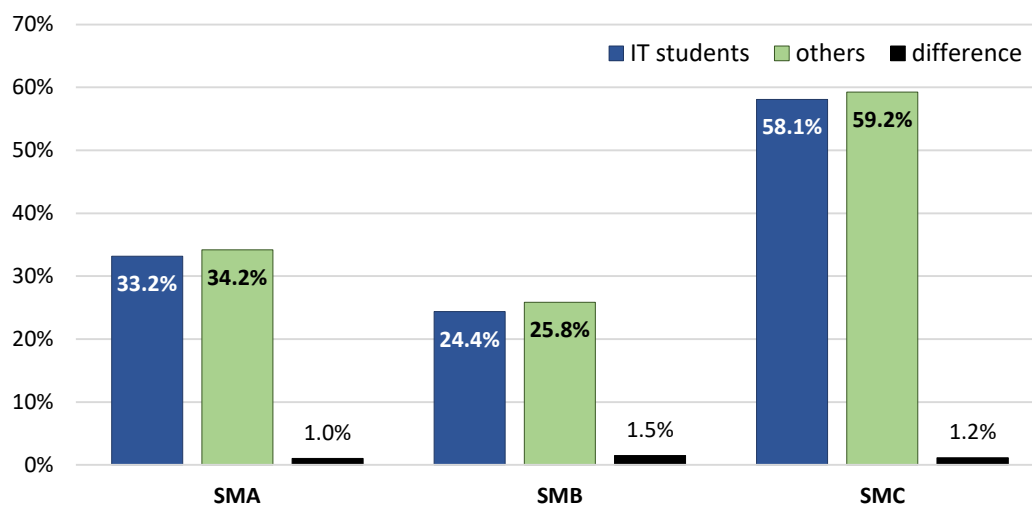




**Figure 1.** Differences from gender perspective.

#### 4.2. Differences between informatics and non-informatics fields of study

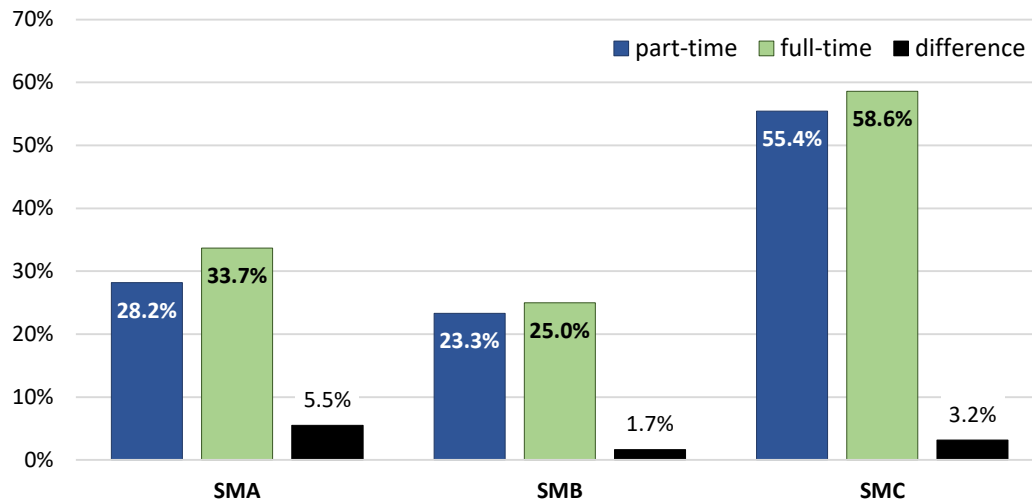
The closest to the limits of statistical weight are the ranges of procedures evoking negative emotions (SMA), where non-informatics students have higher score (34.2%) than informatics students (with 33.2%). A slightly higher difference between the two groups of respondents was shown in the area of healthy coping with stress situations (SMC), where non-informatics students achieved a 1.2% higher share than IT students (see Fig. 2).



**Figure 2.** Differences between informatics and non-informatics fields of study.

#### 4.3. Differences between part-time (distance) students and full-time students

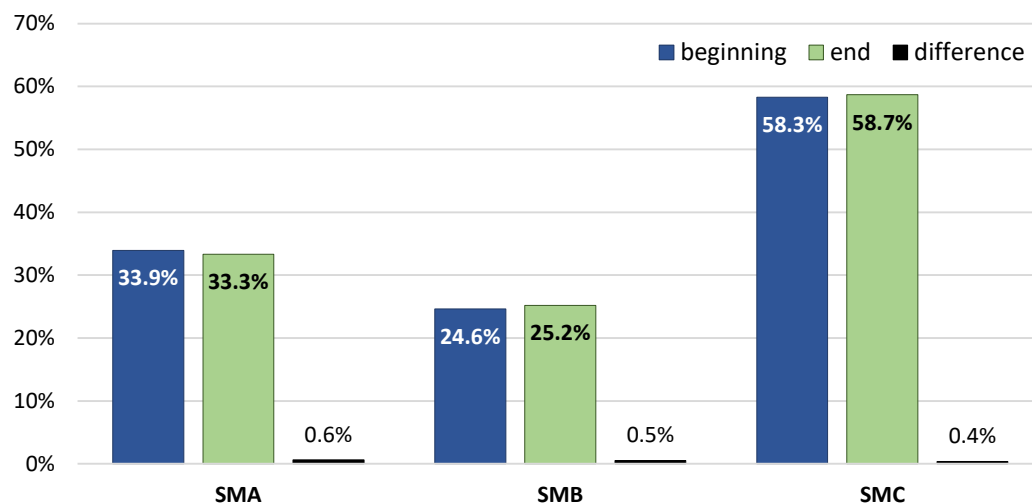
The biggest difference between part-time and full-time students (Fig. 3) was found in procedures evoking negative emotions (SMA), where full-time students showed 33.7%, which is 5.5% more than in part-time students. Also in the case of healthy methods of coping with stress factors (SMC), in general, the highest values were achieved by full-time students with 58.6%, i.e. 3.2% more than students of consultative form of study (55.4%).



**Figure 3.** Differences between part-time (distance) students and full-time students.

#### 4.4. Differences between beginning and end of semester

The ways of coping with stress situations at the beginning and the end of the semester (Fig. 4) remain approximately the same with minimal differences. The biggest difference (a drop of only 0.6% was seen in malcoping procedures that evoke negative emotions (SMA). Again, coping strategies (SMC) were the most commonly used stress management methods, both at the beginning and the end of the semester, with a positive finding that these healthy behaviours increased slightly at the end of the semester (by 0.4%).



**Figure 4.** Differences between beginning and end of semester.

#### 4.5. Stress management

The differences between individual ways of handling stress are statistically significant. In all four areas of investigation (see Fig. 1, 2, 3 and 4), the values of healthy ways (coping strategies) of stress management (SMC) are prevalent in the vast majority of cases. Healthy ways of dealing with stress situations thus prevail (58.5%) among university students over those that are health harming (see Fig. 5).

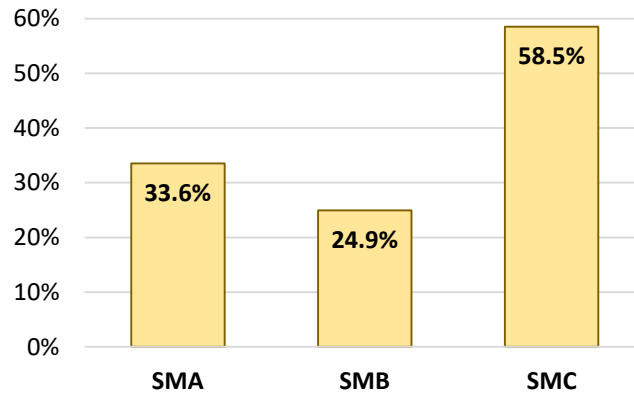


Figure 5. Differences between ways of dealing with stress.

#### 4.6. Relation between measured scales

From the statistical comparison of the studied scales by the factor analysis, principal axis factoring method with the rotation of rounds, two determining factors were identified in relation to coping with stressful situations. It is a factor of *hardiness* and *adaptability* (a degree of ability to adapt to new conditions). Both factors are correlated negatively (-0.284).

Table 1. Significant correlation of two latent factors to individual stress scales.

Factor	low hardiness	adaptability
SMA	0.800	
SMB	0.737	
SMC		0.300

These effects (see Tab. 1) are manifested by the fact that low hardiness contributes positively to the variables of the procedures evoking negative emotions (SMA), harmful ways of behaviour (SMB). High adaptability contributes positively to the variable which related to healthy coping (SMC).

## 5. Discussion

Our research has confirmed the interdisciplinary connection of the area of health economics and contemporary psychological branches – psychohygiene, psychosomatic medicine, behavioural medicine and psychology of health.

Consistent with the statements made by Ingledew and McDonagh (1998) it can be concluded that people with a *healthy lifestyle*, who eat low-fat meals, drink alcohol only moderately and have enough sleep and exercise, often report that they can manage stress events and have their life under control. This suggests that healthy behaviour can alleviate the feelings of everyday stress and reduce the risk of the occurrence of numerous serious diseases.

The research studies also confirmed the concept of positive and negative *stress management strategies* by the scientists Skinner, Edge, Altman and Sherwood (2003). People try to manage their negative emotions in many ways. Positive behavioural strategies include for example exercise and physical activity, seeking emotional support from friends. Negative strategies include alcohol and drug consumption, rage and aggressive practices. The example of a cognitive strategy is to temporarily postpone the problem and reduce the threat by changing the meaning of the situation, so called re-framing. Cognitive strategies often involve a complete reassessment of the situation and a change of attitude. As we can see, some behavioural and cognitive strategies are adaptive, purposeful and beneficial, others are maladaptive, harming us and causing additional stress. In accordance with the findings of Hallaraker, Arefjord, Havik and Maeland (2001) and Pakenham, Bursnall, Chiu et al. (2006) we can find the importance of seeking *emotional support from other people*, family members and peers.

Emotional support is a strategy that helps people adapt to the pressure of emotional and physical stressors.

We can confirm the data reported by Carano (2007) in his research that the *anti-stress influence of sport* on the psychological level lies in the mechanism of emotional re-tuning with good psycho-hygienic effects. The experience of joyful engagement, the so-called flow, has a harmonizing effect and is an expression of quality of life enhancement. Occupation and duties in everyday life lead to a build-up of tension, which is perceived as a worry. In sport, this unpleasant tension decreases. Through the unwinding process the adverse emotional tension is weakened and stress is thus reduced.

## 6. Conclusion

In terms of *fields of study* it has been proven that non-informatics students have a more hectic way of life and have to withstand higher demands of the current lifestyle than students of computer science. In both groups of students – full-time and part-time – *healthy ways of coping with stressful situations* significantly prevail (58.5% of respondents) over those that harm health. The research has confirmed *the increase in the degree of resilience and the growth of adaptive abilities* of university students with the increasing length of study. During the survey two determining factors were identified in relation to coping with stress situations. The first is *the factor of hardiness* and the other factor is *a degree of ability to adapt to new conditions*.

The empirical research described in this article was based on the assumption that body and mind interact. These issues are dealt with in the field of *health economics* and individual *psychological fields*. Simple models of stress effects on health are currently being replaced by more complex models that explain how the effects of *biological, psychological and social* impacts on health and diseases are mutually interconnected. As we can conclude from the mentioned research, the body responds to stress by characteristic physiological reactions. In people who do not have substantial biological resistance, such as those with genetic predispositions to a heart disease, physiological responses to stress can lead to deterioration in health. Nevertheless, the individual perception of stress is largely influenced by the nature of events, the individual's past, his/her assessment of events and the ways in which he/she usually copes with stress. Thus, the degree of experiencing psychological stress or deteriorating health in a stressful situation depends on the *biological and mental resilience of the individual* who finds himself/herself in the stressful situation. Due to the fact that the complex demands of everyday life often require flexible stress management, the ability of relaxation may not be sufficient in some stressful situations. Programs focused on coping with stress often combine biofeedback, relaxation training, exercise and techniques of cognitive modification.

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# Comparative Analysis of the Dynamics of Indicator Changes GDP per Capita in the Regions of Greece, Germany and Romania

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**Abstract:** Recently, the subject of economic development of regions has a special place in economic literature. In numerous studies we find many ways to measure this phenomenon using various indicators. In most of them, regional GDP per capita is the main and most commonly used measure for measuring economic growth and development of the regions of the European Union. Sometimes it is treated as the simplest synthetic measure of regional development or convergence processes. It was used in the text to verify the dynamics of changes (2008-2017) of the relative position of the regions of Greece, Germany and Romania in transition matrices for Eurostat data. The test is a continuation of the research carried out by the author for Polish, Bulgarian, Slovak, Lithuanian regions, and the results of which have been published. The researchers' approach allowed to verify the degree of diversification of the economic strength of the studied regions and to conduct a comparative analysis of the dynamics of changes in the general distribution of income and the location of the regions studied in the transition matrices for regions of selected countries (NUTS2).

**Keywords:** GDP per capita; regional development; quantitative methods; competitiveness

**JEL Classification:** R11; O11

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## 1. Introduction

Recently, many studies have been prepared on the economic development of the regions. (Muayedovich Kaziyev, Valer'yevna Kaziyeva and Yur'yevna 2018; Avram 2016). GDP per capita is an important indicator of economic growth, competitiveness and regional development of the regions of the European Union (Nadaud and Bouba-Olga 2019; Popescu 2017; Podstawka and Suchodolski 2018). As some authors note, competitiveness is measured by the GDP per capita indicator and "divided" into two components determining its level; which is labor productivity and the rate of economic activity of the population in the region - employment rate (Pietrzyk 2000). This means that for a region to be considered competitive it must have at the same time high productivity (and the associated high quality of employment) as well as sufficient number of jobs (Pietrzyk 2000).

Recently, the minds of researchers are dealing with the most difficult problem, which is the subject of many discussions, namely the problem of measuring regional development using GDP per capita (Surówka and Prędką 2016; Surówka 2019; Nadaud and Bouba-Olga 2019). By analyzing historical statistical data in dynamic terms, we observe that when it comes to interregional differences in indicators in the EU, they are (as is commonly known) very large in terms of both the absolute level and the rate of growth. Likewise, strongly differentiated was formation of the growth rate of components (productivity and employment) and even that in regions with a similar GDP per capita indicator (Nadaud and Bouba-Olga 2019). For example, in the Portuguese and Spanish regions similar in this respect, in the first case we had to deal with very low productivity (around 60% of the EU average compared to 90% for Spain) and a relatively high level of employment (Pietrzyk 2000). The opposite problem is observed for Spain, therefore the main challenge for Spain should be to increase the size of employment, and for Portugal the problem is to increase labor productivity. Observations, however, prove that in both countries the evolution is taking place in the right direction. Nevertheless, differences existing in both countries in relation to the EU average suggest that catching up in both cases will be a long-term process (Pietrzyk 2000; Badoiu Catalina 2017). The situation in Greece was

less favorable, where both productivity and employment levels are very low. Analyzing historical data, we note that in terms of the first indicator Greece, next to the Portuguese regions, is at the lowest level in the EU, but unlike Portugal, at the same time, it achieves a low growth rate. In addition, in many regions of the country the share of employees in the number of people of working age does not exceed 50% for all of Greece.

## 2. Methodology

Given the above, it is justified to develop new tools for shaping the examined trends (Muayedovich Kaziyev, Valer'yevna Kaziyeva and Yur'yevna 2018). An in-depth analysis of this phenomenon induced the author to attempt research on a given topic. The text analyzes the dynamics of changes in income distribution measured using GDP per capita for regions of selected European Union countries (Greece, Germany, Romania). The transition matrix was used as the research tool. As some authors note, most studies are limited to assessing and analyzing global trends and failing to distinguish between situations in which regions maintain their relative position; from situations where the overall distribution of income changes little, but the location of some regions changes significantly. In this case, individual regions may significantly differ from each other in their pace of development, even in periods when no convergence has been detected. As some authors rightly point out, the method that allows verification of these trends is the construction of a transition matrix, which makes it possible to track the relative change in position of regions over time (Lewandowski, 2011). Transition matrices were determined in the studying dynamic terms for the regions of Greece, Germany and Romania (2008-2017) (Surówka and Prędką 2016).

## 3. GDP per Capita as a Determinant for the Economic Development of Greece, Germany and Romania - Results of Empirical Research

Transition matrices are tools that express the frequency with which in the same period of time, regions from any income class remain in the same class or move to other classes. Diego Puga constructed a matrix of potential GDP per capita transitions in relation to the EU average, which analyzed changes in the location of regions between 1987 and 1995. The presented description of the method is only brief; more details can be found in the economic literature (Lewandowski 2011); (Surówka and Prędką 2016; Lai and Leone and Zoppi 2017). In the study, dynamic transition matrices were determined for the regions of Greece, Germany and Romania (2008-2017). The typologies of Greece regions according to their position in the designated transition matrices are presented in the table below (see Table 1). The presentation of results was preceded by an illustration of the administrative division of the countries studied on figures 1, 5 and 7.

**Table 1.** Table description include reference to its source if the figure does not come from your original research.

GDP per capita 2008	Number of districts	GDP per capita interval (national average)	GDP per capita 2009				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	8	0-0,6	1				
	3	0,6-0,75	0,33	0,67			
	0	0,75-1,00					
	0	1,00-1,3					
	2	1,3 +					1
		GDP per capita interval	0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
GDP per capita	Number of districts	GDP per capita interval (national average)	GDP per capita 2010				
			0,889	0,111			
	9	0-0,6	0,889	0,111			
	2	0,6-0,75	1				
	0	0,75-1,00					

2009	0	1,00-1,3					
	2	1,3 +					1
	GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,00-1,3	1,3 +
	<b>Number of districts</b>	<b>GDP per capita interval (national average)</b>	<b>GDP per capita 2011</b>				
<b>GDP per capita 2010</b>	8	0-0,6	1				
	3	0,6-0,75		1			
	0	0,75-1,00					
	0	1,00-1,3					
	2	1,3 +					1
	GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	<b>Number of districts</b>	<b>GDP per capita interval (national average)</b>	<b>GDP per capita 2012</b>				
<b>GDP per capita 2011</b>	8	0-0,6		0,889	0,111		
	3	0,6-0,75		1			
	0	0,75-1,00					
	0	1,00-1,3					
	2	1,3 +					1
	GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	<b>Number of districts</b>	<b>GDP per capita interval (national average)</b>	<b>GDP per capita 2013</b>				
<b>GDP per capita 2012</b>	7	0-0,6	1				
	4	0,6-0,75	0,5	0,5			
	0	0,75-1,00					
	0	1,00-1,3					
	2	1,3 +					1
	GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	<b>Number of districts</b>	<b>GDP per capita interval (national average)</b>	<b>GDP per capita 2014</b>				
<b>GDP per capita 2013</b>	9	0-0,6	1				
<b>2014</b>	2	0,6-0,75		1			
	0	0,75-1,00					
	0	1,00-1,3					
	2	1,3 +					1
	GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	<b>Number of districts</b>	<b>GDP per capita interval (national average)</b>	<b>GDP per capita 2016</b>				
<b>GDP per capita 2015</b>	9	0-0,6		0,889	0,111		
	2	0,6-0,75		1			
	0	0,75-1,00					
	0	1,00-1,3					
	2	1,3 +					1
	GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	<b>Number of districts</b>	<b>GDP per capita interval (national average)</b>	<b>GDP per capita 2017</b>				
<b>GDP per capita 2016</b>	8	0-0,6	1				



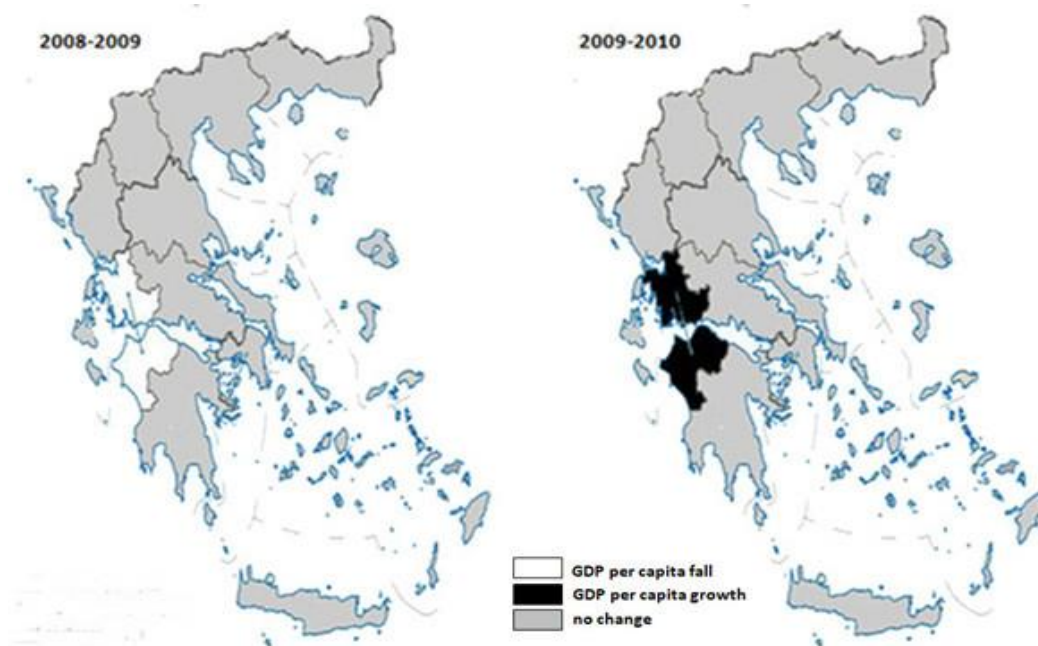
3	0,6-0,75					1
0	0,75-1,00					
0	1,00-1,3					
2	1,3 +					1
GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +

The main diagonal of the matrix shows the share of regions that were in the same income range in both periods studied. Analyzing the above matrix (see Table 1), we note that most regions of Greece did not change their position, being in the same income range in designated transition matrices. Based on the analysis of data and the results of research so far, it can be concluded that the position of individual regions of Greece is stable in the period adopted for the study; there is no significant mobility of regions with national averages.

Given the above, it can be concluded that the regions of Greece are developing at an analogical pace; there is high income stability. Some change can only be seen in the periods: 2008-2009; when the Dytiki Ellada region (see Fig. 2) shifted from the higher income range (0.6-0.75) to the lower (0-0.6) and 2009-2010; when the region moved again to a higher income range (0.6-0.75) in the transition matrix. Another change in the range of this region (see Fig. 3) took place in the period 2012-2013; when it shifted again to a lower level (0-0.6) and its position did not change until the end of the examined period. Changes can also be observed in the Sterea Ellada region (see Fig. 3) in the period: 2011-2012, when the region shifted from a lower one (0-0.6) to the higher (0.6-0.75) income range, then in the following year it returned to the lower range again and remained at this level for three consecutive years. In the period 2015-2016 there was a new change; Sterea Ellada region shifted back to a higher range (0.6-0.75). Data analysis suggests that the most, because eight examined objects (Anatoliki Makedonia, Dytiki Makedonia, Ipeiros, Ionia Nisia, Sterea Ellada, Peloponnisos, Voreio Aigaiou, Notio Aigaiou, Kriti) were in the ranges with the lowest GDP per capita values compared to other Greek regions. In the period 2008-2017, none of these regions changed their position in the designated transition matrices.

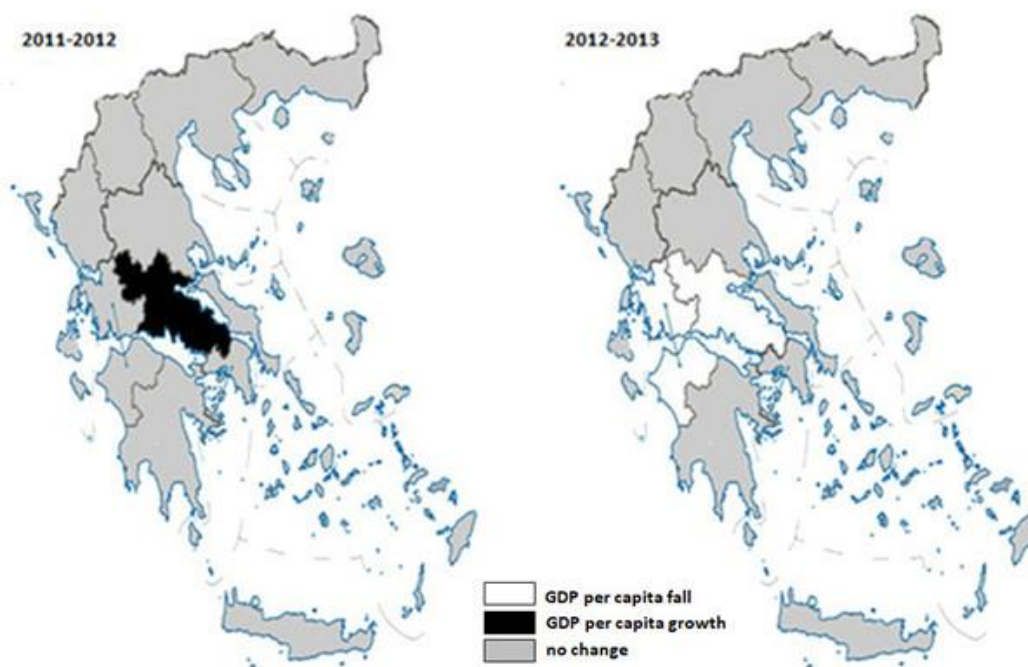


Figure 1. Administrative map of Greece.

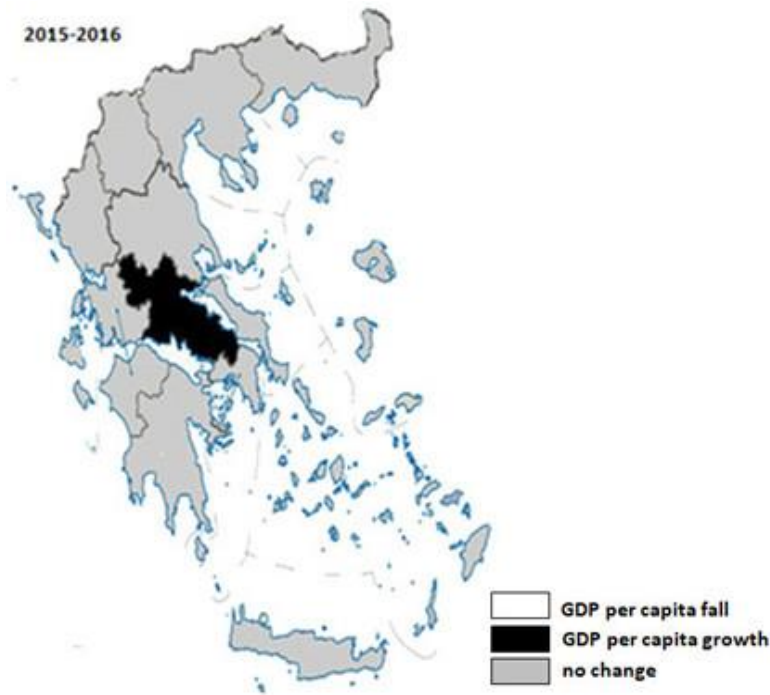


**Figure 2.** Map of potential transitions for Greece sub-regions in the 2008-2010.

The results obtained are presented graphically in Figures 1-4. The stability of the ranges occupied by the Greek regions also suggests that the analysis of the transition matrix for these regions shows only the static dimension of this phenomenon; despite the observed increase in the studied variable for all research units in the period adopted for the audit. A group of leading regions has developed (Kentriki Makedonia, Attiki) whose position in transition matrices has not changed throughout the entire research period.



**Figure 3.** Map of potential transitions for Greece sub-regions in the 2011-2013.



**Figure 4.** Map of potential transitions for Greece sub-regions in the 2015-2016.

A similar study was carried out for regions in Germany. Analyzing the results obtained, we can conclude that, as in the case of Greece, the majority of objects in Germany did not change their position, being in the same income range in designated transition matrices.

In the period 2008-2009, the position changed in transition matrices it concerned the Unterfranken object (see Fig.6). This region changed its position and there was a shift from 0.6-0.75 to a lower range of 0-0.6. In 2009-2010, out of two regions that were in the range of 0.6-0.75 in 2009, the change in the income group concerned the Braunschweig region; shifting to a higher income range (0.75-1.00). During this period there was a shift from the first (0-0.6) to the second (0.6-0.75) compartment of the Unterfranken object. In the period 2010-2017, no region changed its position in constructed transition matrices. As many as fourteen regions were located in the lowest income range in the entire research period (Niederbayern, Oberpfalz, Oberfranken, Bremen, Gießen, Kassel, Mecklenburg-Vorpommern, Lüneburg, Koblenz, Trier, Saarland, Dresden, Chemnitz, Leipzig).

**Table 2.** A matrix of potential transition per capita for German regions with regard to medium domestic (2008-2017).

GDP per capita 2008	Number of districts	GDP per capita interval (national average)	GDP per capita 2009				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	14	0-0,6	1				
	3	0,6-0,75	0,33	0,67			
	9	0,75-1,00			1		
	3	1,00-1,3				1	
	9	1,3 +					1
		GDP per capita interval	0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
GDP per capita 2009	Number of districts	GDP per capita interval (national average)	GDP per capita 2010				
			0-0,6	0,6-0,75	0,75-1,0		
	15	0-0,6	0,93	0,07			
	2	0,6-0,75		0,5	0,5		

GDP per capita 2010	Number of districts	GDP per capita interval (national average)	GDP per capita 2011, 2012, 2013 ,2014, 2015, 2016 ,2017				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	9	0,75-1,00			1		
	3	1,00-1,3				1	
	9	1,3 +					1
		GDP per capita interval	0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
2011	14	0-0,6	1				
2012	2	0,6-0,75		1			
2013	10	0,75-1,00			1		
2014	3	1,00-1,3				1	
2015	9	1,3 +					1
2016		GDP per capita interval	0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +



Figure 5. Administrative map of Germany.

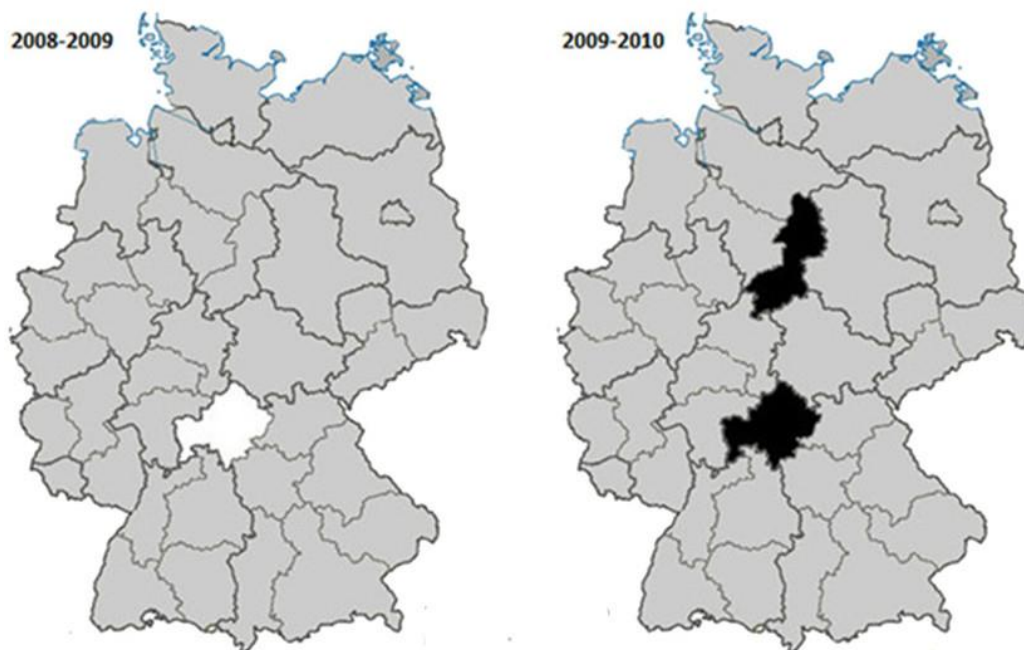


Figure 6. Map of potential transitions for Germany sub-regions in the 2008-2010.

Table 3. A matrix of potential transition per capita for Romania regions with regard to medium domestic (2008-2017).

GDP per capita 2008	Number of districts	GDP per capita interval (national average)	GDP per capita 2009				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	0	0-0,6					
	1	0,6-0,75		1			
	5	0,75-1,00			1		
	1	1,00-1,3				1	
	1	1,3 +					1
	GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
GDP per capita 2009	Number of districts	GDP per capita interval (national average)	GDP per capita 2010				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	0	0-0,6					
	1	0,6-0,75		1			
	5	0,75-1,00			1		
	1	1,00-1,3			1	0	
	1	1,3 +					1
	GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
GDP per capita 2010	Number of districts	GDP per capita interval (national average)	GDP per capita 2011				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
	0	0-0,6					
	1	0,6-0,75		1			
	6	0,75-1,00			0,833	0,167	
	0	1,00-1,3				1	
	1	1,3 +					1
	GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +

GDP per capita	Number of districts	GDP per capita interval (national average)	GDP per capita 2012				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
2011	0	0-0,6					
	1	0,6-0,75	1				
	5	0,75-1,00		1			
	1	1,00-1,3		1	0		
	1	1,3 +					1
		GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3
GDP per capita	Number of districts	GDP per capita interval (national average)	GDP per capita 2013				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
2012	0	0-0,6					
	1	0,6-0,75	1				
	6	0,75-1,00		1			
	0	1,00-1,3				1	
	1	1,3 +					1
		GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3
GDP per capita	Number of districts	GDP per capita interval (national average)	GDP per capita 2014				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
2013	0	0-0,6					
	1	0,6-0,75	1	0			
	6	0,75-1,00		0,167	0,666	0,167	
	0	1,00-1,3					
	1	1,3 +					1
		GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3
GDP per capita	Number of districts	GDP per capita interval (national average)	GDP per capita 2015				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
2014	1	0-0,6	1				
	1	0,6-0,75		0	1		
	4	0,75-1,00			1		
	1	1,00-1,3			1	0	
	1	1,3 +					1
		GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3
GDP per capita	Number of districts	GDP per capita interval (national average)	GDP per capita 2016, 2017				
			0-0,6	0,6-0,75	0,75-1,0	1,0-1,3	1,3 +
2015	1	0-0,6	1				
	0	0,6-0,75					
	6	0,75-1,00			1		
	0	1,00-1,3					
	1	1,3 +					1
		GDP per capita interval		0-0,6	0,6-0,75	0,75-1,0	1,0-1,3

Romania was the third country that became a source of interest in the study. In the entire research period, the change in income position related to only three facilities (Sud - Muntenia, Sud-Vest Oltenia, Vest). In the period 2009-2010, a decrease in the Sud - Muntenia position in transition matrices was observed. This facility in the period 2009-2010 moved to the middle range (0.75-1.00). In the next period (2010-2011) it returned to the higher income range (1.00-1.3), and then in the next one (2011-2012) this object was moved back to the lower income group. Another change in the income group for this object

can be observed in 2014 compared to the previous period (a shift from the range (0.75-1.00) to the range (1.00-1.3)). In 2014, the Sud-Vest Oltenia region shifted from the second income position (0.6-0.75) to the first (0-0.6) and remained at this level until the end of the adopted research period. In turn, the Vest region in 2014 recorded a decrease by one position to the second level (0.6-0.75), then in the following year it returned to the initial level (0.75-1.00). Analyzing statistical data, we note that only one region (Bucuresti - Ilfov) throughout the entire research period it was in the highest income group. No object was found in the lowest income range in the whole research period. The latest empirical research also confirmed regional divergence based on different time spans (Goschin Zizi 2017).



Figure 7. Administrative map of Romania.

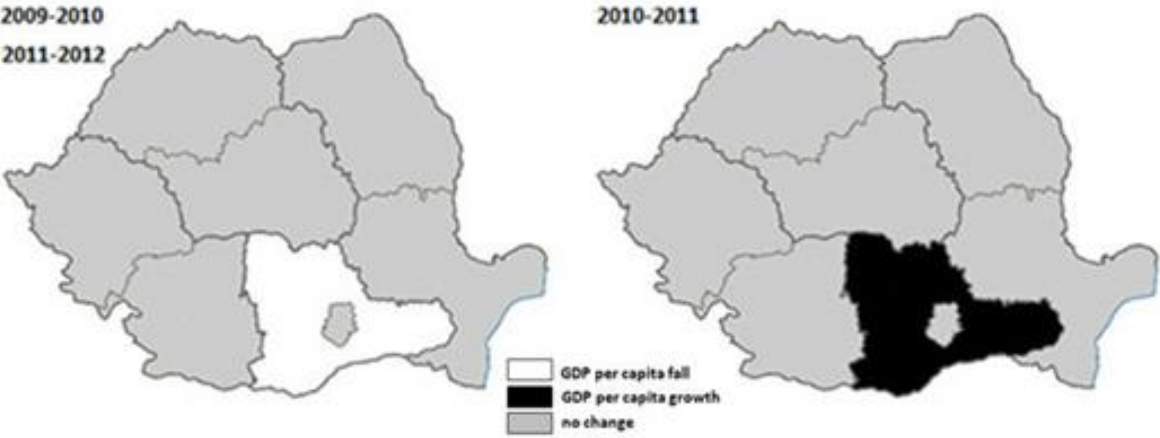


Figure 8. Map of potential transitions for Romanian sub-regions in the 2009-2012.



Figure 9. Map of potential transitions for Romanian sub-regions in the 2013-2015.

#### 4. Discussion and Conclusions

As some Authors note it was found that economic growth positively influences income inequalities as well as decreases the share of population under the poverty threshold in all regions. However, the development differs across regions (Michálek Anton and Výboštok Ján 2018). During the author's own research, this problem was taken up by her in publications. This article is a continuation of the author's own research in the field of regional development, innovation and competitiveness of European Union regions (Surówka 2014; Surówka 2015). The purpose of the article was to present a different way of measuring the GDP per capita in dynamic terms. Transition matrices were used to achieve the goal. The research approach used in the study enabled verification of the degree of diversification of the economic power of regions of three European Union countries (Greece, Germany and Romania). Thanks to the dynamic analysis, it was possible to compare the dynamics of changes in the general distribution of income and the location of the examined units in the constructed transition matrices. Analyzing the results presented in the text, we note that the position of most of the analyzed regions of each country (Romania, Greece and Germany) in the designated matrices is fixed. A group of leading regions developed in each country, which were in the highest income range in the entire research period. In the case of Greece, these are two of the thirteen regions (which is 15.4 percent). In Germany, nine out of thirty-eight. Which is 23.7 percent, therefore more compared to Greece. Comparing the three countries, the lowest percentage of regions classified in the highest income bracket in the constructed transition matrices was observed in Romania. As some Authors note territorial economic development in Romania has led to the existence and intensification of gaps, thus it is very important to reduce and manage them by implementing coherent programs designed for continuous and sustainable growth at regional level (Avram 2016).

The highest income stability among the analyzed countries can be seen in Germany. The most unstable in Greece. So The situation in Greece was less favorable, where both productivity and employment levels are very low. It is worth emphasizing that in Germany only one region (Braunschweig) has changed its position in transition matrices. It was moved to a higher range. In the case of Germany, no changes can be observed since 2010, later it happened for the other two examined countries. In Romania from 2015 and in Greece from 2016. The research has practical significance and the results can be used. Statistical data also shows that, as in the case of Greece, German regions are developing at an analogical pace. However, the hypotheses that GDP changes and development tendencies in regions are different, were confirmed. (Michálek and Výboštok 2018). In addition, Greece is distinguished from the other two countries (Romania and Germany) by the fact that its studied regions were classified as either in the lowest or in the highest ranges in transition matrices during the period considered. None of them was in the third or fourth income range (middle components) in the calculated transition matrices.

The obtained results may be a source of interest for people dealing with regional development issues. In the author's opinion, they should be treated as a new view on the verification of the dynamics of changes in the GDP per capita measure. They can also become an inspiration to deepen this type of



analysis in the future, as well as an incentive to develop new, more in-depth methods sensitive to the slow dynamics of changes taking place in the studied regions. They are part of the overall research into the phenomenon of broadly understood socio-economic development.

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# Social Media and other Channels of Communication in Municipality Environment – Case Study of Hradec Kralove Region

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**Abstract:** The article deals with the ways of municipality communication with their citizens through selected social networks and other channels. Communication via the social network can offer better service, better communication and faster response than printed sources. The cities were selected in the Hradec Králové region in the Czech Republic. Size of the cities is from 1,000 citizens to 5,000 and from 5,001 citizens to 10,000. Introduction and the second part deals with methods of communication and forms of how cities can get to the citizen and presents various social media. The main part of the article focuses on the analysis of the websites and management of the social media that cities use and the other channels that the municipalities offer to the citizen for possible communication. It was found that smaller municipalities use social media less than the larger ones. Facebook is the most often used social media. Most of the cities use one social network. Web pages, newsletters and application are the next most often used channels for communication with citizens.

**Keywords:** application; municipality; social media; usage

**JEL Classification:** H00; O35; R10

## 1. Introduction

With the advancement of information technology society generally establishes itself from the traditional ways of communication to the modern one. New trends had to be adapted and offered by municipalities to its citizens. Municipalities make use of the possibility of remote control via websites and social networks. It is necessary to be able to correctly and secure offer and provide information to citizens in this information space.

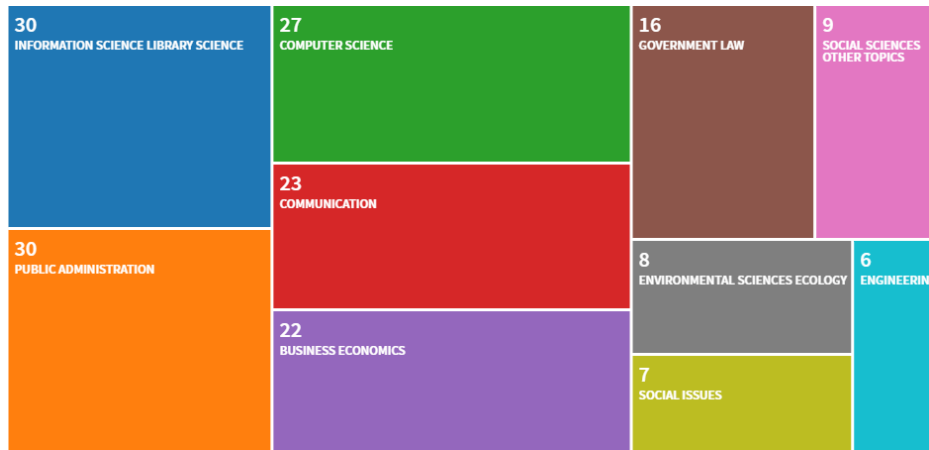
Web sites are still the most widely used information tool for municipalities and cities at present time not only in the Czech Republic. Regions, cities, and the vast majority of municipalities make full use of web sites and consider them an inseparable part of the structure of their information systems. Websites allow direct information transfer, image building, relationships and advertisement serving. Municipalities have an obligation to use the Internet to the extent stipulated by law. However, the Internet now offers a wealth of opportunities to municipalities that they can use to support their activities. Towns and municipalities' websites should meet the basic three functions: Informative (static communication), Interactive (dynamic communication) and Presentation.

The paper focuses on social networks used in municipalities and focuses on the other ways of communication with citizens. The citizen of the municipality should be informed via social networks about all the important opportunities that they do in their municipality. Communication through social networks is significantly faster in this manner than in the printed form.

### 1.1. Analysis of sources from Web of Science on municipality and social media

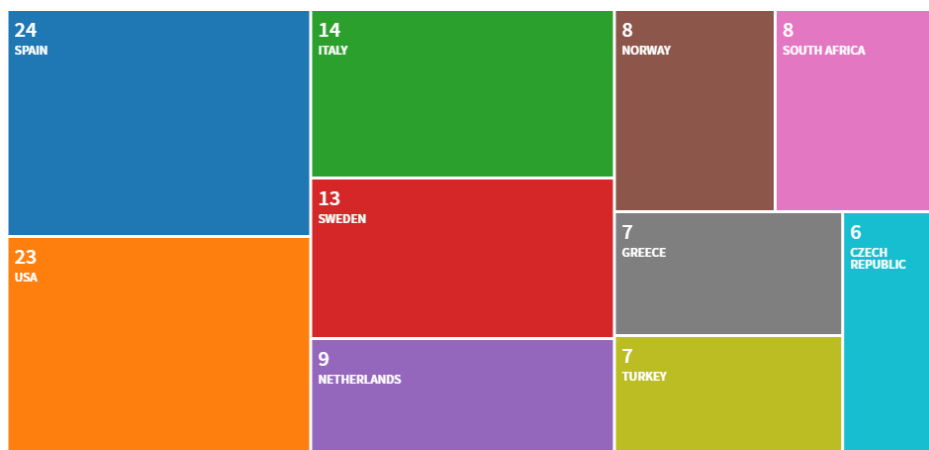
The analysis of keywords connected with municipality and social media on Web of Science was done 24th of October 2019. Into search engine was put „municipality“ and „social media“. There were founded 151 articles focused on the selected topic. The biggest number of published articles were 44 in

2018, 34 in 2017 and 27 in 2016. In 2019 were included into database 14 published articles. 116 were articles in journals, 33 proceedings paper 16 book chapters and others. Most of the articles were put on the information science and library science, public administration, computer science and information systems, communication and 22 in business economics etc. All research areas according to Web of Science are presented in fig. 1.



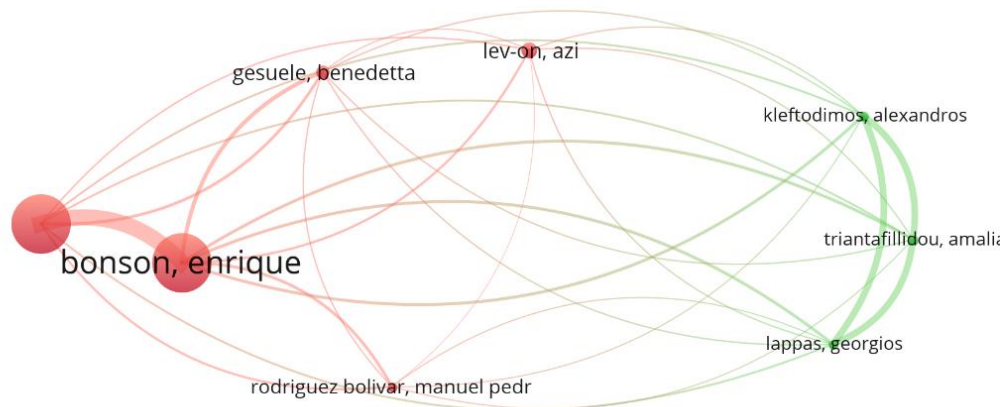
**Figure 1.** Research areas, according to Web of Science.

The biggest number in countries/regions were in Europe or in USA. The statistics won Spain with 24 articles. Detailed statistics are presented in fig. 2. In the Czech Republic were published 6 articles included in Web of Science with selected topic. Four articles are papers from Svobodová (Svobodová et.al. 2019; Svobodová 2017; Svobodová and Dittrichová 2016; Svobodová and Hedvičáková 2016). There is still possibility and space to publish articles with connected topic municipalities and use of social media to communicate with their citizens.



**Figure 2.** Countries/regions, according to Web of Science.

From VOSviewer were done next statistics according to most often published and cited authors on the selected topics. Into selection were put authors that have 4 and more publication and there were analysed their citations. The biggest number of publication have Bonsón et al. (2012) with highest number of citations. On the next positions is Royo with 5 documents and 414 citations and Lev-On with 5 documents and 30 citations. All other authors have 4 publications. Gesuele gained 21 citation, Rodriguez Bolivar 12 and 6 citations gained Klefodimos, Lappas and Triantafillidou. Authors that have 4 and more publication are presented in the connection with citations in fig. 3.



**Figure 3.** Authors with 4 and more publication on selected topic and citations, based on VOSviewer and Web of Science.

The most often cited article was Bonsón (2012) with 300 citations according to WoS. Sandoval-Almazan and Gil-Garcia (2012) are with 114 citations placed on the second position. Bonsón et al. (2015) is placed also on the third position with 88 citations. On the next positions are Agostino (2013) and Sobaci and Karkin (2013) with 63 and 43 citations.

The most often used keywords were the last monitored issue. Minimum number of occurrences of a keyword was set as 10. Of 710 keywords, 21 meet thresholds. There were founded 4 clusters of the keywords.

- Cluster 1 – communication, governance, internet, local government, management, social media, twitter.
- Cluster 2 – adoption, citizens, engagement, impact, municipalities, participation, social media use.
- Cluster 3 – e-government, facebook, information, transparency, trust, web 2.0.
- Cluster 4 – e-participation.

The most often used keywords that also have the biggest link with this topic were:

- social media – 88
- e-government – 39
- municipalities – 31
- participation - 25
- adoption – 24
- transparency – 24
- facebook – 24

Remaining keywords gained 19 points and less.

A new trend in online communication to increase the attractiveness of the municipality in the Moravian-Silesian Region was written by Klepek (2014). The impact of social media in the local government of the Spanish municipalities was analyzed by Criado and Francisco (2015). Social media in Smart City were addressed in the Mexican Communities (Sandoval-Almazan et al. 2012). Social media as the interactivity of municipal citizens in the management of American cities was solved by Mossberger et al. (2013). Italy also focused (Agostino 2013) on the use of social media to attract citizens in the municipalities.

## 2. Methodology and Goal

The paper deals with communication between cities and citizens via social networks and other channels of communication. In recent years, this topic is very actual, but in the Czech environment in some towns it is still almost unexplored area. The main goal of the research is to find out how officials communicate with citizens through social networks and through what social networks they

communicate and what other communication channels do they offer. In the results it will be analyzed through which networks municipalities communicate and on how many social networks are cities active. Furthermore will be analyzed, what other possibilities the municipalities offer for the mentioned communication with citizens.

Secondary sources were used in the first part of the article. Primary sources were used in the part with results of the research.

#### *Conceptual framework of the research*

The conceptual framework of the paper was developed into methodological bases and procedures. The course of methodology is outlined in the following diagram, fig 4.



**Figure 4.** Methodology of research.

- Selection of respondents

The selection of a sample of respondents is the next phase. The Hradec Králové Region has 551,089 inhabitants and 448 municipalities. The research included a set of towns in the Hradec Králové Region in two samples. The first sample was determined by population, from 1 000 to 5 000 inhabitants and in the second sample the population threshold was set from 5001 to 10 000 inhabitants. The first sample has 56 cities and the second sample has 14 cities. A total of 70 cities were surveyed. These two samples were used to examine in detail the social networks and other forms of communication that cities use. (Czech Statistical Office 2019)

- Methods of data collection

The accuracy and quality of the obtained data are significantly influenced by data collection methods. The data were collected by observation, when the data was collected by visiting of the official websites and profiles of municipalities and in the Hradec Králové Region on social networks, namely on Facebook, Twitter, YouTube and Instagram during March 2019. Observation is an indirect data collection tool that does not require direct contact with the respondent. Websites and other communication channels like application, newsletters etc. were also observed and analyzed. In terms of the methods used, quantitative research was applied in the research.

- Monitoring of data

The primary research consisted of monitoring the use of social networks and other forms of communication by selected Czech towns, which was carried out by means of observation. The data were observed from March 1, 2019 to March 31, 2019. In the first part it was examined which towns belong to two samples according to their population. Furthermore, it was examined whether municipalities refer to social networks through websites and which of the social networks surveyed are used by municipalities and what other forms do they offer to citizens for communication.

- Analysis and evaluation

The choice of the method of data analysis depended on the main objective of the whole research, which was to evaluate the use of social networks and other forms of communication in cities in the Hradec Kralove region, namely on two samples. The social networks examined included Facebook, Twitter, Instagram, LinkedIn, Youtube and web sites and applications for mobile devices and other forms of communication were evaluated. Data were signed into tables. Graphs were used for better visualization of data.

### 3. Use of Social Media and Communication Channels in Municipalities

#### 3.1. *The main communication channels in the municipalities*

Communication channels (networks) differ in their speed, cost, number of respondents, efficiency, etc. It also depends on the citizens that we want to address with the given message or information. It is also important what goals we want to achieve, because each communication channel has its advantages and disadvantages.

Communication channels that are the most often used between municipalities and citizens are:

- Internet – web pages and social media,
- boards,
- radio,
- meetings and consultations,
- newsletters or bulletins,
- public relations,
- fairs or exhibitions,
- conferences,
- deliberations,
- emails to residents,
- others.

#### 3.2. *Social media and social network*

Boyd and Ellison (2007) define social network sites as web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system.

Socialmediatoday (2019) presented the latest global statistics from social networks. Research mapped active users of the following social networks - Facebook, YouTube, Twitter, Instagram, Snapchat, Tumblr, Pinterest and LinkedIn.

Social media statistics (Emarsys 2019) show that there are 3.2 billion social media users worldwide, and this number is only growing. That equates to about 42% of the current population. In fact, people spend more than an hour and a half on social media every day! One of the reasons for this high usage of social media is because mobile possibilities for users are continually improving which makes it simpler by the day to access social media, no matter where you are. Most social media networks are also available as mobile apps or have been optimized for mobile browsing, making it easier for users to access their favorite sites while on the go.

Facebook has been shaping the social media landscape since its launch and is continually evolving to meet its user's needs. With over 2.32 billion active monthly users, Facebook remains the most widely used social media platform.

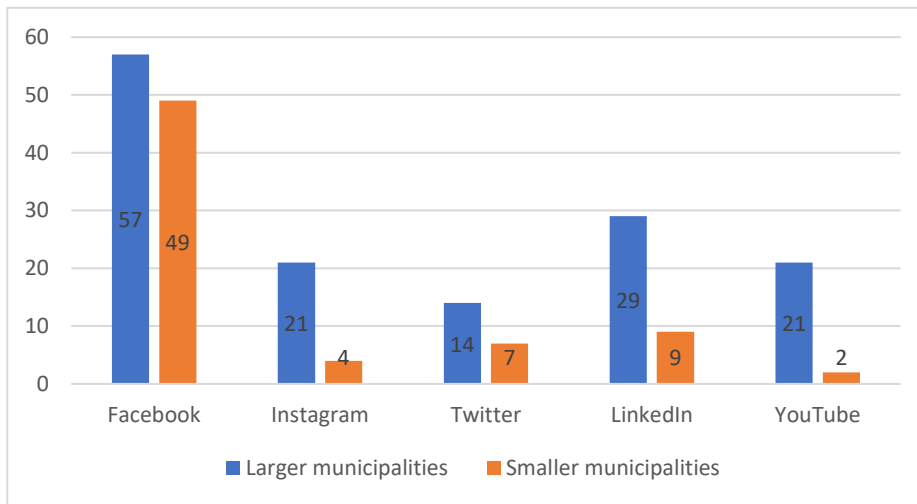
90.4% of Millennials, 77.5% of Generation X, and 48.2% of Baby Boomers are active social media users. Users spend an average of 2 hours and 22 minutes per day on social networks and messaging. 91% of all social media users access social channels via mobile devices. (Oberlo 2019)

Most people use Facebook (with 2.3 billion monthly active users) and YouTube (with 1.9 billion). Then there are WhatsApp (1.6 billion users), Instagram and Wechat (1bn users), LinkedIn (610 million users), Weibo (600 users), Reddit (542 users), Twitter (330 million) and others (Brandwatch 2019).

### 4. Results of the Analysis

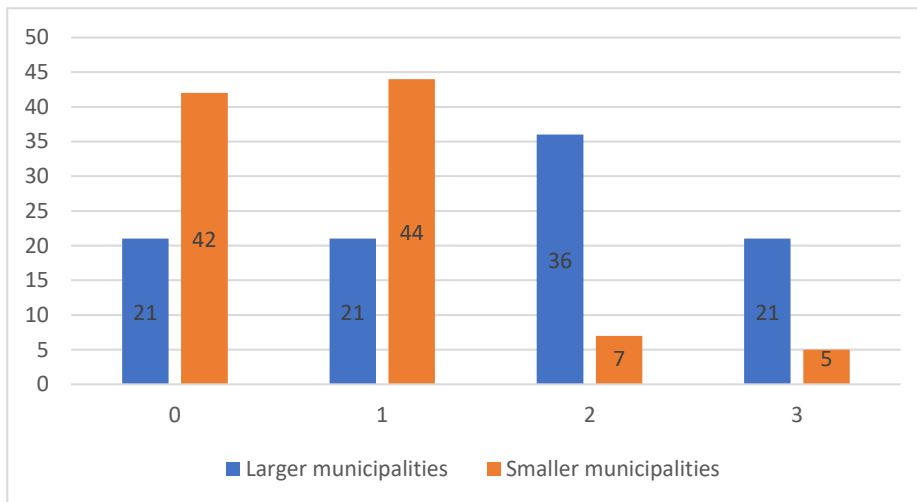
Use of social media, use of more social media and use of other channels for communication will be analyzed in the results of research.

After the analysis in the observed cities, it can be stated that larger cities use selected social networks more than smaller cities. Facebook, LinkedIn, Instagram and YouTube are the most often used in the communication, fig. 5. Facebook shows the dominance in the use of social media by citizens.



**Figure 5.** The social networks over which cities communicate, in %.

The gained data show that cities use more social networks at the same time for communication. This can be seen in fig. 6. The graph shows that 42% of smaller and 21% of larger municipalities do not use any social network to communicate with citizens. 44% and 21% use one network. There is also a significant difference in the use of two and three social networks. Two use only 7% smaller and 36% larger municipalities and three only 5% smaller and 21% larger. The results show that larger municipalities cumulate more social networks to inform citizens than smaller municipalities.



**Figure 6.** The number of social networks over which cities communicate, in %.

It has been found that larger cities offer more other channels for communication than smaller cities, see fig. 7. Also application are a little bit less used in smaller cities than in larger. From our sample it was specifically 30% of small cities and 36% of large cities. The results of the research also show that smaller cities invested money for their own applications. All municipalities used web pages to inform citizens and similar results gained also newsletters that are still often used. Webcams recorded the highest difference between larger and smaller municipalities.

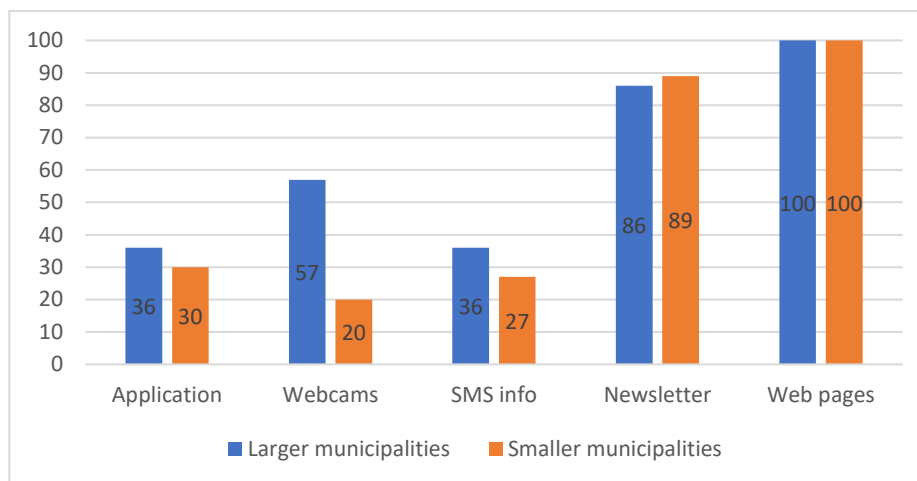


Figure 7. Other forms of communication which cities use, in %.

## 5. Conclusion, Discussion and Recommendations

Just as the popularity of social networks is growing, their use by the public administration increases as well with the development of information technologies. Czech citizens and businesses can communicate with the government and local authorities through e-mail, they can browse their websites, where required forms can be found, downloaded or directly filled in and sent electronically. The current situation of the use of social networks by selected municipalities in the Hradec Králové region was based on the quantitative research and monitoring of data. Types of social networks used by the municipalities and whether municipalities use other forms how to communicate with citizens was monitored. Selected topic is not often solved by the Czech researches. The monitoring of the use of social networks by the Czech municipalities is not often and into deep mapped and presented to the auditorium. In the processing of the article it was necessary to focus on the detailed collection of data gained from the visit and observation of individual social networks, web pages, used applications and others.

The most often used social media is Facebook. YouTube, LinkedIn and Twitter have similar usage in the selected cities. Similar results were gained also in the previous research (Svobodová and Dittrichová 2016; Svobodová and Hedvičáková 2016). Most of the cities use one social network. Web pages, newsletters and application are the next most often used channels for communication with citizens. Important is to connect social networks with the www pages of municipalities. The links should be placed clearly on the first page.

It is possible to recommend to municipalities to do not use only web pages that citizens do not visit each day. Hot topics have to be communicated on social media, via application developed for municipality communication in the manner of network management system and communication. Those recommendation and channels of communication are mostly beneficial for the younger generation. Radio, boards and newsletters are mostly directed at elderly people or people that are not used to use advanced technologies and modern trends in the communication. Next solved issue may be the Involvement of Public Participation in the Czech Republic (see e.g. Bednarska-Olejniczak et. al. 2019).

The results (Bonson et. al. 2019) show that the majority of Andalusian local governments have an official corporate Twitter account with certain level of activity. There is no, however, a significant relationship between the population of a municipality and its citizen's engagement, and there is a significant negative relationship between audience and engagement and between activity and engagement. The findings of the study also show the particular media and content types generate higher engagement than others. In our sample is Twitter the least used social media in the selected cities. Our results also show that smaller municipalities use this type of communication less than larger municipalities.



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# Circular Economy as an Answer to the Challenge of Improving the Quality of Life

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**Abstract:** The paper is an attempt to presents the influence the idea of circular economy on improving the quality of life. In the article the author presents the quality of life concept (understands as the element of sustainable development), as well as living standard idea, and the key assumption of circular economy: i.a. the 'take-make-waste' approach, characteristic of the linear model of economy, as well as 'reduce, reuse, recycle and recover' which is used in circular economy. It seems that circular economy could have positive effect on increasing the quality of life, especially due to the fact that environment aspects have it. The main part of the article is the literature review in the field of quality of life and circular economy connection. As an attempt to demonstrate of dependence between analysed phenomenon, author uses the available data come from international databases (Human Development Index and Quality of Life index, as well as from Eurostat). The preliminary analysis of existing relation is based on linear regression model, which results state that there is a positive influence of circular economy on increasing quality of life.

**Keywords:** circular economy; linear model of economy; quality of life; living standard; sustainable development; statistical analysis

**JEL Classification:** C0; O1; Q5

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## 1. Introduction

The present paper is the second one in the publication series devoted circular economy and sustainable development matters. In this paper – as was marked in abstract – the major attention will be focused on practical implementation of the postulates of improving the quality of life through the using of circular economy approach, which is an expression of sustainable development.

Nowadays, circular economy concept is one of the most popular issue, interested both practitioners, politician, and scientists. Defining, both the circular economy and circularity, is very difficult, due to the various approaches. Since crucial article of Kirchherr, Reike, and Hekkerts (2017), presented the literature review of 114 definitions of circular economy, newer papers often refer to the main conclusion of that article from 2017 (see i.e. Prieto-Sandoval et al. 2018; Camacho-Otero et al. 2018; Aguilar-Hernandez et al. 2018; Ruiz-Real et al. 2018; Velenturf et al. 2019). Based on that analysis, in present article circular economy is defined as the description of *an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes* (Kirchherr et al. 2017). These activities are done on three levels: micro, meso and macro and aiming at sustainable development in such a way that should lead to ensure the benefits for current and future generations. These three levels (micro, meso and macro) are understand as the levels of main actors of circularity process: both people, institutions and networks. What is worth to underline, all efforts taken by the actors in this process could have an impact on different dimensions (pillars) on which the concept of sustainability development is based. These pillars are: society, environment and economy (Diaz-Sarachaga et al. 2018). All the effects should be considered in these three dimensions. I assume that we cannot assess the process as positive while even if only in one dimension there will be a loss. Since the publication of Brundtland Report (1987) the present and future needs are presented as equally important. It means that taking each activity, aiming at meeting the present needs, we should take into consideration the possibility of meet the needs of future generations. The first association refers to the natural resources, but it is very difficult to predict how the technology will develop and which resources we will need in the future. It seems more reasonable to take quality

approach in this analysis. The main question in this case is not: “*which resources will we need?*” but: “*what level of quality of life we want to achieve?*”.

Before extending this thread, it is necessary to present sustainable development concept. Although, sustainable development as an expression, is rather well-known (on the Internet exist more than 408 million pages contain this expression in English), it needs to be underlined that this expression consists two crucial word: *sustainable* and *development*. The *sustainability*, etymologically derived from the word *sustain*, assumes that our common and future behaviour will be the same (or at the same level). This approach to understanding the sustainability concept underline the future right to use the common goods (or right for future generations to live as we would like to live). According to *development*, it is often identified wrongly as only quantity value (i.a. in economic analysis, when we try to present the set of indices that could testify that the analysed area is developed), while it is only the growing process. The growth is just a process effects multiplying production factors and consumer goods and has quantified character. The development is broader concept than growth due to the fact that it has a dynamic character and consists of two dimensions: quantitative changes (growth) and the qualitative changes in the economic and social area. However, the sustainable development is most often defined as *a development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (Brundtland 1987), it does not exhaust the various ways of understanding this phenomenon. Deep analysis in this matter was conducted by Hopwood at al. (2005), in which Authors presented the results of mapping of views on sustainable development, showing the various approaches depended on increasing environmental concerns (1<sup>st</sup> dimension) and increasing socio-economic well-being & equality concerns (2<sup>nd</sup> dimension). It is worth to underline that these two dimensions are also connected with the de-growth trend (but with using different approach). The de-growth trend is defined as *an equitable downscaling of production and consumption that increases human well-being and enhances ecological conditions at the local and global level in the short and long-term* (Kerschner 2010). However, this concept is not so new, but is postulated now by some circles with renewed force. It is an effect of taking climate- or environment-orientation in many aspects of present science and political discourse. Nevertheless, sustainable development taking into consideration environment as one of key dimension, it seems to be comprehensive point of view which ensures the wide range of potential activities. In this place, I would like to note that interactions between those three spheres: society, environment and economy could be different. Between society and environment, the interactions should be bearable, between environment and economy – viable, between economy and society – equitable, but between all those three – sustainable (Zikic 2018). The last one interaction is understanding as the optimal development which guarantees increasing the quality of life.

## 2. The Approach to Measure of Quality of Life

The quality of life is nowadays one of the most important aspect for modern society. This category is underline in many strategies, operational programs and different-level projects, but the common definition of this category is unavailable. In this paper, I assume that the quality of life is *a multi-dimensional construct* (Rapley 2003), which *broadly encompasses how an individual measure the ‘goodness’ of multiple aspects* (Theofilou 2013). Multidimensionality assumes both (a) possibility to take into consideration various plains of analysis, ex. types of capital (human, economic, etc.), utility of life dimensions (Petelewicz and Drabowicz 2016), and (b) various elements, ex. material aspects of life, main activity & work, health, etc. (Statistics Poland 2017). Quality of life covers intangible, immeasurable issues (Piecuch and Chudy-Laskowska 2017) which means that to assess the quality of life the subjective measurement is applied. The concept closely related to quality of life is a living standard, but most authors distinguish between them (Babiarz et al. 2018; Bérenger and Verdier-Chouchane 2007; Błachut et al. 2017; Kasprzyk 2013; McGregor and Goldsmith 1998; Piasny 1993; Piecuch et al. 2018; Słaby 2007; Turkoglu 2015; Zeliaś 2000). Living standard concept is described by the living conditions and the level of meet the needs, which could be expressed by the set of objective indices. Ones of the most widely implemented measures in this subject are:

- a) Human Development Index (HDI), created by Mahbub ul Haq in 1990 with the help of Amartya Sen that measures the level of social development of countries (ul Haq 2003; Anand and Sen 1994);
- b) Quality of Life Index that measures the quality of life in terms of i.a.: costs of living, health, safety and the environment (Kasprzyk 2013).

Both mention measures are in line with the postulate to “move away from GDP” put forward by The European Commission based on analysis of the most prominent scientists (Stiglitz et al. 2009; Fleurbaey and Blanchet 2013; Stiglitz et al. 2018).

Human Development Index is composed of indices which correspond to three basic dimensions of human development:

1. long and healthy life (indicator: life expectancy at birth),
2. knowledge (indicator: the mean/expected years of schooling),
3. material standard of living (indicator: an income index designed to proxy for purchasing power).

Despite of the potential of HDI, which is frequently used especially in international comparisons, many authors criticize it (Cahill 2005; Kovacevic 2010; Neumayer 2001; Noorbakhsh 1998, Pinar et al. 2015; Shaikh 2017) or – in a lighter version – propose its modification (Alkire and Foster 2010; Babiarz et al. 2018; Busato and Maccari 2016; Herrero et al. 2010; Maccari 2014; Migala-Warchoł 2017; Silva and Ferreira-Lopes 2014; Rahjou et al. 2014; Trabold-Nübler 1991) or modification of the mathematical model used to calculate it (Mishra and Nathan 2014). Nevertheless, using HDI (in assessment of the quality of life) seems to be the best way to ensure the possibility to compare the received results, especially when this index is compiled with another(s).

Quality of life index was developed by Carol Estwing Ferrans and Marjorie Powers in 1984 to measure quality of life in terms of satisfaction with life (Ferrans and Powers 1985). In formula proposed by Numbeo portal (calculated the value of Quality of Life Index every year for each country), the index is *an estimation of overall quality of life by using an empirical formula which takes into account* (Numbeo 2019):

1. purchasing power index,
2. pollution index,
3. house price to income ratio,
4. cost of living index,
5. safety index,
6. health care index,
7. traffic commute time index,
8. climate index.

Some of these indices are inhibitors, the rest of them are stimulants, what caused the necessity of transformation the inhibitors into stimulants (higher value of the index is better). The using of this index is not so wide as in HDI's case, but some research papers based on using it (Abilkayir 2019; Eusuf et al. 2018; Helwa and Saleh 2015; Ho 2015; Lapates et al. 2017; Polous 2018; Žmuk 2015). It seems to be comprehensive and takes into consideration various dimensions, but for the final opinion the critical analysis of the index is need (it is not a subject of this article).

Practical use of any concept (ex. indices) requires its operationalisation, which means firstly formulate the definition and secondly – use appropriate measures. As Mark Rapley (2003) said: *It is routinely observed that not only do particular studies frequently lack a formal definition of QOL (quality of life – ed. author), but also that widely used measures of QOL fail to relate to an explicit theory of QOL and fail to show how QOL 'outputs' are related to 'inputs' in the shape of either public policy.* To avoid this misunderstanding, in the case of quality of life, I use the definition mentioned above, and I exploit the data from both mention databases: Human Development Index: (<http://hdr.undp.org/en/content/human-development-index-hdi>) and Quality of Life: (<https://www.numbeo.com/quality-of-life/rankings-by-country.jsp>).

### 3. Implementation of the Circular Economy Approach

Implementation of circular economy concept based on using various business models. It has practical dimension and it seems that theory of circular economy is later than practical solution operated in business. This statement need to be verify by conducting systematic literature review, however Heshmati (2015) prepared an analysis in this matter, and my own literature review results that the polish articles concerns circular economy were prepared for the first time after 2010, but this conclusion was drawn not on systematic analysis. Also, the crucial analysis prepared by Kirchherr et al. (2017) and Korhonen et al. (2018b) indicated that the most part of articles concerns circular economy were written after the year of 2007, although Prieto-Sandoval et al. (2018) showed the earliest papers. Nevertheless, the literature about circular economy has become since 1990, when the circular economy was conceptualized by David Pearce and R. Kerry Turner (1990). Presented the economic system consists of production, consumption of goods, capital goods and resources as the input of the whole system. They noticed that: *If we ignore the environment then the economy appears to be a linear system. Production (P), is aimed at producing consumer goods (C), and capital goods (K). In turn, capital goods produce consumption in the future. The purpose of consumption is to create 'utility' (U), or welfare* (Pearce and Turner 1990). Conducting the analysis, the Authors took into consideration: wastes, the Laws of Thermodynamics, entropy phenomenon and possibility of recycling. In conclusion They wrote: *Instead of being an open, linear system, it is closed and circular* and presented the circular model of economy (Pearce and Turner 1990).

Many of further papers are focused on practical implementation of circular economy approach, and presented many interesting practical examples come from business life (Alhola and Salmenperä 2019; Cavallo and Cencioni 2017; Davis et al. 2016; Diaz Lopez et al. 2019; Huerta Morales 2019; Kane et al. 2018; Lanz et al. 2019; Ellen MacArthur 2013), but also the scientists would like to fill the gap in theory (see: Galvão et al. 2018; Geisendorf and Pietrulla 2017; Kirchherr et al. 2017; Korhonen et al. 2018a; Korhonen et al. 2018b; Moreau et al. 2017; Prieto-Sandoval et al. 2018; Ritzén and Sandström 2017).

Implementation the circular economy approach into practice express by wide range of behaviour, starting from change the behaviours or habits in everyday life in the sphere of using the resources, through choosing proper materials or products and being aware of environmental consequences of our approach and ending on the implementation different business models into economy. 'Take-make-waste' approach, which is characteristic for the linear model of economy try to be replaced by 'reduce, reuse, recycle and recover' concept, which is used in circular economy. In case of linear economy, all resources are used only once. It means that their economic potential or broader – utility for consumers – are finished together with ending of using of the products. But resources using to manufacture the products are still in them. In effect, in our wastes there are many resources that can be used once again and this possibility depends on the technology we can use. In circular economy we use "xR" approach which means that depends on our activities the number of "R" increases. "R" means all taking efforts that have positive effect on environment (Table 1).

**Table 1.** Various "R" approach to circular economy implementation. (Kirchner et al. 2017; Manickam and Duraisamy 2019)

Development	"R" Strategy	Detailed description	No. "R"
Smarter product use and manufacture	R0 Refuse	Make product redundant and abandoning its function or by offering the same function with a radically different product	-
	R1 Rethink	Make product use more intensive (e.g. by sharing product)	-
	R2 Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials	3R/4R
Extend lifespan of product and its parts	R3 Reuse	Reuse by another consumer of discarded product which is still in good condition and fulfils its original function	3R/4R

	R4 Repair	Repair and maintenance of defective product so it can be used with its original function	
	R5 Refurbish	Restore an old product and bring it up to date	
	R6 Remanufacture	Use parts of discarded product in a new product with the same function	
	R7 Repurpose	Use discarded product or its parts in a new product with different function	
Useful application of materials	R8 Recycle	Process materials to obtain the same (high grade) or lower (low grade) quality	3R/4R
	R9 Recover	Incineration of material with energy recovery	4R

Apart of the used strategy, thinking about implementation circular economy should be considered in depend on the stage of product development. It means, it is not enough to think about the product after its using, but before its creation. In effect, we received different concrete actions which could be apply in each phases: production, consumption and recovery (CircularPP 2019). Analyzed this issue from the point of view ensuring higher quality of life, the potential influence of each activity can be direct or indirect. It means that, chosen activities affect on increase of the quality of life in short or long time. Observed effects depend inter alia on the complexity of the business (production) system. Single effort taken by us, or complex actions taken by one person, are not effective. Only common, continuous effort for better future will be effective and will have a sense. Table 2 presents chosen circular actions that can be applied by single person (not an enterprise or industrial operators). The main criterion of choosing the action was direct impact on quality of life which is belonging to human. The description of some actions were changed, in purpose to present their connection with quality of personal life (not efficiency of enterprises as was in original material), as well as place of some actions (ex. 'sharing platform' is placed on consumption phase, not in production as in original).

**Table 2.** Different circular actions applied on different phase of the product lifecycle by the single user that have direct impact on quality of life.

Stage	Action (strategy)	Description
Production	<i>Circular design</i>	Including design for long life or life extension, for biological cycle (separable biological and technical components, safe materials, materials can return to nature), for resource conservation.
	<i>Long-life model or performance model</i>	Products remain with their owners for a long time, through maintenance, product attachment and upgrade or paying for its use/access without formal ownership.
	<i>Sufficiency model and substitution</i>	Reducing absolute demand of resources by influencing and mitigating consumerism behaviour and eliminating the need of a product by a radical innovation or providing it in a different way (e.g. de-materialization, shifting physical products, services or processes to virtual ones).
Consumption	<i>Sharing platform</i>	Facilitate a user-user interaction in the form of, physical or virtual, platforms markets
	<i>Incentivised Revenue Model</i>	Use a revenue model that incentivises users (and all the actors involved), to take actions to achieve circularity (ex. selling, servicing the products, etc.).
	<i>Circular criteria during purchase</i>	Use the circular criteria during purchase.
Recovery	<i>Reverse logistic</i>	A logistics plan aimed to take back (supplier's own) or collect (other suppliers) products, components or materials.

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*Next-life sales and cascading*

Selling a product (at the end of a “use-life”) or transferring (to another supply chain or different end customer).

*Retrofitting and material recycling*

Renovating old infrastructures (ex. houses) and conducting downcycling, upcycling, or functional recycling.

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Assessment direct impact of implementation circular economy on improving the quality of life requires conducting deep analysis with using detailed data (especially unit data come from questionnaire survey or focused interviews). For the purposes of this article, I conduct a preliminary analysis based on data available data from two mention international surveys (Human Development Index and Quality of Life Index).

#### 4. Methodology of Preliminary Analysis

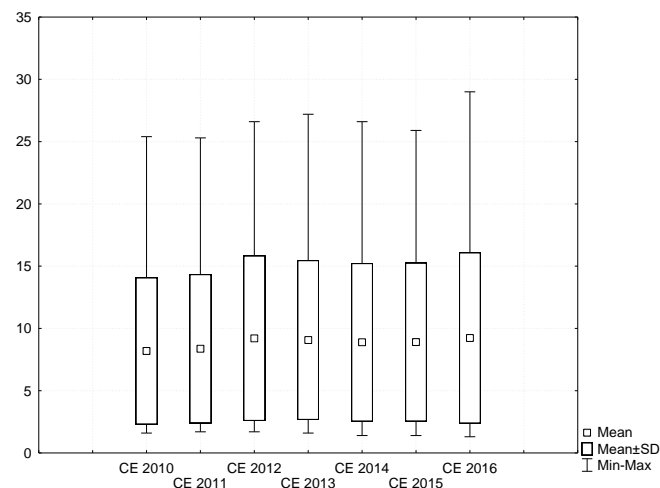
Due to the fact that the data concern the circular economy are limited (essential content, profile and time range), also the possibility to compare these data with the international quality of life databases is limited. In the present paper, which is the second one in the publication series treated about circular economy and its influence on our life, I decide to conduct and show preliminary analysis of dependence between circularity and quality of life. Data used within analysis come from two mention databases (HDI and QoL) as well as from Eurostat (circular economy indicator). The time range of availability of the data was the following:

- Quality of Life Index (2012-2019),
- Human Development Index (2010-2017),
- Circular material use rate expressed as % of total material use (2010-2016).

Due to using Eurostat data, for analysis I chose only countries belongs to European Union. Unfortunately, for some of them Quality of Life Index was unavailable. Finally to the analysis, I choose 24 countries and limited the analysis between the indices to the common period of 2012-2016 (all indices were available for that time).

#### 5. Results

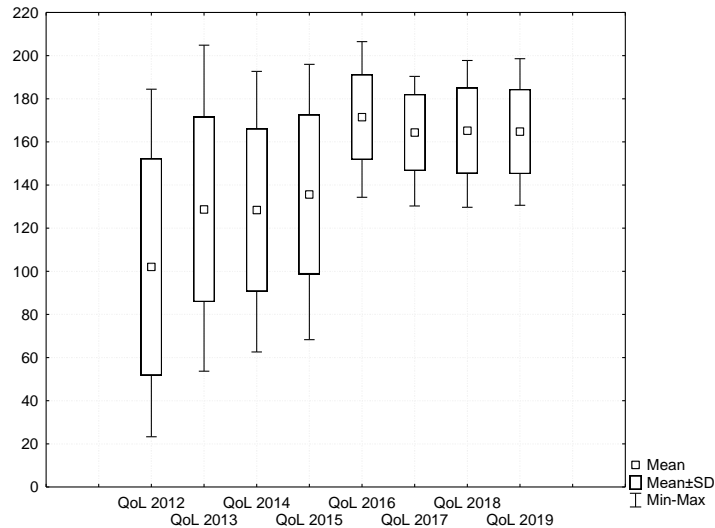
The circular material use rate is expressed as % of total material use. It is estimated that the global economy is only about 9% circular (PACE 2019), European – 11% (Eurostat 2020). We as society consume 50% faster than our resources are renewable, thus – if the consumption model remains at its current level – in 2030 we will need resources corresponding to two globes, while in 2050 it will be similar in size to three globes. Chart 1. Presents the mean of circular material use rate (CE) for analysed countries in available period of time (Box-Plots). Between 2010 and 2016 the highest values of this indicator were observed in the Netherlands, the lowest in: Croatia, Portugal, Ireland, Greece and Romania (depend on the year).





**Figure 1.** The mean of circular material use rate (CE) for EU countries in 2010-2016.  
Source: (Eurostat 2020)

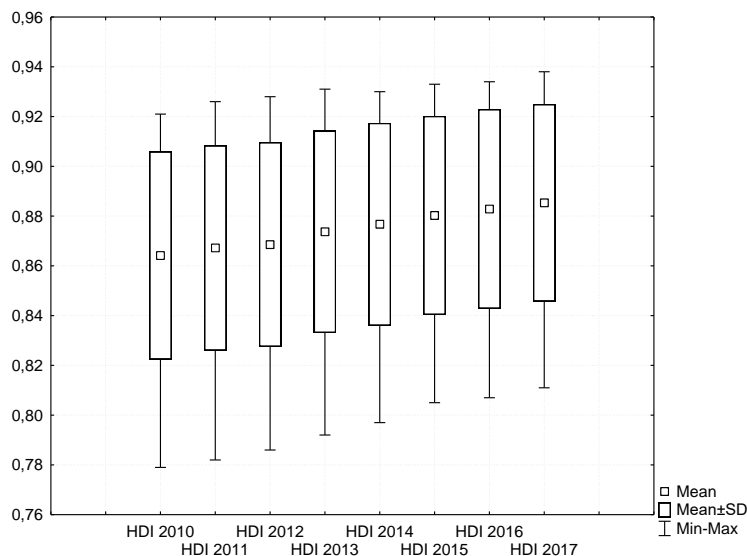
Mean value of Quality of Life Index of increased between the period of 2012 and 2019 from 102.02 to 164.78 points. Chart 2 presents the mean value of that Index for analysed EU countries. What is worth to underline, the difference between the countries were decreased (decreasing of minimum and maximum range, as well as value of standard deviation).



**Figure 2.** The mean of Quality of Life Index for EU countries in 2012-2019. Source: (Numbeo 2019)

Between 2012 and 2019 the highest values of this indicator were observed in German, Denmark and Austria, and the lowest in: Bulgaria, Greece and Lithuania (depend on the year).

Mean value of the last indicator used in present analysis – Human Development Index – increased between period of 2010 to 2017 from 0.864 to 0.889. Chart 3. presents the mean value of that Index for analysed EU countries. The lowest values of the HDI in each year were observed in Bulgaria and Romania. The highest values were observed in Denmark, Ireland and Germany (depend on the year).



**Figure 3.** The mean of Human Development Index for EU countries in 2010-2017.  
Source: (UNDP 2017)

In order to analyse the connection between circularity and increased quality of life, I standardized the values of each indicator and use Pearson's correlation coefficient and linear regression (Table 3). The statistically significant relation is observed only between HDI and CE; the relation between QoL

and CE is not statistically significant, what caused that in the analysis of linear regression only the dependence between CE (independent variable) and HDI (dependent variable) was estimated.

**Table 3.** The summary of results of linear regression between circularity (CE) and quality of life (HDI).

Year	Multiple R	Multiple R <sup>2</sup>	Adjusted R <sup>2</sup>	F(1,22)	<i>p</i> ( <i>p</i> <0.05)	Std.err. of estimate
2012	0.561	0.315	0.284	10.111	0.004	0.846
2013	0.559	0.313	0.281	10.007	0.0045	0.848
2014	0.511	0.261	0.227	7.771	0.011	0.879
2015	0.510	0.261	0.227	7.751	0.011	0.879
2016	0.477	0.228	0.193	6.4961	0.018	0.898
Year	Component	Beta	Std.err. of Beta	B	Std.err.of B	t(22)
2012	<i>Intercept</i>			0.000	0.173	0.000
	CE 2012	<b>0.561</b>	<b>0.176</b>	<b>0.561</b>	<b>0.176</b>	<b>3.180</b>
2013	<i>Intercept</i>			0.000	0.173	0.000
	CE 2013	<b>0.559</b>	<b>0.177</b>	<b>0.559</b>	<b>0.177</b>	<b>3.163</b>
2014	<i>Intercept</i>			0.000	0.179	0.000
	CE 2014	<b>0.511</b>	<b>0.183</b>	<b>0.511</b>	<b>0.183</b>	<b>2.788</b>
2015	<i>Intercept</i>			0.000	0.179	0.000
	CE 2015	<b>0.510</b>	<b>0.183</b>	<b>0.510</b>	<b>0.183</b>	<b>2.784</b>
2016	<i>Intercept</i>			0.000	0.183	0.000
	CE 2016	<b>0.477</b>	<b>0.187</b>	<b>0.477</b>	<b>0.187</b>	<b>2.549</b>

The regressions' models are consisting on independent variable only in each year (without intercepts). The results are statistically significant, but not explain the whole dependency. Adjusted R<sup>2</sup> reaches the values between 0.193 and 0.284, what means that in maximum only 28% of the model is explained by this combination of variables. To verify the correctness of the models built in this way, analysis of variance was used (tested hypothesis assumes that there is no difference between means:  $H_0: \alpha_1 = 0$ ). The results of the analysis allow to reject of the tested hypothesis. The F-ratio (from Snedecor's F-distribution) for degrees of freedom (1&22) counts 6.4961 and in each year F is higher than tested ratio (in 2016 is equal, but the difference appears in 6 place after decimal, so I have decided to approve this observation). It can therefore be said that each of the models is correctly matched to the data.

## 6. Discussion

The results of literature review allow to state that there is a lack of analysis of influence of circularity on increasing quality of life. It is possible to assume that the influence exists and it is positive, but there is no evidence based on detailed data. The attempt to evaluate of the connection between increasing circularity (express by use circular materials) and increasing the quality of life level, based on international, aggregated data shows positive impact but in some conditions. Firstly, using indicators concerns the same matter could affects different results (HDI is correlated, and QoL not). It is caused probably due to the construction of the indices and lack of changing methodology of its counting (QoL was changed slightly in analysed period). Secondly, overall data do not reflect the whole spectrum of analysed phenomenon. Adjusted determination coefficient (Adjusted R<sup>2</sup>) in my opinion is not so satisfied and testifies that it is necessary to enrich the model of influence the quality of life by new variables (but it could not reflect only the circular aspects). On that base I can state that there is a real need to conduct deep analysis of several aspects related with circular behaviour of single household members on the chosen quality of life dimension. It is caused the fact, that quality of life has various dimension and is very broad concept, so circularity and – in result – circular economy has

not got direct influence of all of them. So, that is why, there is a need to narrow down the analysis to only direct factors.

Due to the fact, that the present paper is one from the publication series, in next I try to undertake this issue once again and deepen the analysis.

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# People's Republic of China's Economic Diplomacy Instruments in Southeast Asia - Chosen Aspects

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**Abstract:** The paper presents the issue of China's use of economic diplomacy instruments in Southeast Asia. The authors have chosen those they consider to be the most important ones, and their use in Southeast Asian countries has been presented. The goal of the paper is analyzing the role of selected economical instruments used by the China's government in Southeast Asian countries, and answering the following questions: which economical instruments are used by China in the region?; how important is People's Republic of China as a trade partner for SEA states?; what is the role and scale of Chinese direct investment in Southeast Asian countries, including the Belt and Road Initiative?; what are the consequences of China's activities for SEA countries? The methodology of the paper is based on literature review and statistical data analysis. The results show that China has become an important trade partner and a source of FDI for the SEA region, especially for less developed states. Countries such as Cambodia, Lao PDR or Myanmar (which are corrupt and fragile) are areas of PRC economic expansion, which also enhances PRC political influence in the region.

**Keywords:** China; Southeast Asia; trade; FDI; geoeconomic strategy

JEL Classification: O53; O57; P45; P48

## 1. Introduction

*China is a sleeping giant. Let her sleep, for when she wakes she will move the world* - Napoleon Bonaparte is supposed to have said that over 200 years ago. Actually, even if these words were not spoken, China woke up and transformed the world economy and politics. After the period of 'national humiliation' (Wang 2012) (when China was a victim of Western colonialism, tsarist Russia's expansionism, and Japanese militarism and imperialism) and socio-economical experiments by Chairman Mao Zedong, in the end of 1970s People's Republic of China (PRC) initiated pro-market economic reforms, including the 'Open Door policy' and trade liberalisation. The results were spectacular. According to the U.S. Congressional Research Service, *since opening up to foreign trade and investment and implementing free-market reforms in 1979 China has been among the world's fastest-growing economies, with real annual gross domestic product (GDP) growth averaging 9.5% through 2018, a pace described by the World Bank as "the fastest sustained expansion by a major economy in history"*. Such growth has enabled China, on average, to double its GDP every eight years and helped raise an estimated 800 million people out of poverty. China has become the world's largest economy (on a purchasing power parity basis), manufacturer, merchandise trader, and a holder of foreign exchange reserves (Morrison 2019). Table 1 presents the value of China's GDP, export and import in 1979 (the beginning of the transition), 1989, 1999, 2009, and 2018.

**Table 1.** People's Republic of China's GDP, import and export value in 1979, 1989, 1999, 2009, and 2018 (USD) (Word Bank).

	1979	1989	1999	2009	2018
GDP (current USD)	178.281 bn	347.768 bn	1.094 tn	5.1 tn	13.608 tn
GDP (current international USD)	--	1.121 tn*	3.343 tn	11.12 tn	25.362 tn
GDP per capita (current USD)	184	311	873	3,833	9,772
Exports of goods and services	9.204 bn	41.191 bn	198.699 bn	1.25 tn	2.656 tn

(current USD)					
Imports of goods and services	10.561 bn	46.119 bn	168.058 bn	1.03 tn	2.549 tn
(current USD)					

\* Data for 1990

Such economic growth has significantly enhanced PRC regional and international position, which led to a rise of so-called 'fear of China'. At the international level, the United States started to consider China to be a threat for the U.S. global dominance, and the PRC is perceived mostly as an economic and technological rival; however, growing China's military capabilities are also feeding that fear (Ezrati 2018). In 2011, U.S. president Barack Obama announced the 'pivot to Asia' (Manyin et al. 2012, Chen 2013: 39), and in 2018 Donald Trump began to set tariffs and trade barriers on China. It was a clear sign of an ongoing conflict between the two largest world's economies. At the regional level, Japan, South Korea and Taiwan are concerned about growing PRC potential in political, economic and military terms. For Southeast Asian (SEA) countries [...] *the rise of China is a mixed blessing. While they have benefited greatly for its economic ties, they are alarmed about more assertive China in their neighborhood* (Cho and Park 2013: 69). The PRC is more assertive in the South China Sea's territorial disputes, and 'China's peaceful development' (Yi 2005: 78-79) causes some concerns amongst SEA political elites and societies, too. For instance, in August 2018, Malaysian prime minister Mahathir Mohamad alarmed that PRC Belt and Road Initiative (BRI) may be a new form of colonialism and that the Sino-Malaysian deals signed under the former cabinet had been unfair and would leave Malaysia indebted to China (ABC News 2018). Moreover, Indonesia, the Philippines and Thailand raised concerns about their growing dependency on PRC investment, especially in infrastructure (Taj 2019). In fact, since the PRC emerged as a great economic and political power, the balance of power in Asia, including the Southeast Asian region, changed. The RAND Corporation highlights the fact that China considers itself a 'Great Power' and that China's 'Grand Strategy' strives for three main objectives: (1) *to control the periphery and ward off threats to the ruling regime; (2) to preserve domestic order and well-being in the face of different forms of social strife; and (3) to attain or maintain geo-political influence as a major, or even primary, state* (Swaine and Tellis 2000).

Southeast Asia is composed of eleven countries (Brunei, Cambodia, East Timor (Timor-Leste), Indonesia, Lao PDR, Malaysia, Myanmar (Burma), the Philippines, Singapore, Thailand and Vietnam). Ten countries are members of the Association of Southeast Asian Nations (ASEAN), and East Timor is an observer state. In the last decade, SEA experienced a fast economic growth, which accounted for a growing importance of the whole region. Southeast Asia has a significant strategic importance for the PRC in political, economic and military terms. Controlling the SEA region secures the PRC south-east borders, where important cities and industrial centers are located. Moreover, it is a region of potential projection of China's influence and securing the PRC dominant position would be a step towards establishing China a world power, responsible for shaping the international order. Moreover, SEA is economically vibrant and possesses a close communication with China's coastal provinces, which are important for Beijing's rapid economic development (Stuart-Fox 2004: 117). Additionally, two waterways located in SEA (the Strait of Malacca and the South China Sea) play a key role for PRC economic development and trade exchange. About 80% of China's crude oil import passes through the Strait of Malacca and the South China Sea. Particularly, the Strait of Malacca became a PRC strategic chokepoint due to its geography. It is a narrow waterway between the Malay Peninsula and the Indonesian island of Sumatra. During a conflict, it could be easily blocked by hostile forces and the PRC could be cut off from strategic energy resources, mostly crude oil (Zhong 2015, 88-89). This so-called 'Malacca Dilemma' is a challenge for PRC security and development - especially in a long-term perspective - and therefore the reinforcement of China's influence in the region would reduce the risk. A similar situation occurs in the South China Sea basin, which is a crucial waterway not only for Beijing, but also for other Far Eastern countries, including strong economies such as Japan, South Korea or Taiwan. Taking control over the SCS would significantly improve PRC geopolitical position and secure a key sea line of communication (SLOC). Moreover, some SEA countries are strategically important for Beijing. For instance, the Philippines form part of so-called 'first-island chain', which stretches from the Kuril Islands through Japanese Archipelago,



Taiwan and the Philippines to Borneo. From Beijing's perspective, *the island chain idea stimulates China's fear of strategic encirclement, underscores the geostrategic value of Taiwan, frames Chinese military option at sea, and engages important economic interests* (Yoshikara 2012: 293). For PRC economic penetration, the Philippines are much easier target than Japan or Taiwan, especially under the Rodrigo Duterte's presidency (he was elected in 2016, as the 16th president of the Philippines), who leads more pro-Chinese policy than his predecessor. Thailand attracts PRC attention due to the Kra Isthmus. Building a canal through the Kra Isthmus (the narrowest part of the Malay Peninsula) would enable ships to bypass the Strait of Malacca, and for Beijing this has a strategic significance (Menon 2018). Myanmar is a place of Sino-Indo geopolitical rivalry in the Indian Ocean region. Myanmar being a PRC 'client state' would enhance China's presence in the Indian Ocean (Malik 1994: 142-144).

Generally, China has some tools which could help it to achieve its goals in the SEA region: diplomacy, economy, and military power. Despite the fact that growing Beijing's military capabilities give the PRC significant advantage over the armed forces of any other SEA country, using the People's Liberation Army would be the worst option for the PRC. A military conflict in the region could destroy the fruits of China's economic reform and the image of the PRC as a 'status quo power' (Cheng 2013: 54). Additionally, China cultivates its 'soft power' and puts an effort into building a positive image of the whole country (Cheng 2013: 59-60). Thus, although powerful PRC armed forces are one of the pillars of China being a world power, using the army recklessly could only complicate Beijing's plans.

China's economic dominance over SEA would be the most effective and politically profitable, and therefore using economic diplomacy is an obvious solutions for the PRC leaders. Recently, economic dominance has been associated mostly with financial power. Increasing capital mobility combined with the developing countries' need for money may lead to a situation in which a large part of manufacturing industry, key infrastructure, natural resources or financial institutions fall into the hands of foreign owners. It may lead to the situation in which a country becomes dependent on foreign states (Luard 1984). According to Vannarith Chheang (2018), economic statecraft (using economic power to achieve strategic goals), combined with institutional statecraft (the development of multilateral mechanism led by China), are major components of Beijing's economic diplomacy.

In the SEA region, China uses various tools of economic diplomacy. The most important ones include:

1. Trade (overdependence on China as a major trade partner for the SEA countries, dominant Beijing's trading position and very strong balance of payment).
2. Direct foreign investments (the PRC as the key investor).
3. Financial aid (China as an important donor).
4. Credits and loans (overdependence on China as a source of money, risk of the debt trap).

Moreover, the Belt and Road Initiative (BRI), widely discussed and analysed (Google Scholar has shown over 19,500 results, EBSCO 950, and the Web of Science Core Collection 1,232 ones), is also a part of Beijing's economic diplomacy (Chheang 2018) and - despite all the risk and uncertainties - it will improve PRC position, both in the SEA region and international environment (Wang 2016). The Belt and Road Initiative (also called One Belt, One Road) is an ambitious PRC project to build the Silk Road Economic Belt and the 21st Century Maritime Silk Road. The aim of the programme, announced by China's President Xi Jinping in 2013, is construction of infrastructure. On land, China aims to connect its undeveloped regions to Europe through Central Asia (the Silk Road Economic Belt). The 21st Century Maritime Silk Road connects China's southern provinces with South East Asia, the Indian Ocean, part of East Africa, the Red Sea, and the Mediterranean Sea through ports and railways (Cai 2017). In the SEA region, the PRC promotes the China-Indochina Peninsula Economic Corridor, which aims to strengthen the cooperation between China and the Indochina states, and to support trade between the PRC and ASEAN countries, mostly by developing transport network (motorways, railways, and air connection (OBOREurope)). *Belt and Road Initiative (BRI) hopes to deliver trillions of dollars in infrastructure financing to Asia, Europe, and Africa. If the initiative follows Chinese practices to date for infrastructure financing, which often entail lending to sovereign borrowers, then BRI raises the risk of debt distress in some borrower countries* (Hurley et al. 2019: 152). The risk of the 'debt trap' or the debt

problem is more serious in poorer, more fragile and corrupt SEA states which need credits, financial support or aid to improve their economy. However, weak and corrupt institutions do waste money. For Beijing, such situation creates an opportunity to enhance its political and economic influence in a country with a debt owed to official or quasi-official PRC moneylender.

This article presents chosen instruments of PRC economic diplomacy in the SEA region. In the age of growing US-Sino competition, it is important to analyze PRC activity in the SEA region, especially given the fact that China's policy has become more assertive. The goal of the paper is to analyze the role of selected economical instruments used by the Chinese government in Southeast Asian countries and to answer the following questions: which economical instruments are used by China in the region? How important is People's Republic of China as a trade partner for SEA states? What is the role and scale of Chinese direct investment in Southeast Asian countries, including the Belt and Road Initiative? What are the consequences of China's activities for chosen SEA countries?

A review of literature allows for a few remarks. First of all, more publications address the issue of China's economic involvement in African (Li et al. 2013) and South American countries rather than Southeast Asian ones (Quer 2019). Secondly, publications take into account the issue of the Sino-US or Sino-Japanese competition in selected countries in Southeast Asia (Qi et al. 2019). Thirdly, the issue of Chinese leadership in the region is much more often perceived in the context of political rather than economic influence.

In turn, publications present the issue of economic connection between China and Southeast Asia, as follows:

- Southeast Asian direct investment in China (Samphantharak 2011; Buckley et al. 2010),
- Specificity of investment conditions in SEA countries and types of investment undertaken i.a. by China (Lele 2012),
- The role of Chinese enterprises in the region (Liang, Zhou, Liu 2019; Yutian, Zhenge, Yi 2019),
- China's investment diplomacy (Copper 2016),
- Chinese direct investment in Southeast Asia (Frost, Ho 2005),
- Chinese infrastructure investments in the region (Ganesan 2018),
- Chinese overseas industrial parks (Tao et al. 2018),
- economic relations between SEA countries, e.g. between China and Indonesia (Sinaga 2018) or China and Thailand (Lauridsen 2018),
- Chinese economical initiatives in the region (Ba 2018),
- China's Geoeconomic Strategy in Southeast Asia (Sung 2017),
- Chinese impact on regional institutions (Bünthe 2018).

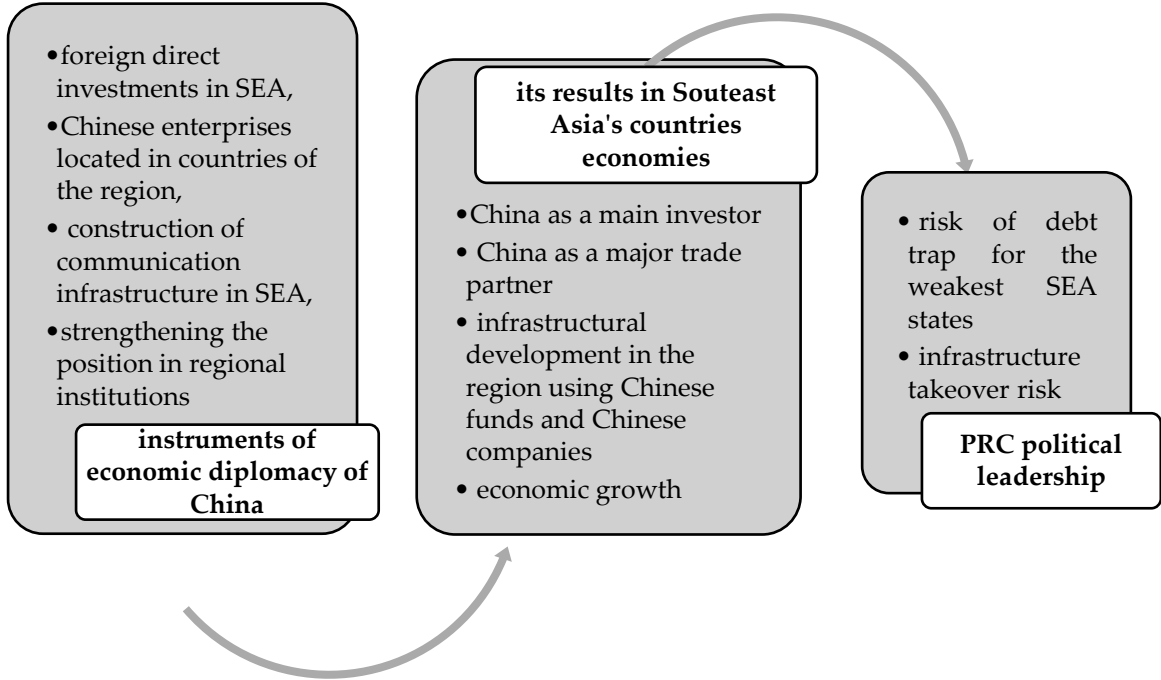
## 2. Methodology

The methodology of the paper is based on literature review and statistical data analysis. The thesis is interdisciplinary since it includes both political and economic aspects, which are interrelated. On the one hand, this interdisciplinarity has a positive dimension since it facilitates explaining many aspects which may be vague from an economist's point of view. On the other hand, it is difficult to estimate to what extent the economic instruments are used to serve economic growth and development, and to what extent they are only aimed at temporary or long-term political purposes.

The authors have chosen indicators such as trade balance, export and import value between SEA and the PRC, as well as the value of Chinese FDI and the scale of public debt in SEA countries. Problem of state fragility and corruption is illustrated by the Fragile State Index (FSI) and the Corruption Perception Index (CPI). Export and import value indicate PRC importance as a trade partner of SEA states. The FDI shows the scale of Chinese economic activity in the region. The scale of public debt, the FSI and the CPI are indicators which illustrate the problem of indebtedness and state fragility in the SEA region.

### 3. Results: People’s Republic of China’s Economic Diplomacy in Southeast Asia - Chosen Instruments

In a European Union’s document, the term ‘economic diplomacy’ has been described as follows: There are at least three strands, each one wider in scope, that are common to all definitions of economic diplomacy: 1) facilitating access to foreign markets for national businesses; 2) attracting foreign direct investment (FDI) to a national territory; and 3) influencing international rules to serve the national interest. (...)The goal can be as narrow as boosting economic growth or as broad as developing geo-political influence and a diplomatic network (EP, Imbert 2017). The document also points out to selection of actors (the state, enterprises) and issues (e.g. natural resources). In Southeast Asia, China has implemented a wide range of economic instruments to become a major power in the region. This, in turn, is supposed to bring specific results (Figure 1), and finally the leadership in the region. As L.S. Lauridsen has emphasized, *China has been seeking to expand its regional influence by engaging in regional rule-making and institution building. The two-pronged strategy of setting up new multilateral investment banks and overseas infrastructure projects (...) has lifted regional competition and infrastructure diplomacy to a higher level* (Lauridsen 2018: 219).



**Figure 1.** Economic diplomacy as a tool to achieve predominance in the region of Southeast Asia.

In terms of economic potential reflected by the GDP and the GDP PPP, there is a huge gap between the People’s Republic of China and SEA countries (table 2). In such conditions, economic diplomacy may be used efficiently, especially in developing states which require investments. Moreover, fragile, corrupt and badly governed countries are more vulnerable. PRC main instruments in low-income countries are direct loans and FDI in commodity-producing industries, energy and transport (Horn et al. 2019: 38-39). Loans form an important PRC economic diplomacy instrument and according to Horn, Reinhart and Treben (2019) [...] *about one half of China’s large-scale lending to developing countries is “hidden” and not recorded in the main international databases used by researchers and practitioners alike. These hidden overseas debts pose serious challenges for country risk analysis and bond pricing.* In the SEA region, Cambodia, Lao PDR, Myanmar and Vietnam are low income developing countries (Horn et al. 2019: 55). Moreover, Cambodia, Lao PDR and Myanmar are classified as fragile states (table 3). Corruption is a widespread problem in all the region, with the exception of Singapore and Brunei (table 3).

**Table 2.** The GDP and the GDP per capita of SEA countries (data for 2018) (Word Bank).

Country	GDP (current USD)	GDP PPP (current international USD)	GDP per capita (current USD)
Brunei	13.567 bn	34.65 bn	31,628
Cambodia	24.572 bn	70.753 bn	1,512
East Timor	2.581 bn	9.694 bn	2,035
Indonesia	1.042 tn	3.495 bn	3,894
Lao PDR	18.131 bn	52.547 bn	2,567
Malaysia	354.348 bn	999.405 bn	11,239
Myanmar	71.215 bn	357.819 bn	1,326
Philippines	330.91 bn	952.967 bn	3,103
Singapore	364.157 bn	571.494 bn	64,582
Thailand	504.993 bn	1.32 bn	7,274
Vietnam	244.948 bn	710.312 bn	2,564

**Table 3.** State fragility (the Fragile State Index - FSI) and corruption (the Corruption Perception Index - CPI) in SEA states (Fragile State Index Annual Report 2019, Corruption Perception Index 2018).

Country	Fragile State Index 2019			Corruption Perception Index 2018	
	Score	Rank		Score	Rank
Brunei	57.5	124	More stable	63	31
Cambodia	82.5	54	High warning	20	161
East Timor	85.5	41	High warning	35	105
Indonesia	70.4	93	Elevated warning	38	89
Lao PDR	78.7	62	Elevated warning	29	132
Malaysia	60.5	119	Warning	47	61
Myanmar	94.3	22	Alert	29	132
Philippines	83.1	50	High warning	36	99
Singapore	28.1	162	Sustainable	85	3
Thailand	73.1	77	Elevated warning	36	99
Vietnam	66.1	109	Warning	33	117

NB: The higher the place in the FSI, the more fragile a state is. A lower score means lesser fragility of an indexed country. The CPI measures public sector corruption in 180 countries, giving each a score between 0 (highly corrupt) and 100 (very clean). The lower the place in the CPI, the less corrupt a state is.

### 3.1 China as a trade partner

In recent decades, the PRC trade value has expanded enormously and China became the top world exporter and the second largest world importer. For SEA countries, this situation is both opportunity and threat. China is becoming an important sales market for SEA economies (table 5). On the other hand, the PRC significantly increased its export to the region (table 5) and almost all the SEA region has a negative trade balance with the PRC (table 4).

**Table 4.** Trade balance between SEA countries and the PRC (The Observatory of Economic Complexity).

Country	Import (bn USD)		Export (bn USD)		Trade balance (bn USD)	
	2007	2017	2007	2017	2007	2017
Brunei	0.129	0.649	0.222	0.314	+ 0.093	- 0.335
Cambodia	1.01	4.77	0.056	0.991	- 0.950	- 3.77
East Timor	--	0.112	--	0.0032	--	- 0.108

Indonesia	9.82	34.3	11.9	25.8	- 2.08	- 8.50
Lao PDR	0.162	1.34	0.071	1.18	- 0.091	- 0.160
Malaysia	16.4	38.1	16.9	42.5	+ 0.5	+ 4.4
Myanmar	1.68	8.34	0.298	4.46	- 1.382	- 3.88
Philippines	5.16	21.9	10.3	20	+ 5.14	- 1.9
Singapore	30.4	42.6	17.7	50.3	- 12.7	+ 7.7
Thailand	16.1	38.3	17.5	40.7	+ 1.4	+ 2.4
Vietnam	11.9	70.6	3.22	39.9	- 8.68	- 30.7

As table 4 shows, only Malaysia, Singapore and Thailand do not have a trade deficit with China, and during the last decade the PRC has improved its trade balance statistics with SEA. Moreover, the PRC is the top import origin for countries such as Brunei, Cambodia, Indonesia, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam (table 5).

**Table 5.** Import and export value of SEA countries, three top import origins and three top export destinations (The Observatory of Economic Complexity).

Country	Total value*		Top three import origins		Three top export destinations	
	Import	Export	Country	Value*	Country	Value*
Brunei	3.14	5.53	<b>PRC</b>	<b>0.649</b>	Japan	1.68
			Singapore	0.604	South Korea	0.795
			Malaysia	0.575	Malaysia	0.627
Cambodia	12	15.8	<b>PRC</b>	<b>4.77</b>	United States	3.06
			Singapore	2.95	Germany	1.78
			Hong Kong	0.908	United Kingdom	1.3
East Timor	0.651	0.108	Indonesia	0.202	Singapore	0.067
			<b>PRC</b>	<b>0.112</b>	United States	0.001
			Singapore	0.085	Indonesia	0.008
Indonesia	153	188	<b>PRC</b>	<b>34.3</b>	<b>PRC</b>	<b>25.8</b>
			Singapore	17.9	United States	19.9
			Japan	13.5	Japan	19
Lao PDR**	6.22	4.7	Thailand	4.04	Thailand	1.84
			<b>PRC</b>	<b>1.06</b>	<b>PRC</b>	<b>1.36</b>
			Vietnam	0.402	Vietnam	0.538
Malaysia	197	263	<b>PRC</b>	<b>38.1</b>	<b>PRC</b>	<b>42.5</b>
			Singapore	28.4	Singapore	35.7
			United States	14.7	United States	33.1
Myanmar	21.3	15	<b>PRC</b>	<b>8.34</b>	<b>PRC</b>	<b>4.46</b>
			Singapore	2.66	Thailand	2.66
			Thailand	2.02	Japan	1.19
Philippines	105	99	<b>PRC</b>	<b>21.9</b>	<b>PRC</b>	<b>20</b>
			Japan	11.6	Hong Kong	14.8
			South Korea	8.74	United States	13
Singapore	293	320	<b>PRC</b>	<b>42.6</b>	Hong Kong	60.8
			Malaysia	35.7	<b>PRC</b>	<b>50.3</b>
			United States	25.4	Malaysia	28.4
Thailand	160	215	<b>PRC</b>	<b>38.3</b>	<b>PRC</b>	<b>40.7</b>
			Japan	26.2	United States	28.2
			Singapore	13.4	Japan	22
Vietnam	204	220	<b>PRC</b>	<b>70.6</b>	United States	46.2
			South Korea	47.7	<b>PRC</b>	<b>39.9</b>
			Japan	13.1	Japan	18.1

\* bn USD

\*\*Data for 2016

### 3.2 Chinese foreign direct investment in ASEAN countries and Timor Leste

In 2017, foreign direct investment flows to ASEAN countries was on the level of 137 billion USD, whereas a year before it was 123 billion USD. Indonesia was the country which noted the highest increase of FDI between 2016 and 2017. The largest source of intraregional investment was Singapore - 69%. It was also the largest investor of the region; the second place was taken by Japan, and the third by China. Among the top 30 digital MNEs present in ASEAN in 2016, the Chinese ones were Alibaba Group – metal and mining (selected locations: Indonesia, Malaysia, the Philippines, Singapore, Thailand, Vietnam) and Tencent Holdings – insurance (Indonesia, Malaysia, the Philippines, Singapore, Thailand, Vietnam). China was also on the second place according to active venture capital companies in terms of investments made in the region. China made investment in construction, real estate and finance. Taking into account the destination of investment and the largest investors, in 2017 Chinese companies dominated in Cambodia (77% of FDI) and Laos (77% of FDI). The third place was taken by Vietnam (10.1% FDI). The lowest level of activities was noted in Myanmar (0.7% of FDI). Table 7 illustrates the scale of Chinese FDI in the SEA region.

**Table 6.** Chinese FDI in SEA states (2013-2018, bn USD) (American Enterprise Institute).

Country	2013	2014	2015	2016	2017	2018	Total
Brunei	0	3.44	0.530	0	0	0	3.97
Cambodia	0.660	0	0.630	0.990	1.23	3.57	7.08
East Timor	0	0	0.560	0	0	0.490	1.05
Indonesia	1.98	4.97	8.55	3.77	7.38	3.3	29.95
Lao PDR	1.33	0.250	3.33	6.58	3.81	3.11	18.41
Malaysia	5.13	4.01	8.66	8.58	6.04	0.930	33.35
Myanmar	0.300	0.370	0	2.65	0	1.62	4.94
Philippines	0.600	1.21	0	2.29	3.6	0.850	8.55
Singapore	1.64	1.84	4.58	4.2	14.17	2.95	29.38
Thailand	0.110	1	0.730	1.14	0.590	3.71	7.28
Vietnam	1.24	0.210	3.52	0.420	1.4	2.41	9.2

About the PRC investment examples, in Cambodia Green Leader Holdings Group (Hong Kong, China) launched construction of cassava processing plant and National Petroleum Corporation (China) launched construction of a 620 million USD oil refinery. Moreover, Chinese enterprises also invest in garment and The Bank of China expands its operations. In Laos, PRC invests mostly in hydropower plants and railway construction. In Myanmar, China is investing in mining, production of animals feed, and garment. In turn, photovoltaic cells production was launched in Vietnam in 2017. Enterprises from China developing in the region include Alibaba, which set up a logistics base in Thailand, or Lenovo, which established a regional hub in the same country.

In total cumulative FDI in ASEAN in the period of 2010-2017, percentage share of China was 11.3% (including Hong Kong), with a value of 106.614 billion USD. At the same time, the share of USA was 12.8% and 120.988 billion USD. Apparently, the differences between the two countries are not very big. China took the third place in terms of greenfield ICT projects between 2013 and 2017. China also took a high position in terms of M&A deals in the period of 2014-2017 (ASEAN 2018).

China also makes infrastructure investment in the region to promote the Belt and Road Initiative (BRI). As N. Ganesan emphasises, China [establishes] a number of a road and rail networks to bypass the Strait of Malacca and directly integrate the country into the region. The mentioned infrastructure investment is the following (Ganesan 2018: 1): Malaysia: railways (the East Coast Rail Line) and ports (the port of Kuala Linggi in Malacca); Myanmar: the port of Kyaukphyu in Rakhine state; the dams on the Salween and Irrawaddy rivers; Thailand: part of the Southeast Asian Belt and Road Initiative.

Investment in Malaysia will help to connect the East and the West Coast of the country, and to develop the Eastern part in particular. Further, China would like to have access to the railway network which connects Singapore and Kunming in Chinese Yunan province. Chinese investment in Malaysia and Myanmar allow for access to the Indian Ocean (Ganesan 2018: 1).

China competes with Japan for infrastructure investment in the region. For instance, China is constructing the Jakarta-Bandung railway section and Japan is modernizing the Jakarta-Surabaya railway connections. In 2017 Japan, following the invitation from India, agreed to develop the Asia-Africa Growth Corridor (AAGC), a maritime route which would compete with China's Maritime Silk Road (Brînză 2018). Japan also provided Myanmar with a loan for construction of roads, power plants, ports, and train stations (Hong 2018: 7). However, there are also examples of cooperation between these two countries, such as the high-speed railway which connects Thailand's three main airports: Don Muang, Suvarnabhumi, and U-Tapao (Brînză 2018).

Infrastructure action taken by China are related with the Belt and Road Initiative. At the same time, Japan is developing two projects: the Partnership for Quality Infrastructure for the period 2016-2020, and the Expanded Partnership for Quality Infrastructure for 2017-2021, both in collaboration with the Asian Development Bank. The intended investment amounts to 100 billion USD and 200 billion USD, accordingly (Brînză 2018).

As Hong points out, *while some mainland ASEAN countries like Laos and Cambodia view the Sino-Japanese competition as beneficial to their countries in terms of economic capacity-building, some maritime ASEAN countries like the Philippines and Indonesia are more concerned about major-power dynamics as a whole, especially Sino-US relations* (Hong 2018: 5). He also describes China's infrastructure diplomacy: *Currently, Chinese investment in the ten ASEAN countries is still much lower than that of Japan (...) and various public funds have been set up to support this venture. Chinese projects are managed by state-owned enterprises (SOEs), and are funded with government-provided loans. China is seen as more flexible and can complete infrastructure projects relatively quickly* (Hong 2018: 14).

PRC investment is both chance and challenge for less-developed and more fragile and corrupt SEA states. On the one hand, it is an opportunity to build infrastructure and industry, and to boost economic growth. However, there have been cases that Beijing offered loans and investments not only for purely economic purposes. In 2017, the analysis of 'Project Syndicate' stated that China had been using debt to bend other states to its will and *unlike International Monetary Fund and World Bank lending, Chinese loans are collateralized by strategically important natural assets with high long-term value (even if they lack short-term commercial viability)* (Chellaney 2017). The PRC 'cash for resources' policy is mostly oriented on poor, fragile countries, which need to develop their infrastructure. In return, the PRC demands access to their natural resources and key existing infrastructure (Gopaldas). The Sri Lankan port of Hambantota is given as an example (Chellaney 2017; Gopaldas).

According to John Hurley, Scott Morris and Gailyn Portelance (2018: 152-153), Lao PRD is at high risk of possible debt distress related to the Belt and Road Initiative. Cambodia has been classified as less threatened; however, Chinese investment in this country are also significant. Both Lao PDR and Cambodia are amongst the poorest countries in the region and they have experienced problems related to state fragility and corruption (Table 3). Moreover, the value of public debt (also in relation to GDP) in the region is growing (Table 8), which creates a condition for 'debt-trap diplomacy', especially when a country is less-developed, corrupt and fragile.

**Table 7.** Public debt in Southeast Asian countries (International Monetary Fund; World Bank).

Country	Public debt (m USD)		Debt (% of GDP)		Debt <i>per capita</i> (USD)	
	2008	2018	2008	2018	2008	2018
Brunei	150	351	0.94%	2.59%	401	793
Cambodia	2,792	6,998	27%	28.64%	200	431
East Timor	0	107*	0%	4.28	0	86
Indonesia	169,006	307,572	30.25%	30.09%	732	1,164
Lao PDR	3,007	9,528*	51.72%	55.80%	509	1,370
Malaysia	95,280	199,175	39.36%	55.57%	3,452	6,150

Myanmar	14,701	26,194	58.56%	38.16%	300	488
Philippines	90,535	128,743	52.14%	38.92%	1,012	1,207
Singapore	186,765	416,198	97.85%	113.63%	38,596	73,807
Thailand	102,323	209,736	34.95%	42.08%	1,570	3,094
Vietnam	38,742	128,357*	39.42%	58.22%	455	1,357

\* Data for 2016

#### 4. Discussion

China is gaining importance as a trade partner in the SEA region primarily thanks to exports of goods, and also loans and foreign direct investments. The reasons for China using these economic diplomacy instruments, the role of each of them in target countries, and the effects of these actions both for China and SEA countries should all be analysed. Undoubtedly, the goal of China is to make countries dependent in order to gain access to raw materials or infrastructure, such as ports or railways. This, though, is part of the Belt and Road Initiative. In turn, countries of the region gain support on their path to development thanks to financial resources or support for infrastructural solutions. On the other hand, those countries are gradually becoming dependent on China, especially if they are the less developed and struggle with foreign debt. PRC loans and FDI are becoming an instrument of China's foreign policy and they are enhancing PRC political influence in the region, especially in countries highly dependent on PRC funds.

Further discussion should include detailed presentation of each country in the region, with the influence of economic instruments used by China taken into account. This would allow for obtaining comprehensive knowledge on the methods of selecting these instruments, depending on the situation of particular countries.

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# The Importance of High Nature Value Areas in the Development of the Rural Areas of Lower Silesia

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**Abstract:** The purpose of this article is to diagnose the state of resources of natural areas under legal protection and to attempt to assess the importance of naturally valuable areas for rural development in the province Lower Silesia in 2005-2018. This study uses desk research methods: descriptive, analytical, and mathematical and statistical (using Excel software). It presents the use pattern of the total area of these lands, according to the forms of protection of their area and subregions administratively separated in this voivodeship. It pays attention to selected possibilities of multifunctional rural development in Lower Silesian Voivodeship, the source of which are the values of the local natural environment. Analysis of source data showed that in Lower Silesia the total area of naturally valuable areas increased, which are under legal protection. Such areas contribute to the multifunctional development of villages and agriculture. Based on the analysis of specialized studies, it was found that in the vicinity of valuable natural and landscape areas in Lower Silesia, various forms of innovative tourism are developing (eco-agrotourism, thematic villages) and organic farming. This is a favorable phenomenon for ecological (better climate, greater biodiversity) and socio-economic (new jobs in rural areas) reasons.

**Keywords:** high nature value areas; rural areas; Lower Silesia

**JEL Classification:** Q0; Q5; R1

## 1. Introduction

High nature value areas include both areas and natural objects under legal protection (national parks, nature reserves, landscape parks, protected landscape areas, Natura 2000 areas, nature monuments, documentation sites, ecological sites, nature and landscape complexes) (Act on nature protection 2020) and those that have not been covered by such protection. One should agree with A. Zielińska that a high nature value area is a broader issue than a protected area (Zielińska 2010).

In Lower Silesian Voivodeship adopted for the research, there are many valuable natural areas and all forms of area and individual protection have been created here (Board of the Lower Silesian Voivodeship...2020; Statistical Office in Wrocław. 2020. Statistical yearbook of Lower Silesian Voivodeship...2020; Marshal's Office of the Lower Silesian Voivodeship. 2020). Geographical location of Lower Silesian Voivodeship makes some valuable natural areas extend beyond Polish borders, to the Czech Republic and Germany.

Numerous areas valuable in terms of nature and landscape, rich mineral water deposits and the largest number of immovable monuments entered in the register of monuments from among all Polish voivodeships (three of them inscribed on the UNESCO World Cultural and Natural Heritage List: the Churches of Peace in Jawor and Świdnica and Centennial Hall in Wrocław) - make Lower Silesian Voivodeship develop dynamically in terms of various forms of tourism and recreation (Marshal's Office of the Lower Silesian Voivodeship 2020).

The purpose of the study is to diagnose the resources of natural areas under legal protection and to attempt to assess the importance of high nature value areas for rural development in Lower Silesian Voivodeship.

The time horizon of the research covered the years 2005-2018; in a few cases this time range was different due to the availability of reliable source data.

## 2. Methodology

The study uses desk research: descriptive, analytical, mathematical and statistical methods (using Excel software). For the preparation of the article, selected subject literature references, specialized studies and data of universal statistics published in statistical yearbooks titled Environmental protection, Environmental protection in Lower Silesian Voivodeship, Statistical yearbooks of Lower Silesian Voivodeship, were used.

## 3. Characteristics of High Nature Value Areas Protected by Law

High natural value areas cover, according to Zielińska:

- Forms of area protection (traditional forms of protection: national parks, nature reserves; newer forms of protection: landscape parks, protected landscape areas; European forms of protection: Natura 2000 areas).
- Forms of individual protection (nature monuments, documentary stands, ecological lands, nature and landscape complexes).
- Forms of species protection of plants, animals and fungi (Protection of plants, animals and fungi of endangered species in the natural environment. Depending on where the protected species are found, species protection in situ or ex situ is distinguished. In situ protection is the protection of plant, animal and fungal species as well as creations of nature in places of their natural occurrence. Ex situ conservation concerns plant, animal and fungal species outside their natural occurrence. It is run in zoos, botanical gardens or gene banks. Ex situ conservation should aim to restore individuals of these species to the natural environment. Ex situ protection also applies to the protection of rocks, fossils and minerals in places of their storage (Poskrobko, Poskrobko 2012; Nature Conservation Act...2020).
- Botanical gardens, zoos, animal rehabilitation centres.
- Green areas and tree stands.
- Municipal greenery and separate protection zones (e.g. city parks, river valleys), the protection of which is not regulated by the Nature Conservation Act (Zielińska 2010).

In Lower Silesian Voivodeship, the traditional forms of area protection include two national parks (Karkonosze and Stołowe Mountains) were created (as of the end of 2018), both are on the list of the International Union for Conservation of Nature - IUCN-WCU) and 67 nature reserves. The Karkonosze National Park has been inscribed by UNESCO on the list of biosphere reserves (UNESCO research program "Man and Biosphere" - MaB). This reserve has a cross-border character (Polish and Czech Karkonosze Biosphere Reserve). Biosphere reserves are a global form of nature protection. The Karkonosze National Park is also covered by the Convention on Wetlands of International Importance, in particular as the living environment of water birds (the so-called Ramsar Convention). As a result of the implementation of the Convention on Wetlands, the "Ramsar" World Reserve Network is created (Convention of February 2, 1971. Journal of Laws No. 7, item. 24 and item 25). In total, seven national parks are covered by this Convention in Poland (Statistics Poland 2020).

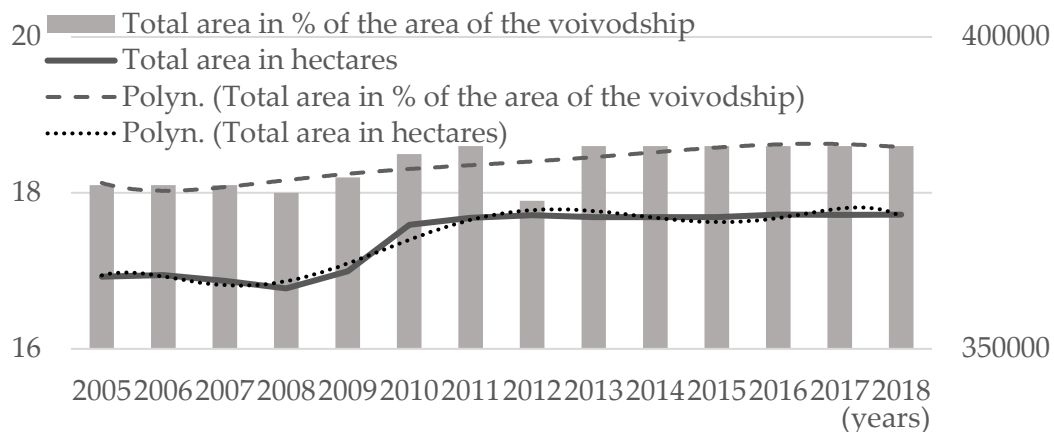
Currently, Lower Silesian Voivodeship has 12 landscape parks and 16 protected landscape areas. The forms of individual nature protection in this voivodeship include: nature monuments (2,579 of such monuments), ecological sites (167, respectively), nature and landscape complexes (18) and documentation sites (4). In addition, different plants, animals and fungi are under species protection. As noted by Boć, Nowacki, Samborska-Boć, in the scope of legal protection of nature, Poland has traditions that go deep into its history. The area protection, in the form of national parks and nature reserves, was decided relatively early, during the Second Polish Republic (1918-1939). New forms of nature protection were introduced only at the turn of the 1970s and 1980s. That was also the time of the qualitative and quantitative broadening of the scope of individual nature protection forms in Poland (Boć et al. 2004).

There are also designated Natura 2000 Areas, the purpose of which is to maintain biodiversity by protecting not only the most valuable and rarest elements of nature, but also the most typical, still widespread natural systems that are characteristic of given biogeographic regions. The NATURE 2000 European Ecological Network began to be introduced in Poland in the early 2000s. These are areas of importance for the European Union, protected in order to preserve natural habitats and species that are important from a supranational (European) point of view, connected by a network of ecological corridors. The NATURA 2000 area, designated in a given biogeographical region, should significantly contribute to the preservation or restoration of the characteristics of that region or ensuring the protection of the species of interest to the European Union (Poskrobko, Poskrobko 2012).

The NATURA 2000 Area Network includes Special Protection Areas of Birds (SPAs) and Special Areas of Habitat Protection (SACs). In the analysed years 2005-2018, their area increased significantly. SPAs areas increased to 292,801.8 ha (3.6 times), and SACs to 354,732.4 ha (increase up to 9.4 times). In total, the acreage of these areas in Poland (SPAs and SACs) increased less dynamically than in Lower Silesian Voivodeship (respectively: 1.6 times and 3 times).

In 2018, the SPAs area constituted 14.7% of the total area of Lower Silesian Voivodeship (by 10.7 percentage points more than in 2005), while SACs respectively 17.8% of the voivodeship's area (i.e. more by 15.9 percentage points). For comparison, in the corresponding period SPAs in Poland occupied 15.7% of the total area of the country, while SACs - 11.2%. In 2018, compared to 2005, the area of both types of these sites increased by 5.8 percentage points and 7.4 points percent, respectively.

In the analysed years 2005-2018, the total area of high nature value areas, covered by legal protection, in Lower Silesian Voivodeship increased to 371, 513.7 ha (by 2.7%). The trend in this respect can be described by the equation for the trend line (equation of the polynomial trend line:  $y = -0.5525x^6 + 24.808x^5 - 421.54x^4 + 3335.3x^3 - 12150x^2 + 18532x + 352437$ ; fitting the trend to data  $R^2 = 0.9589$ ) (Figure 1).



**Figure 1.** General area of special natural values objects legally protected in Lower Silesian Voivodeship in the years 2005-2018 (ha, % of the voivodeship's area).

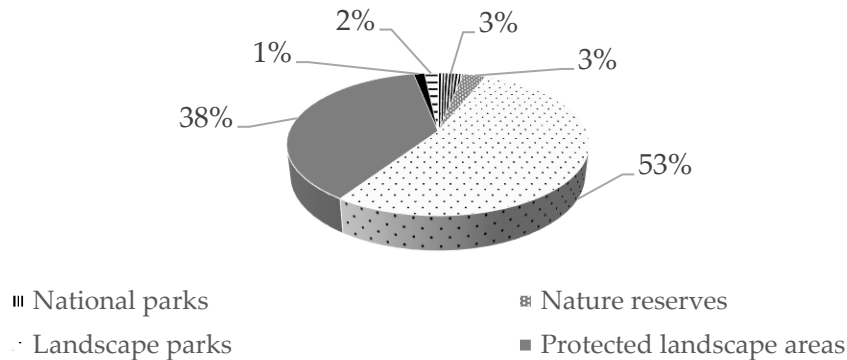
Among the types of areas with special natural values legally protected in Lower Silesian Voivodeship, in the analysed years 2005-2018:

- The area increased, ranking this growth in descending order, in the case of: nature and landscape complexes (up to 6 times, to 9472.4 ha), ecological sites (by 9.1%, to 5242.5 ha), nature reserves (by 3.3%, up to 10,677.3 ha), national parks (by 3.2%, up to 12,303.5 ha) and protected landscape areas (by 1.6%, up to 138,420.6 ha).
- However, the area of landscape parks decreased (by 0.7%, to 195,397.4 ha).

As a result, the share of the total area of high nature value areas in the total area of Lower Silesian Voivodeship increased, up to 18.6% in 2018 (by 0.5 percentage point, compared to 2005). Equation of the polynomial trend line ( $y = 6E-06x^6 - 0.0003x^5 + 0.006x^4 - 0.0603x^3 + 0.3101x^2 - 0.6889x + 18.561$ ; fitting the trend to  $R^2 = 0.5831$ ).

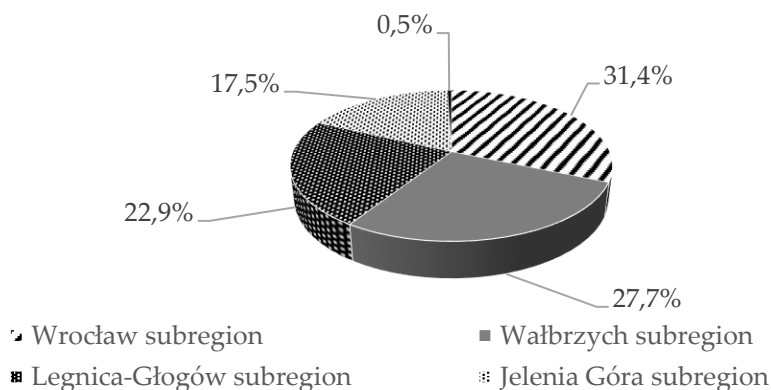
In 2018 general area of high nature value lands per one inhabitant of Lower Silesian Voivodeship was 1,281 m<sup>2</sup> and was larger, by 29 m<sup>2</sup> than in 2005, with simultaneous increase in the population to 2.9 million people.

The largest average annual share (for the years 2005-2018) in the total area of special natural values objects that are under legal protection in the Lower Silesian Voivodeship was the one of landscape parks (53.2%), relatively large areas of protected landscape (37.5%), and much smaller in the case of national parks (3.3%), nature reserves (2.9%), nature and landscape complexes ( 1.7%), while the smallest was the share of ecological sites (1.4%) (Figure 2).



**Figure 2.** The average annual structure of the total area uses in respect to special natural value objects legally protected in Lower Silesian Voivodeship for 2005-2018, by type of area (%).

The structure of the use of the total surface of special natural value areas legally protected in Lower Silesian Voivodeship was analysed according to administratively separated subregions. The analysis shows that Wrocław Subregion has the largest average annual share of the total surface of areas with special legally protected natural values in their total area in Lower Silesian Voivodeship (31.4%). The analysed indicator for Wałbrzych Subregion (27.7%) has a slightly smaller value, and significantly smaller for Legnica-Głogów (22.9%) and Jelenia Góra (17.5%) subregions. The city of Wrocław has relatively the smallest share (0.5%) (Figure 3).



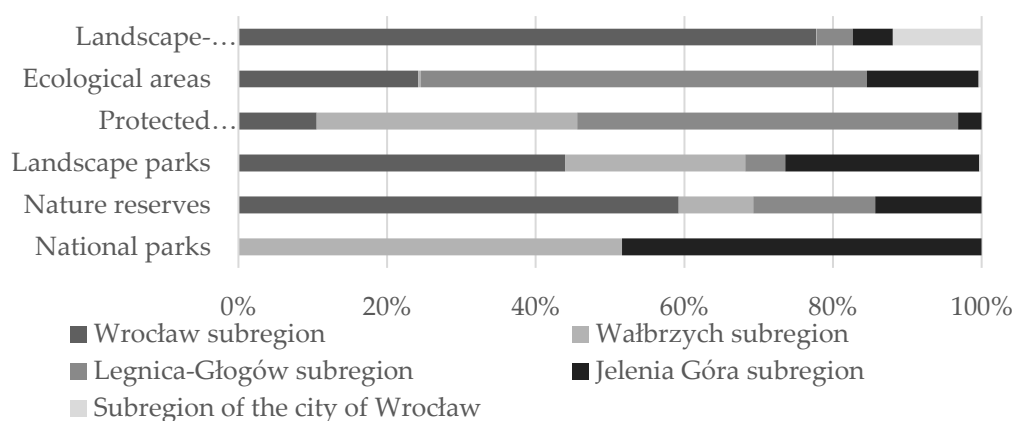
**Figure 3.** The average annual structure of the total area uses in respect to the areas with special natural values legally protected in Lower Silesian Voivodeship by subregions of Lower Silesian Voivodeship (%).

National parks in Lower Silesian Voivodeship were established within its two subregions (Jelenia Góra and Wałbrzych Subregions), out of five administratively separated in this voivodeship. The area occupied by both of them is similar. The share of the area of the Stołowe Mountains National Park in the total area occupied by this form of nature protection in Lower Silesian Voivodeship is slightly larger than in the case of the Karkonosze National Park (51.6% versus 48.4%, respectively). Nature reserves occur in four subregions of Lower Silesian Voivodeship (they were not created only in the city of Wrocław Subregion). The largest share in the total area of nature reserves created in this voivodeship have those located in Wrocław Subregion (59.3%), definitely smaller in Legnica-Głogów (16.4%), Jelenia Góra (14.3%) and Wałbrzych Subregions (10%). Most of the area of nature reserves in Wrocław Subregion is occupied by the "Milickie Ponds " Nature Reserve. It is a unique ornithological

reserve on both Polish and European scale where carp breeding is carried out. In 1995, this reserve was entered on the list of protected areas under the RAMSAR Convention, and in 2000 it was included on the Living Lakes program list as one of the unique water areas in the world (this list includes Lake Baikal and the Dead Sea). The "Milickie Ponds" nature reserve is part of the "Barycz Valley" Landscape Park. It is a nesting area for about 166 species of birds, another 108 species of birds appear there during migrations. In this respect, this reserve is comparable with the Biebrza National Park (Provincial Inspectorate for Environmental Protection in Wrocław. 2020. Report on the state of the environment of Lower Silesian Voivodship...2020).

The "Sulistrowicka Meadow" Reserve is also considered by specialists to be one of the most valuable nature reserves located in Wrocław Subregion. This floristic reserve aims to protect the mid-forest meadows with all the richness of plant species found there. It is located in the Ślęza Massif (Report on the ... 2007). One of the most valuable nature reserves in Lower Silesian Voivodship are also those located in Jelenia Góra Subregion ("Ostrzyca Proboszczowska" and "Myśluborski Gorge" Nature Reserves) as well as in Legnica- Głogów Subregion ("Przemkowskie Ponds" Nature Reserves). The "Ostrzyca Proboszczowska" nature reserve - a floristic reserve; it was also created to preserve a prehistoric relic - an extinct, Tertiary volcano. The "Myśluborski Gorge" nature reserve - a floristic reserve the purpose of which is to protect the stand of a fern - *Phyllitis scolopendrium* - which is the only site of this kind in the Sudety Mountains. The "Przemkowskie Ponds" nature reserve - a fauna reserve; there are 250 species of birds, including approx. 150 breeding ones. Since 2018, this reserve has been part of the NATURA 2000 Area (Board of the Lower Silesian Voivodship...2020; Provincial Inspectorate for Environmental Protection in Wrocław. 2020. Report on the state of the environment of Lower Silesian Voivodship...2020).

Landscape parks have been created in the area of all administratively separated subregions in Lower Silesian Voivodship. The largest share in the total area of landscape parks created in this voivodship have those located in Wrocław Subregion (44%), smaller in Jelenia Góra (26.1%) and Wałbrzych Subregions (24.2%), definitely smaller in Legnica- Głogów (5.4%), while the smallest in the city of Wrocław Subregions (0.3%) (Figure 4).



**Figure 4.** The average annual structure of the total area use of special natural value areas legally protected in Lower Silesian Voivodship by subregions of Lower Silesian Voivodship and the type of areas with special natural values protected by law (%).

Most of the area of landscape parks in the Wrocław Subregion is occupied by the "Barycz Valley" Landscape Park (partly located in the Greater Poland Voivodship). It includes three types of habitats, namely: fish ponds, wet meadows and forests. Important Bird Areas (IBA) as well as SPAs and SACs have been designated in this park as part of the NATURA 2000 Area. Within the "Barycz Valley" Landscape Park, there is the largest fish pond complex in Europe - consisting of almost 300 ponds. It is worth mentioning that the first ponds in this area were built by the Cistercians as early as the 13th century. Currently, there are mainly carp (90% of production), but also grass carp, silver carp, tench, zander, catfish, pike, Prussian carp, roach and perch cultures here. In the area of the "Barycz Valley" Landscape Park there are nature reserves ("Wydymacz", "Radziądz", "Olszyny Niezgodzkie", "Milickie

Ponds", "Joanna's Hill") (Provincial Inspectorate for Environmental Protection in Wrocław. 2020. Report on the state of the environment of Lower Silesian Voivodship...2020).

Protected landscape areas occur in four subregions (they were not created only in the Subregion of the city of Wrocław). The largest share in the total area of protected landscape areas have those created in Legnica-Głogów Subregion (51.3%), smaller in Wałbrzych Subregion (35%) followed by Wrocław Subregion (10.5%), and the smallest share is recorded in Jelenia Góra Subregion (3.2%). Protected landscape areas have been created in the regions of special landscape values that have tourist and recreational significance and can also act as ecological corridors. Only those of protected landscape areas that are created by an ordinance of a voivode or a resolution of the commune council (landscape parks only by an ordinance of a voivode, like nature reserves) are included in spatial development plans (Nature Conservation Act...2020). In turn, agricultural and forestry lands and other real estate located within the boundaries of the landscape park is left for economic use. However, so-called vicinities (protection zones designated individually, securing against external threats resulting from human activity), similar to those around national parks and nature reserves, may be established.

Ecological sites and nature and landscape complexes were created in all subregions of Lower Silesian Voivodship. Such complexes are fragments of the natural and cultural landscape that deserve protection due to their scenic or aesthetic values.

In addition, within the boundaries of Lower Silesian Voivodship, there are objects created in order to provide ex-situ conservation of endangered species of plants, animals and fungi in the natural environment. These include two arboretums (Arboretum in Wojsławice and S. Białobok Forest Arboretum in Ślizzów), the Botanical Garden of the University of Wrocław, the Municipal Zoological Garden and the Gene Bank in Kostrzyca. There are also: Forest Promotional Complex "Rychtalskie Forests" and Forest Promotional Complex "Sudety", which are compact forest areas created for the promotion of pro-ecological forest policy of the state.

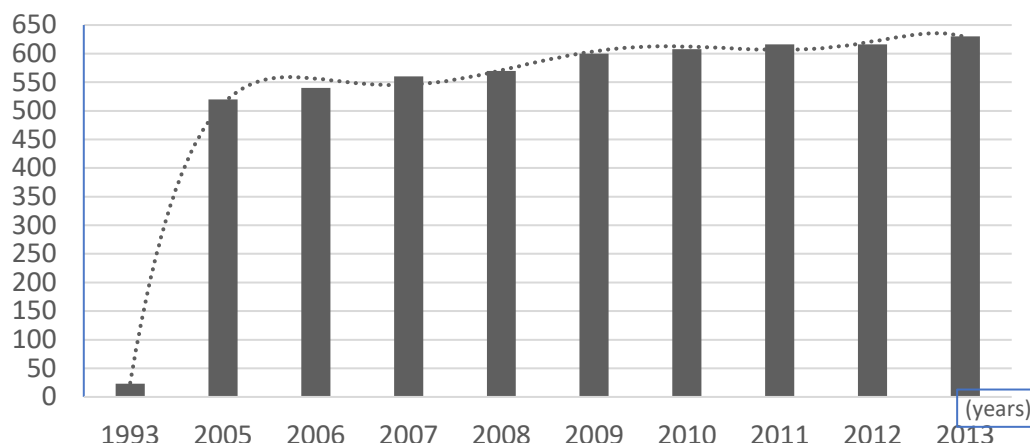
As specialists emphasize, in terms of biodiversity and the rank of landscape values, Lower Silesian Voivodship is one of the most attractive regions in Poland (Provincial Inspectorate for Environmental Protection in Wrocław. 2020. Report on the state of the environment of Lower Silesian Voivodship...2020).

#### **4. Some Possibilities of Using the Assets of High Nature Value Areas**

Areas valuable in terms of nature and landscape features as well as cultural values (especially material heritage resources) that occur in Lower Silesian Voivodship are conducive to the development of various forms of tourism and recreation, including their innovative forms (e.g. eco-agritourism, theme villages, educational farms) and organic farming, as it is in general in Poland and the European Union. They stimulate multifunctional and sustainable development of villages and rural areas (Marshal's Office of the Lower Silesian Voivodship. 2020. Development strategy of Lower Silesian Voivodship 2020...2020; Zielińska 2013, Lower Silesian Agricultural Advisory Center. 2020. The state and development of agritourism in Lower Silesia...2020) in terms of the number of immovable monuments entered in the register of monuments, Lower Silesian Voivodship occupies the first position in Poland, over 83,000 historic buildings. The churches of Peace in Jawor and Świdnica as well as Centennial Hall in Wrocław have been entered on the UNESCO World Cultural and Natural Heritage List. The highest share in national resources (24%) is held by residential complexes located in this voivodship - castles and palaces, including the largest on the regional scale castle in Książ near Wałbrzych, and the accompanying historic facilities of shaped greenery - parks and gardens (12%) (Marshal's Office of the Lower Silesian Voivodship. 2020. Development strategy of Lower Silesian Voivodship 2020...2020).

According to estimates, currently there are over 600 agritourism farms in Lower Silesian Voivodship. Compared to the beginning of the 1990s (23 agritourism farms in 1993), their number increased dynamically, which can be described by the equation of the trend line (equation of the trend line:  $y = - 0.0923x^6 + 3.4408x^5 - 5.135x^4 + 384.85x^3 - 1534.5x^2 + 3063.6x - 1841.8$ ; fitting of the trend to data  $R^2 = 0.9977$ ) (Figure 5). Most of these farms are located in the mountain and foothill areas of the voivodship, in the vicinity of high nature value areas.



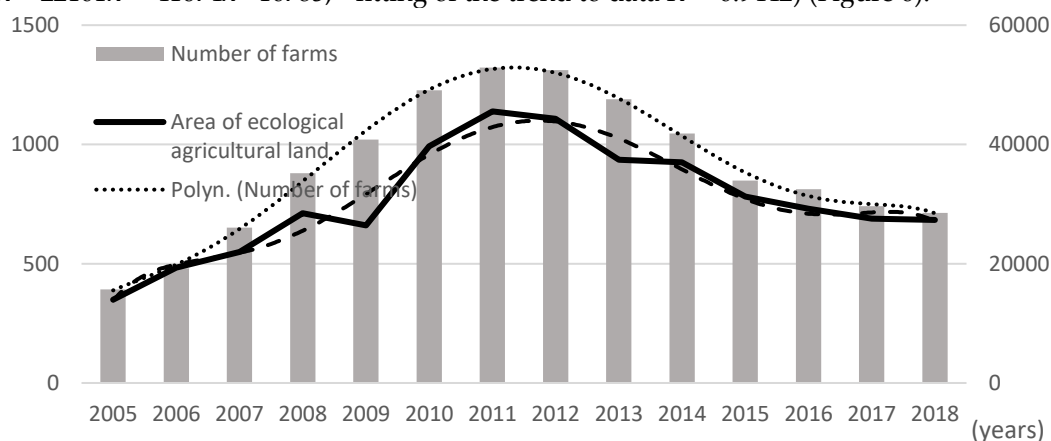


**Figure 5.** Number of agritourism farms in Lower Silesian Voivodeship in 1993 and in the years 2005-2013.

The advantage of these rural quarters is their offer enriched with homemade food, the possibility of horse riding, carriage rides, participation in sleigh rides with torches. Joint mushroom picking, art workshops and other events are organized (Lower Silesian Agricultural Advisory Center. 2020. Lower Silesian agritourism catalog...2020). The source of supply for these farms with products are very often raw materials obtained from their own crops, farmed using environmentally friendly methods (ecological farms) or bought from the neighbours running such farms (eco-agritourism).

One should agree with the thesis that the strength of agritourism farms in Lower Silesia comes from its proximity to the Czech Republic and Germany. Tourists from Germany are frequent guests in such accommodation facilities, and this is often due to their sentiment to these areas (until World War II these areas belonged to Germany) (Kurtyka-Marcak, Kropsz-Wydra 2014).

In the analysed years 2005-2018 the number of organic farms in Lower Silesian Voivodeship increased, to 713 (by 81.4%), the area of their ecological agricultural land grew to 27,357 ha (by 95.8%). Nonetheless, multidirectional mid-term fluctuations (increase-decrease fluctuations) are observed. After the initial increase (2005-2011), both the number of these farms and the analysed area of land decreased (2011-2018). In the years 2005-2011 the number of organic farms increased to 1322 (3.4-fold increase), while the area of ecological agricultural land occupied by them increased to 45,546 ha (3.3 times, respectively). In the subsequent examined period (2011-2018), the number of organic farms decreased to 713 (decrease by 46.1%), while the area of ecological agricultural land occupied by them decreased to 27,357 ha (decrease by 39.9%). There were similar trends in Poland in general, which is unique in Europe. Changes in the considered area in Lower Silesian Voivodeship can be presented in the form of a polynomial trend lines (the equations of the polynomial trend lines take the following forms: Number of organic farms:  $y = -0.013x^6 + 0.5563x^5 - 8.5749x^4 + 55.93x^3 - 147.32x^2 + 271.44x + 216.24$ ; fitting of the trend to data  $R^2 = 0.9955$ ; Area of organic farm:  $y = -0.9056x^6 + 41.323x^5 - 711.96x^4 + 5732.9x^3 - 22101x^2 + 41674x - 10785$ ; fitting of the trend to data  $R^2 = 0.9442$ ) (Figure 6).



**Figure 6.** Organic farms in Lower Silesian Voivodeship in 2005-2018 (farms, ha).

According to the Report on the Commercial Quality Inspection of Agricultural and Food Products, the decrease in the number of organic farms and the area they occupy i results from a combination of many factors. They include, in particular, the lack of successors in the situation of retirement of the current host; difficulties in selling raw materials for organic processing plants, and as a result difficulties in obtaining profitability of production, with its relatively small scale; lack of employees (higher human labour input in organic farms); the lack of production directed to the market and the use of subsidies as the only source of income that would expire with the end of rural development programs from which such farms are supported (BioKurier. pl. 2020. The number of organic farms in Poland is decreasing...2020).

One of the innovative forms of rural tourism includes thematic villages, the most of which, when compared to the administrative units in Poland, were created in Lower Silesia Voivodeship (over 68). Such villages are often based on local natural, cultural or historical resources (in Lower Silesia, e.g. historical, educational and natural paths along the trail of stone crosses in Czaple in the Land of extinct volcanoes).

Among the innovative forms of rural tourism, usually of weekend-break type (several-hour stays), educational farms can also be mentioned. Educational farms - an enterprise based on European experience, established on the initiative of the Agricultural Advisory Centre in Brwinów on behalf of the Ministry of Agriculture and Rural Development. It comprises the network of educational farms located in rural areas throughout Poland. The main purpose of educational farms is to raise the prestige of the farmer's profession and to disseminate knowledge about the origin of food, diversify non-agricultural activities in rural areas, and preserve the cultural heritage of the village. In Lower Silesian Voivodeship they are concentrated in mountain and foothill areas (Agricultural Advisory Center in Brwinów. 2020. Catalog of educational farms 2015...2020).

They contribute to economic recovery of the village, integration of the local community and increase of self-esteem of the village inhabitants. Thematic villages and educational farms primarily create new jobs in the countryside, skilfully using various types of resources, including valuable natural and cultural ones. They can also contribute to the professional and social activation of older rural residents. Such an initiative is an opportunity to obtain external funds and new partners interested in rural development. As a result, it brings measurable socio-economic effects. Most of the thematic villages and educational farms create their tourist product based on regional gastronomic and agricultural products, including those from organic farms (Idziak 2008; Kłoczko-Gajewska 2015; Sala 2016; National portal of thematic villages 2020).

The protection of high nature value areas in the European Union is financially supported by a special fund, the LIVE Financial Instrument. The LIVE Financial Instrument aims to support The 7th Environmental Protection Action Program, which sets out the tasks of the European Union's environmental policy. The priority objectives of the Seventh Program are: protection, preservation and improvement of the Union's natural capital; transforming the Union into a resource-efficient, green and competitive low-carbon economy; protecting Union citizens against environmental pressures and threats to health and well-being; maximizing the benefits of environmental legislation, improving knowledge and evidence base in the field of environment and climate protection; securing ecological investments and supporting sustainable cities; better consideration of more coherent environmental policy in activities and effective international challenges regarding the environment and climate (Now the environment pl. 2020. The Seventh EU Action Program for the protection of the environment...2020). As the only one, it focuses entirely on the field of the environment.

## 5. Conclusions

High nature value areas should be considered a broader concept than protected areas. Protected areas are covered in Poland by certain legal provisions, in accordance with the Act on nature protection. Some of the high nature value areas are not covered by such regulations.

Lower Silesia Voivodeship has all forms of nature protection included in Polish legislation, including the ones of international range, extending to the territories of Poland and the Czech

Republic (e.g. Karkonosze National Park) and numerous areas and objects that were not covered by such forms of conservation but should be considered high nature value areas.

In the analysed years 2005-2018, the total area of high nature value land under legal protection increased in Lower Silesia, just like in Poland in general. As a result, the share of this area in the total area of the studied region increased. This is a positive phenomenon, not only for ecological (environmental), but also for socio-economic reasons.

The richness of the Lower Silesian animate and inanimate nature, and additionally numerous landscape values of many sites and the history of this region affect the development of various forms of tourism, including innovative forms of rural tourism (eco-agritourism, thematic villages or educational farms), which are supported by EU funds. This stimulates the multifunctional and sustainable development of villages and rural areas.

Organic farming is also developing in the analysed region. However, a surprising phenomenon is the observed decrease in the number of organic farms and the area of arable lands they use in Lower Silesian Voivodeship in the examined period. A similar tendency occurs in Poland in a mediocre way and may be considered unique in the whole Europe, where a different phenomenon is observed - an upward trend.

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# Implementation of GDPR into Payroll Accounting in the Czech Republic

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**Abstract:** The General Data Protection Regulation (GDPR) 2016/679 which came into effect on 25 May 2018 is a regulation in EU law on data protection and privacy for natural persons - individual citizens. Payroll accounting is one of the most affected by the GDPR as it handles personal information and focuses on the exchange of personal data between employees, employers and authorities like the tax office and the social security and health insurance institutions. Methods for compiling this paper include a desk research and a case study of GDPR implementation into a payroll accounting in a small company in the Czech Republic. The results show that the main obstacles in the implementation of GDPR are related to the physical and personal security of data protection.

**Keywords:** GDPR; payroll accounting; employees, wages, data protection

**JEL Classification:** M14; M48; M41

## 1. Introduction

The General Data Protection Regulation (GDPR) 2016/679 is a regulation of the European Parliament and of the council of European Union on the protection of natural persons with regard to the processing of personal data and on the free movement of such data. This regulation is applicable in all EU member states from 25 May 2018 and replaces the previous Directive 95/46/EC on the protection of individuals with regard to the processing of personal data. Rapid technological developments and globalization have brought new challenges for the protection of personal data. As (Rindaşu 2017) states, the technological progress brings obvious benefits for the companies and the development of the accounting profession, helping to reduce the costs by increasing the productivity level and enhancing process automation. Personal data protection and new technologies has a common challenge: the security of sensitive data.. According to the GDPR regulation, personal data means “any information relating to an identified or identifiable natural person (‘data subject’); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person”. There are some special categories of personal data (‘sensitive data’) which should not be processed (Article 9, GDPR 2016/679), such as racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person’s sex life or sexual orientation. Biometric data means personal data resulting from specific technical processing relating to the physical, physiological or behavioural characteristics of a natural person, which allow or confirm the unique identification of that natural person, such as facial images or dactyloscopic data. Data concerning health means personal data related to the physical or mental health of a natural person, including the provision of health care services, which reveal information about his or her health status. Processing data means any operation which is performed on personal data, whether or not by automated means, such as collection, recording, organisation, structuring, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, restriction, erasure or destruction (GDPR 2016/679). Data processing is constantly under threat due to a number of challenges, such as the accelerating change of technology, open networks, third-party dependencies, stakeholder involvement and government requirements for stricter regulation through compliance and

policies (Chatzipoulidis et al. 2019). A processor is a natural or legal person, public authority, agency or other body which processes personal data on behalf of the controller. (Article 9, GDPR 2016/679).

Processing data is supposed to be lawful for example only if and to the extent that the data subject (the person) has given consent to the processing of his or her personal data, or processing is necessary for the performance of a contract to which the data subject is party or in order to take steps at the request of the data subject prior to entering into a contract (GDPR 2016/679). Employees are data subjects where data processing is necessary due to statutory requirements regarding their employment contract and to liabilities to the tax office and other authorities, like the Czech Social Security Administration. The GDPR regulation offers the member states a more individual approach as to the employees' data, in their Article 88 which says that the EU member states may provide more specific rules to ensure the protection of the rights and freedoms in respect of the processing of employees' personal data in the employment context, in particular for the purposes of the recruitment, the performance of the contract of employment, management, planning and organisation of work, equality and diversity in the workplace, health and safety at work, protection of employer's property and for the purposes of the exercise and enjoyment of rights and benefits related to employment, and for the purpose of the termination of the employment relationship.

In the Czech Republic, Act No. 110/2019 Coll. on personal data processing is the implementation of the EU new legal framework of GDPR. Both GDPR 2016/679 and Act No. 110/2019 adapt to a modern need of data protection to ensure they are effective. (The Czech Office for personal data protection 2019)

## **2. Methodology**

The methods for compiling this paper include a desk research and a case study of GDPR implementation into a payroll accounting in a small company in the Czech Republic. The desk research focused on the legal framework related to GDPR (GDPR 2016/679) and on the data required for calculating the wages in the Czech Republic (mainly related to the calculation of the personal income tax of the employees, determined by the Czech Income Tax Act No 586/1992 as amended up to date). Data for the case study were collected in 2018 by a third party (a student who works there).

## **3. Results**

Every data processor (company) needs to have a legitimate reason as to why they hold an individual's personal details. Data processors can hold employee's payroll information to complete the payroll (see Table 1), such as the employee's date of birth. Under the GDPR legislation, this is classified as a valid and legitimate reason to hold a personal data. To understand what type of information is needed to calculate the wages to be paid and the mandatory deductions, it is necessary to know how the wages are calculated in a specific country (see chapter 3.1).

### *3.1. Personal data required in payroll accounting in the Czech Republic*

In the Czech Republic, wages to be paid are calculated as gross wages (recorded wages as a liability to employees based on their performance or fixed base, plus bonuses and/or personal supplements) minus the mandatory deductions (like income tax and social and health insurance contributions) minus individual personal deductions (regarding child support, court-ordered deductions in case of seizures, savings, etc.). The determination of the gross wages are based on records of personal performance and in some cases also on the previous work-related qualifications. The evidence of these personal data is necessary to determine the gross wages. Other personal information is needed to calculate the income tax. In the Czech Republic, the tax base for the personal income tax is calculated as super gross wages (gross wages before any deductions plus 34% of these gross wages, rounded up to full 100 CZK (in case of calculating the monthly advance payments of income tax ) to get the tax base. This tax base is then multiplied by 15% (personal income tax rate in the Czech Republic). The calculated income tax amount can be reduced by various tax credits such as the

**Table 1.** Categories of necessary information of employees for data processing.

<b>Category</b>	<b>Personal data included</b>
Data needed from the employee based on the requirements of the Czech Labour Law No 262/2006 Coll.	Data about the identification of the employee, data about the employee's work attendance record, data necessary to calculate the income tax, sick-leave, pension contributions, health insurance, contributions to a social care, data necessary for payroll accounting
Data needed for the fulfilment of the employment contract	Contact information, bank account identification, data about work performance, records about absence in the work place including the reasons, other information necessary for calculating the wages and compensations and the payment to the employee's account
Legitimate interest of the employer due to administrative and operating needs	The use of cameras, GPD tracking of employees' cars, the use of photos of employees

personal income tax credit (applicable in general for all employees) and other tax credits where additional personal information is necessary. These other tax credits are related to the disability credit (there is a need for medical evidence as to the level of disability), students tax credit (there is a need for confirmation from the school the employee attends), children's tax credit (there is a need of further information about the children as to their date of birth and personal identification number). The annual tax refund settlements of employees with the tax office include a need for additional personal information, if the employee wants to apply the tax levies available. This information (which can reduce the employees' annual tax base according to the Czech Income Tax Act and result in refunds) include a necessary evidence about the interest paid of their mortgage (up to 300 000 CZK for a year for a household – note: only the interest paid can be included in the decrease of the tax base, not the total mortgage payments), gifts given for public purposes (the most common public gift is a blood donation, it can reduce the annual personal tax base by 3000 CZK per donation. Other possible reductions of the annual personal tax base include payments of individual life insurance and individual pension contributions. All these deductions has to be evidenced (by providing contracts or confirmations by other parties) and has to be given to the payroll accountant to apply these deductions in the employee's annual income tax settlement. Other personal data required for tax purposes in the annual tax settlement is the information about the co-habiting spouse with no income (in the Czech Republic the upper limit is an income of 68 000 CZK per year to be considered as a co-habiting spouse with no income – usually spouses who stay at home to provide care for the children). (Czech Income Tax Act No 586/1992 as amended). Table 2 and Table 3 shows examples of personal data necessary for HR purposes and general payroll accounting.

**Table 2.** Examples of necessary personal information of employees for various purposes.

<b>Categories</b>	<b>Include</b>	<b>Examples of personal data</b>
Data necessary for HR purposes, general payroll accounting, and identification	CV, documents proving education, information necessary for social contributions and health insurance evidence, data required by the national employment office, by the Foreign Police or by other governmental offices	Name, titles, date of birth, bank account, personal identification number

Data related to health condition	Pre-recruitment medical exams to determine if an employee is physically fit to perform his/her work duties, data related to sick-leave, data related to disability	Results of medical exams (in some cases without specification, in some cases with specification)
Data necessary for tax reliefs	Evidence of contracts and payments	Details of life insurance payments, pension contribution payments, savings, interest payments on mortgage, evidence of disability, evidence of gifts given to public (blood donors)

### 3.2. The implementation process of GDPR

The implementation process of GDPR usually includes:

1. a data protection audit,
2. preparation of the implementation plan,
3. implementation of GDPR and
4. regular check-ups.

The first step of the implementation process of GDPR is a data protection audit. The audit will assess the risk of non-compliance with data protection legislation and highlight any areas of risk to their compliance. (ICO 2018). A data protection audit may identify weaknesses regarding the company's handling of personal data. The data audit of employees includes several steps, such as setting the scope areas and criteria of the audit, review of stored personal data available, analysis of compliance with GDPR, identifying the risk areas and proposing adjustments to achieve compliance with the GDPR regulation.

The implementation plan of GDPR includes a revision of internal processes ensuring the security of personal data, the decisions of whether a company needs a data protection officer, preparation of documentation for the Records of processing activities, plan of risk solutions related to GDPR and staff training. The most important part is the documentation of Records of processing activities (Vodička and Drábková 2019).

**Table 3.** Information necessary for wages calculation in the Czech Republic.

<b>Wages to be paid and deductions</b>	<b>Mandatory and voluntary deductions</b>	<b>Information needed</b>
Gross wages	Base of calculation	Work attendance sheet, evidence of absences and holidays, performance evaluation data, previous education and work experience data
Social and health insurance contribution	Mandatory deduction of 11 % of gross wages (6,5 % for social contribution, 4,5 % for health insurance)	Evidence of personal tax reliefs applied either monthly or annually (medical proof of disability, date of birth of children, confirmation of school, dependent spouse's information, interest on mortgage payments, payments of individual life insurance or pension, public gifts confirmation (blood donation), etc.



Personal income tax	Mandatory deduction of 15 % income tax rate of the tax base (tax base equals to gross wages plus 34% of gross wages) after tax credits	Contracts and bank account specifics, proof of payments
Other deductions from wages	Mandatory or voluntary deductions (alimonies, child support and other court-ordered deductions, voluntary savings, contributions to individual life insurances, payments of mortgages	

<sup>1</sup> Own processing based on the Czech legal requirements

The implementation of European data protection is a challenge for businesses and has imposed legal, technical and organizational changes for companies. (Poritskiy et al. 2019)

The implementation of GDPR requires an implementation of technical and operating measures ensuring data protection and preventing unauthorized access includes (based on Vodička and Drábková 2019):

1. Physical security of data protection – data in printed or written form includes hard copies of electronic documents, hand written documents or notes, access to workspaces, printers, fax machines and trash receptacles.
2. IT security of data protection – include data encryption, complex passwords, technical security and monitoring measures like the history of data changes in files (time and the user), data backup.
3. Personal security of data protection – include the access authorization of employees to the file system and removing the access to an account when employees leave the company.

### 3.3. . Case study of implementing the GDPR into the payroll accounting

The company is a small manufacturing limited liability company, a legal entity registered in the Czech Commercial Register for entrepreneurs. The company has around 40 employees. It uses the Czech economic software Pohoda for processing necessary general and payroll accounting. Personal data are saved in this economic software and in a form of physical (hard-copy) personal employee records.

**Table 4.** Examples of personal data processed by the payroll accountant.

User of personal data	Purpose of processing	Examples of personal data processed
Payroll accountant	Calculation of wages, social and health insurance contributions, income tax calculation	Name of the employees (first name, family name), date of birth, personal identification number, address, data about ability to work, work performance and attendance sheets, data about the health insurance company, phone number, email, bank account number, data about children and spouses (including their date of birth and personal identification number), disability claims medical records

<sup>1</sup> Own processing based on the company's information

Table 3 shows the necessary information which is generally required in the Czech Republic for calculating the wages. Table 4 shows examples of the extent of personal data the payroll accountant has to use for fulfilling the statutory requirements. The personal data audit focused on the type of data stored, the necessity of these data, the physical, IT and personal security of data protection. Examples of non-compliance with GDPR in some areas are shown in Table 5.

Physical security of the employees' hard-copy records was not ensured sufficiently. Unauthorized access was possible, as the records were stored in open shelves albeit in an office which could be locked. The company invested in new filing cabinets which can be locked.

IT security of data protection – the company uses a very common Czech economic software. The supplier of this software gave free updates of the software to increase the compliance with GDPR. This update included a new feature in the Directory (Personal address book), which focus on the „Description of personal data“ where all the information about the employees is stored and is ready to print it out and provide it to the employee (as one of the requirements of GDPR is to provide employees with the summary of their personal data if they wish so). Another sub feature of the updated Directory is the possibility to assign for every personal information the legal reason why it is stored (like for tax purposes). There is a feature enabling to manage and change the access rights to specific information or databases.

The company can send official documents to the data box of the authorities or to the application of financial administration (tax purposes) and the Czech Social Security Administration directly from this software. This helps the company to ensure the security of electronic submission of data to the authorities, which is possible to invoke through the command under the menu for the declaration, respectively overview. Data sent by electronic submission is encrypted and provided with an electronic signature. There is also a possibility of upgrade offered by the software supplier to a more advanced version of the economic software, but it was rejected by the company as not necessary.

**Table 5.** Issues related to the Implementation of GDPR in the company.

<b>Criteria</b>	<b>Assessment</b>	<b>Reasons/Remedy</b>
Designation of a data protection officer	No necessary impact assessment	no <b>high</b> risk of unauthorised interference with the rights and freedoms of the data subject
	Not necessary	the processing is not carried out by a public authority (the company is not a public authority), there is no need for a constant monitoring of data subjects, no special categories of personal data
Personal data stored	Copies of identity cards (IDs) and health insurance cards and, former job applicants CVs found	necessity to dispose of these documents
Physical security of data protection	Hard-copy employee records filed in a book-shelf	Filing cabinet for the records with a lock
Personal security of data protection	Access to most files in the economic software by various employees	Authorizations for access
IT security of data protection	Encrypted data, complex passwords	Sufficient

Special categories of personal data	No special categories of personal data	Only health related non-specific documents (as an evidence for tax reliefs for disability)
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Personal security of data protection was not sufficient enough as the access to information was not strictly determined. All database systems are now password protected and access is terminated to people with a legitimate reason for doing so. All user names must have a password which has to be changed reasonable frequently and also to have a level of complexity. The document „Records of processing activities“ were created where it was determined in a written form what is the purpose of data processing (like employees data for internal administration and labour law related content), who is the data subject (employees), categories of personal data ( like information related to the fulfilment of work contract), duration of processing (how long these personal data are available for processing), etc.

Expenses related to the implementation of GDPR in the company (economic impact) were around 45 000 CZK (around 1 800 €, if 1 € = 25 CZK). Most of the expenses were related to the overtime wages of the accountants (the accountant of the company spent approximately 15 hours and the payroll accountant around 28 hours with the preparation of the implementation of GDPR). Other expenses were related to the purchase of the filing cabinets with a lock, staff training, IT consultations, lawyer consultations, website alteration and literature.

#### 4. Discussion

The positive points about the GDPR regulation are that employees have greater rights to be informed about how long their information will be stored and how it will be used. Employees can also request access to the personal information that is held on them and they can request to have it rectified and in some cases where there are no compelling reasons to retain the data, they can request for it to be deleted (erasure).

Employees now

have the right to increased transparency to ensure their data is being managed correctly. As (Poritskiy et al. 2019) states, the main benefits identified by the application of European data protection include increased confidence and legal clarification.

In the case study, the SME company relied on the economic software provider to update the software they use for the compliance with GDPR to ensure IT security of data protection. Even if the software provider offers updates, data protection depends also on the human factor as IT security is only one part of the technical and organizational measures a company has to take. This issue is pointed out for example in the findings of (Kapoor et al. 2018), where research showed an over-emphasis on technical measures.

A company can recruit an external firm to provide the GDPR implementation, but even though it may appear as cheaper, it is not always the best way as the external firm cannot provide sufficiently the necessary internal data audit.

#### 5. Conclusions

GDPR requires an implementation of technical and operating measures ensuring data protection and preventing unauthorized access. Physical, IT and personal security of data protection has to be implemented. In payroll accounting, a large amount of personal data need to be processed due to statutory requirements regarding information for the calculation of wages and mandatory deductions from wages such as the income tax and the social and health insurance. Physical records of the employees has to be stored in a safe place with a lock and limited access. Internal data audit has to ensure that a company does not have any personal data which is not necessary or not legal, i.e. copies of identity cards or health insurance cards or personal data of former employees.

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# Best Practice in Technology Transfer on Selected Examples from the South Bohemian Region

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**Abstract:** Technology transfer and perhaps even more knowledge transfer in general drives forward, connects, and helps create a shared platform between institutes of higher education and academic institutes on one hand and businesses on the other hand. A demonstration of good practice is an example to follow and evidences the belief that this interconnection of both worlds, i.e., the academic and the business one, is meaningful and, above all, contributes to the dynamic development of companies and increases their competitiveness. Within our qualitative research, we focused precisely on this question and analysed which areas across different public universities are most promoted and by which factors in the first place. The main finding was the fact that innovation vouchers as an incentive to facilitate cooperation between the academic and the business environment are highly effective. Cooperation established in this way continues further in the following years to the satisfaction of everyone involved.

**Keywords:** motivation; technology transfer; commercial entities

**JEL Classification:** L2; L5

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## 1. Introduction

The main mission of research institutes also includes mediation in the field of innovation to other actors interested in this innovation (Dubickis and Gaile-Sarkane 2015). This involves public dissemination of R&D results through industrial research, experimental development, or knowledge transfer (Bessant and Francis 2005; Horner 2014). Knowledge transfer according to the Committee communication – framework for state aid for research, development, and innovation 2014/C 198/01 is defined by Komárek as follows: “A process aiming to obtain, gather, and share explicit and implicit knowledge, including skills and competences in economic and non-economic activities, such as cooperation in research, consulting, licensing, founding spin-off companies, publishing, and mobility of researchers and other staff involved in these activities. In addition to the scientific and technical knowledge, it includes also other types of knowledge, e.g., knowledge concerning the use of standards and legal regulations containing these standards, knowledge of the conditions of real-life operating environments and methods of organisational innovation, as well as knowledge management with respect to identifying, acquiring, protecting, defending, and exploiting intangible assets” (Komárek 2016). Uchida (1990) describes technology transfer as a new era of industrialisation. Petříčková (2017) contends that among the most significant obstacles to the development of technology transfer in the Czech Republic was what is known as the “demotivation factor”, which impacted the meaning of technology transfer itself. She states that in the Czech Republic, there was at first a lack of state economic policy which would be dedicated to formulating a proactive innovation and technology strategy. However, in the course of a few decades, the mindset of the Czech society changed, which brought about positive events that contributed to the development of this area. Since 2019, this area has been developing also through the newly created innovation strategy of the Czech Republic presented under the motto Country for the future. Beneš (1993) includes among the main stimuli contributing to the development of technology transfer the following segments: high degree of SME

entrepreneurial activity; greater focus on innovation business; an increasing number of businesses with foreign partners; development of support for SMEs; foundation of technology, innovation, and business centres and transfer centres at research institutions; and, last but not least, foundation of companies to promote this area.

Motivation and employee remuneration count among major factors influencing the promotion and development of human activities (Kazaz and Ulubeyli 2007), and it is also a subject that draws significant attention (Ezzamel and Willmott 1998). Today this involves an elaborate scientific methodology and resource management strategy. At present, each organisation or institution has a considerable number of options when it comes to remunerating and motivating its employees. Well-directed motivation facilitates success, which in turn promotes positive expectations and boosts self-confidence.

Fischer (2005) summarises the bulk of currently used motivational systems that can be successfully employed or applied within knowledge economy, and divides them into four areas:

- Individual employees are responsible for carrying out assigned tasks, which are defined according to their functions.
- Individual objectives must be challenging and promote performance in order to ensure the return of the funds used to motivate employees.
- The objectives of each institution must be specified in detail in order to make it clear what achievements are expected and what reward will follow the achievement.
- Ideally, there should be a common definition of goals to be collectively pursued by everyone, from employees to top management.

Janeček and Hynek (2010) argue that motivational systems based largely on financial remuneration are to some extent limited in that there is no stable relation between the employee engagement, performance, and financial remuneration. Both authors conclude that when financial remuneration is increased, it becomes less effective and fails to adequately motivate employees to further engagement and initiative for the benefit of the company. Fisher (2005) observes that employees with high income reach a state of prosperity and find themselves in what is known as the comfort zone. This means that such employees will not increase their efforts when their salary increases, hence it is necessary to look for other methods to motivate them. This mostly concerns employees who regard their work as a source of fulfilment, personal growth, contribution to the society, recognition, opportunity to develop their talents, and source of positive emotions.

Janeček and Hynek (2010) conclude that it is necessary to motivate employees to loyalty to their employer. Such loyalty cannot be enforced; the employees themselves must be satisfied with their position and their responsibilities at the given institution.

## **2. Methodology**

Best practice refers to finding and adopting the most suitable approaches and methods. According to Pitra, Mohelská et al. (2015), this involves gaining international experience abroad, as part of proven good practice, and acquiring new knowledge for one's own organisation to be implemented in order to achieve the desired results. Furthermore, the authors defined two types of best practice, namely, procedural practice, which concerns the process itself, and activation practice, which subsequently enables activating the acquired knowledge and skills in the organisation. Acquiring, understanding, and sharing knowledge is according to Pitra, Mohelská et al. (2015) an indispensable stage for receiving knowledge in the given field, however, it is neither sufficient nor does it guarantee success. Above all, it is necessary to understand the knowledge acquired and achieve its mastery so that the knowledge can be repeatedly used and applied (Pitra et al., 2015). At the same time, the authors state that each institution must, on one hand, work on acquiring, creating, and sharing knowledge and experience among its staff and, on the other hand, it must strive to create important types of knowledge, which includes intellectual property, human capital, and intellectual assets.

Desk research is, in its essence, a necessary step in the beginning of each research project because it enables acquiring basic knowledge about the research problem in question and refining the research

design. In some cases, when there is a sufficient amount of relevant data available, this approach can be utilised without the need to proceed to the subsequent practical research in real-life conditions. This is according to the evaluation of a qualitative research by Hendl (1997), which was conceived as desk research, that is, a secondary data analysis based on processing already existing data. This data took the form of outputs from research projects registered in the database of a science and technology park.

The main objective was to find out the number of collaborating scientists and academics employed at research departments of the University of South Bohemia under the South Bohemian Inovoucher scheme and the involvement of these employees in the individual years from the beginning of this project created in the South Bohemian region. The next step was conducting interviews with respondents representing SMEs who had applied for this financial support to promote regional development, and interviews with academics representing the University of South Bohemia as a sample group which significantly contributes to obtaining grants as part of the South Bohemian entrepreneur vouchers. These qualitative interviews were conducted between January 2019 and June 2019 in order to fill in important information and experience necessary for evaluating the effectivity and meaningfulness of the vouchers.

For graphical representation, we used descriptive statistical methods and MS Excel, specifically, pie charts, sunburst charts, and tables.

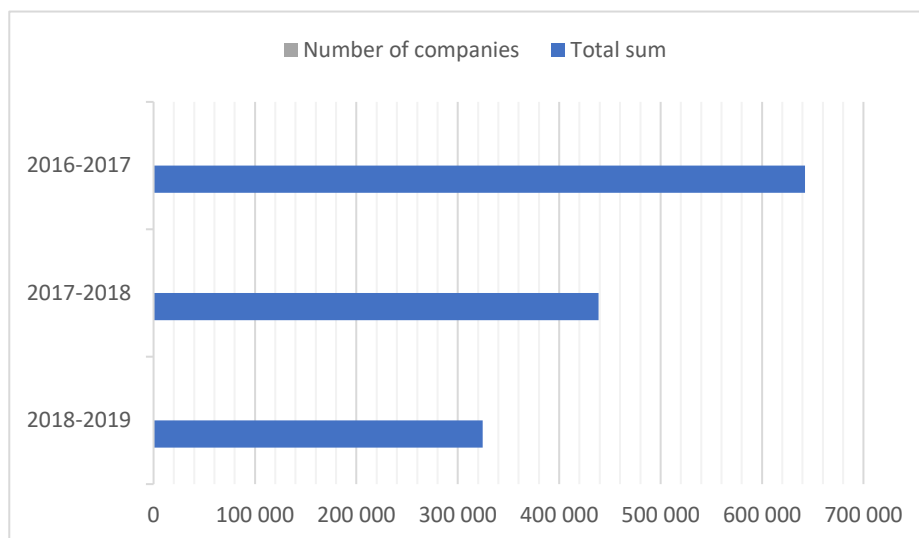
### 3. Results

To start the evaluation, first the thematic or professional areas where the cooperation takes place were analysed. This involves areas crucial for the South Bohemian region. Namely, it is the areas of agriculture, environment, fishery, healthcare, and electromechanics.

The first three mentioned areas are interconnected and typical for the region from the historical perspective. The University of South Bohemia itself as a scientific research institution offers in this area two faculties and several fields of study, which are being continuously innovated and expanded. Unsurprisingly, it is therefore in these areas that innovation vouchers are requested and supported, which takes place under the auspices of the South Bohemian Science and Technology Park, established by the South Bohemian region. In the above-mentioned areas, it is obvious that these are innovations brought about by the times of automation in order to make the traditionally hard work in this area easier.

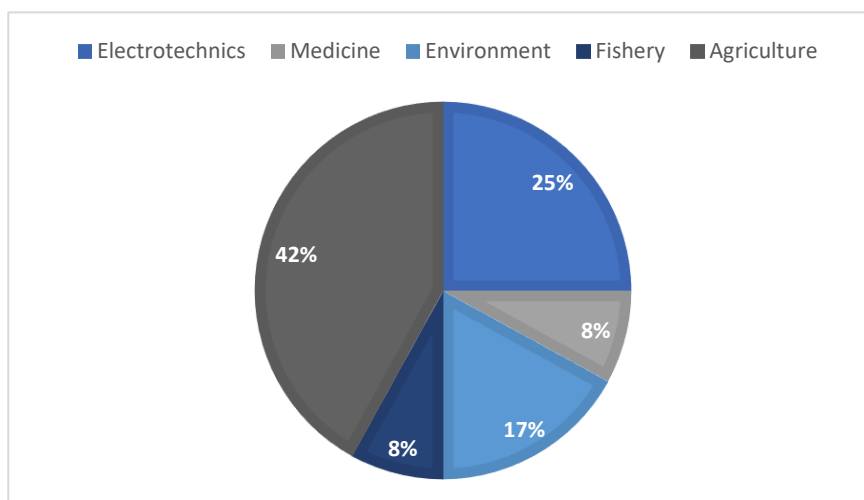
The aim of incentives such as entrepreneur vouchers is above all to facilitate cooperation between the business and the academic sphere, to teach both parties involved how to implement this cooperation, to promote building mutual trust, and to let them see for themselves that the cooperation can be beneficial for both parties. Among the main advantages of this and other incentives is the ease of submitting an application, speed of administrative processing, effectiveness of the solution of a given problem, development of further cooperation between regional SMEs and research institutions, and improving the image of the region. The main goal, however, is to contribute with an effective and beneficial result, hence, to contribute to the society. The South Bohemian region may not be among the fastest to create such opportunity for financial support of mutual cooperation, nevertheless, in the last three years, this opportunity has become well publicised and well known in the region, and much sought for on the part of SMEs.

Figure 1 below illustrates the support provided by the South Bohemian entrepreneur vouchers to SMEs in three consecutive years. It is very interesting that the project enjoyed the greatest popularity in the first year of its so far short existence. The popularity of the project in terms of a number of applications submitted was lower in the following two years. According to qualitative interviews conducted with individual SMEs owners who applied for this financial support, the main drawback is the fact that the maximum amount to be granted for a single voucher is 150,000 CZK, which is a very low sum and it is not always meaningful to apply for this type of support. Given this limitation, applying for support is in many cases not worth it, which explains the low interest in the support on the part of larger enterprises or enterprises in the area of technology, where the costs required for verification or cooperation are several times higher than the financial support received.



**Figure 1.** Number of supported cooperation instances between companies and the University of South Bohemia – South Bohemian Inovouchers.

Figure 2 shows that with respect to the structure of areas with the greatest interest in this type of service and financial support, the greatest interest occurs in the area of biotechnology, that is, mainly focused on agriculture, fishery, and environment. These are areas closely connected to the traditions of the South Bohemian region. As to the services provided, all applicants were representatives of SMEs who were requesting a specialised service from academics according to their specialty. According to the qualitative interviews with academics, they consider this project a very interesting opportunity through which they learn to cooperate with representatives of the business sphere, acquire new experience, and build mutual trust. In one case, this cooperation based at first on the incentive of financial support rewarded through the entrepreneur vouchers went on to develop further into a long-term cooperation in terms of years, based on mutual experience, respect, and professionalism.



**Figure 2.** Number of cooperation instances according to areas.

Within the traditional areas connected with the South Bohemian region, let us present two examples of good practice supported by the incentive scheme of the South Bohemian entrepreneur vouchers. In the fishery area, one case of cooperation involved the development and functionality verification of a prototype of a mechanical equipment for loading live fish, known as a “loader”. The equipment works mechanically and is designed to transfer live fish from fish farm tanks or ponds on trucks or other means of transport. Technically speaking, the loader is either vertical or slanted. As present, the manufactured loaders are equipped with wheels, when the loader itself is mounted on a



wheeled guide frame consisting of two opposing U-profiles connected with cross members, in which the loading hopper moves. On the guide frame there is mounted an electric motor with a gearbox, which engages a system of ropes and pulleys to pull the loading hopper carrying fish up to the top edge of the frame, where the hopper flips and drops the fish on the slipway, on which the fish is transported to tanks on the truck, trailer, or modified transporter. The loading hopper unloads the fish on the slipway at the top dead centre automatically by means of a limit switch, and once the fish is unloaded, the hopper returns back to the bottom edge of the frame for the next load of fish. The loaders are mobile and can be transported with a towing vehicle from one fish farm tank or pond to another as needed. To insert the loader into the tank, the equipment must first be transported to the water edge of the pond or the fish tank, and it must be manually switched from the transport position with a horizontal guide frame to the working position with the frame upright or slanted. In order to do this, up to six workers are needed because the loader is heavy, the workspace is tight, and the surface is slippery. The disadvantages of the loader are the difficulty of transport, the physical demands on handling the loader when inserting it into the fish tank or pond and taking it out, as well as the risk of injury on the slippery surface. With small ponds, given the relatively small amount of fish to be retrieved and the difficulty of transport and use of the loader, the loader is not used at all. The loading of fish on the truck is done by hand. The chief disadvantage of available solutions for loading live fish is their considerable weight, which requires at least several people to handle the loader. Another drawback is the massive size of the loader, which makes it completely unsuitable for use in small ponds, where there is not space enough to place a machine with an undercarriage.

The goal of the mutual cooperation is to develop a device for loading live fish, which will be light-weight, small, and would require no more than one person to handle.

Another interesting example of cooperation, this time in the area of agricultural measuring instruments, is developing and testing a new tool for monitoring the microclimatic values in stables. For a comprehensive evaluation of the thermal comfort of animals, the air cooling power value is used, also known as the kata value. The kata value is a significant zoohygienic parameter in the environment of stables and it is measured with Hill's glass kata thermometer. The kata thermometer consists of two bulbs connected with a tube marked 35 °C and 38 °C and containing dyed alcohol. By heating the lower bulb, the alcohol expands and rises through the tube to the upper bulb. By sufficiently heating the alcohol, the upper bulb fills at least halfway in a full column without air bubbles. Subsequently, natural cooling occurs, and the alcohol starts returning to the lower bulb. Once the 38 °C temperature threshold is reached, the measuring begins (e.g., using a stopwatch) of how long it takes for the temperature of the alcohol to drop to 35 °C, on which calculations are performed to obtain the kata value – the cooling effect value of the surface of the animal's body in W/m<sup>2</sup>. Based on the charts, the perceived thermal comfort of the animal can then be determined. The disadvantage of the current solution is the fact that at least one person is required to perform the measuring, the process is time-consuming and impractical, the glass bulbs of the measuring tool break easily, and this method cannot be used to for automated temperature control in stables. The US 2002/0167990 patent presents the invention of an electronic kata thermometer, which eliminates the drawbacks of the above solution. The kata thermometer consists of a cylinder which is sealed on one end. The cylinder contains a resistive heater and a thermal sensor. The sensor is connected to an evaluation unit. The evaluation unit activates the built-in heater and initiates the measuring of the kata value. As programmed, the heater switches off and measures the time needed for the temperature to drop to the reference value. Heat escapes through the walls of the cylinder while the measuring is being performed. Once the reference temperature value is reached, the stopwatch stops, and the evaluation unit determines the current kata value. The measuring is then repeated. The purpose of this invention is to help create a process of controlling the temperature in stables. This process is designed to respect the physiological needs of livestock, to automate the control of technological equipment of stables, to respond flexibly to weather changes, to reduce the negative impact of prolonged extreme weather conditions, to prevent declines in livestock production, and to contribute to the well-being of the livestock.

Both above-mentioned examples illustrate a close cooperation between the research and development world and the business world, a cooperation which continues developing. In the fishery example, the company took the initiative to approach the University of South Bohemia with their

request for a solution. The agricultural area example was a case of an already established long-term cooperation. Nevertheless, the company approached the researchers with a specific issue they needed to address, looking for a solution to a clearly defined problem.

#### 4. Conclusion

Following from the research described in detail in the methodology section, the general conclusion can be drawn that cooperation between researchers and entrepreneurs draws interest, as confirmed by SMEs representatives.

A very suitable incentive to promote this cooperation are initiatives of regional politics and regional development, such as the entrepreneur innovation vouchers, which were first introduced in the South Bohemian region and subsequently in other regions. Such opportunities draw the interest of particularly small and medium enterprises which are interested in verifying and procuring highly specialised services offered by academic institutions. From this perspective it is apparent that in the course of the first three years after the introduction of this initiative in the South Bohemian region, it attracts the interest of companies and draws applicants particularly from the traditional areas in the region, which are agriculture, environment, and fishery.

Overall, it is apparent that researchers and academics are able to respond to the needs and problems of the business environment. This initiative certainly helps to promote mutual cooperation between both segments, which contributes to the society in general. Both researchers and entrepreneurs are excited with the results of their collaborative efforts, and having gained initial experience of this cooperation, they continue to seek such cooperation in the future, regardless of financial incentives and regardless of regional or national support. Such are the concrete results of cooperation between the academic and the business sphere.

As to employee motivation, it is apparent that such cooperation serves as another motivation factor in the efforts of researchers, promoting and directing their work. Cooperation with the business sphere enables researchers to turn their long-time or even lifetime efforts into practice for the benefit of the whole society. Researchers themselves regard the opportunity to apply their research and development knowledge and innovation as a significant motivation factor encouraging them in further efforts and driving them forwards. Innovation vouchers have therefore been confirmed to facilitate knowledge transfer and promote opportunities for connecting academic institutions and SMEs. The innovation voucher itself is intended to serve as an initial impetus to establish cooperation, which has been proven as successful, as confirmed by the results produced through cases of cooperation started first through this medium. At the same time, it is apparent that as long as the cooperation was to the satisfaction of both parties involved, the cooperation continues in the future even without financial incentives.

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# Whether China's Crude Oil Futures Price Has Become the International Benchmark

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**Abstract:** This paper gives the necessary conditions for judging whether a bulk commodity futures price can become an international benchmark index through the theory of one-way effect causal measure, that is, the conductivity and independence of futures price. Taking Shanghai crude oil futures price as an example, the study finds that: first, the RMB and US dollar prices of SC1809 have a strong influence on WTI and Brent oil prices in a short period and a lasting influence on Brent oil prices in a long period. Second, in terms of the impact on WTI and Brent, the impact of SC1809 RMB price is about 20 times that of US dollar price, which shows that US dollar exchange rate factor absorbs its influence to a large extent, and it is also an important support to maintain the two as benchmark indicators of world oil price. Third, although SC1809 RMB and US dollar prices are not affected by WTI and Brent oil prices in the short term, it only shows a certain degree of isolation. Fourthly, the lack of conductivity of WTI and Brent oil prices indicates that their status as benchmark indicators of world oil prices has been shaken.

**Keyword:** crude oil future prices; conductivity; independence

**JEL Classification:** G13; C32; C52

## 1. Introduction

As one of the most important primary energy sources, crude oil plays an important role in social and economic development. The fluctuation of crude oil price in recent years has brought great influence to economic growth, and maintaining the stability of crude oil price is an important topic in the sustainable development of mankind. As the world's second largest economy and the largest importer of crude oil, China is more concerned about the volatility of international oil prices. The Shanghai International Energy Exchange, established on March 26, 2018, provides new price reference information for world crude oil futures. What is the impact of the establishment of the futures market on the development of the world crude oil market? Does China, which previously had no international pricing power for crude oil, mean it has the ability to price it? Therefore, this paper analyses a series of market impact problems caused by the generation of Shanghai crude oil futures price, and uses the one-way effect causal measures method to focus on the futures price generated by a futures market as a necessary condition for a commodity international benchmark index.

As the king of bulk commodities, crude oil has undergone many changes in its price evolution path with the great changes of international political and economic situation in recent years. Taking the period from Jan. 7, 2000 to Nov. 11, 2011 as the sample interval, Ji and Fan (2016) used graph theory to study the evolution of world crude oil market and the pricing ability of major oil producing and oil consuming countries. By constructing the minimum spanning tree of world crude oil market, the integration development direction of world crude oil market before 2011 was verified. The paper found that the world crude oil market has the characteristics of coexistence of geographical structure and organizational structure, and that the relationship

between South America, North America and Africa is relatively stable. The crude oil markets of the United States, Angola and Saudi Arabia are at the core, while the countries of East and Southeast Asia are at the edge of the market. Globalization of the world crude oil market is becoming more stable, but due to the uncertainty of future world politics, its systemic risk may increase. As expected, after 2011, although the international crude oil futures market traditionally uses WTI(West Texas Intermediate) oil price on the New York Mercantile Exchange and Brent oil price on the London Intercontinental Exchange as the world benchmark index, with a series of changes in the international crude oil market, the crude oil price system has also undergone the following new changes:

After 2011, the international benchmark status of Brent and WTI crude oil futures prices has been shaken to varying degrees. In view of the unidirectional and semi-closed shipping flow in the U.S. domestic crude oil market and the characteristics of North American crude oil transportation pipeline network, Chu and Xu (2011) considered that the WTI oil price system was no longer suitable as the benchmark index of the world crude oil market. Kilian (2016) pointed out that the North Sea Oilfield is short of liquidity due to production decline. Whether its reserves support Brent crude oil system as a world oil price index in the long run has become a realistic problem facing the world crude oil market. On the basis of these studies, Shi et al.(2018) found that the formation of an internationally influential benchmark price index in a crude oil market requires the following qualitative conditions: a favorable market environment, the geographical location of trading centers, the existence of a variety of market players, active futures and spot markets, an effective regulatory system and transparent market information. These factors all affect whether a certain oil price index can develop into a world benchmark oil price.

As a milestone event in the development of international crude oil futures, the successful operation of Shanghai International Energy Exchange (INE) crude oil futures have attracted wide attention of the academic community. Zhang and Ji (2018) used the data from March 26 to July 31, 2018 to quantify the risk spillover relationship between INE and international benchmark oil price, Shanghai Stock Index and RMB exchange rate. The study found that INE is closely related to WTI and Brent information, but relatively weak to stock market and exchange rate market. In addition, this paper also finds that China's crude oil market is the recipient of information. The information of international oil price fluctuation has a significant positive impact on China's crude oil futures market. China's crude oil futures have not yet formed an independent price discovery mechanism. Shi et al. (2018) used the daily dollar price data from March 26 to August 6, 2018, and found that the daily return rate and intraday volatility of INE index were significantly affected by WTI and Brent, while the reverse was not true. The results show that China's crude oil futures market is still largely affected by the other two markets in the early stage of listing. Contrary to the previous conclusions, Zhou (2018) found that, first, INE price is highly correlated with WTI and Brent oil prices, with a correlation coefficient of more than 0.7, and the change of INE price index has a significant positive pull-up effect on the price changes of both. Second, there is a two-way spillover effect between INE and WTI, Brent futures, and the information transmission between markets is good. Third, compared with the price rising, the price correlation between any two markets will increase in the current three major crude oil futures markets while price declining. It reflects that the China's crude oil futures market has been deeply integrated with the varieties of crude oil futures on the New York Mercantile Exchange and the London Intercontinental Exchange. Wu et al. (2018) found that the price of China's crude oil futures still obeys the "one price law" of international commodities through the study of the impact of the listing of China's crude oil futures on the oil price mechanism, the listing of China's crude oil futures will promote the transfer of oil prices in the Asia-Pacific region to China, and ultimately promote the reform of China's domestic oil price mechanism.

In conclusion, although the Shanghai crude oil futures market has been operating steadily and the trading scale has leaped to the third largest in the world, there are opposite views on the relationship between INE and WTI, Brent oil prices. Therefore, the thinking brought to this paper

by these previous studies is how to judge the relationship between INE and the two more accurately. It further extends to what is the criterion for a country's futures market to have the international pricing power of certain commodities, or what are the necessary conditions for the international benchmark index of commodity prices. In order to answer these questions, this paper uses the theory of one-way effect causal measure to test the relationship between INE and WTI, Brent.

The contribution of this paper is to creatively give the necessary conditions for judging whether the futures price formed by a futures trading market can become an international benchmark index: conductivity and independence of price. Conductivity refers to the fact that the price of a commodity generated in a country's futures market can affect the transaction price of the same commodity in other markets, which is the reason for the change of other futures price indicators in one-way causality. Independence refers to the fact that the commodity futures price can truly reflect the supply and demand situation of the market. It is not affected by the price of other foreign trading markets. It is expressed by one-way causality that the price is not the result of the change of other oil price indicators. The above two conditions are that when there is only one world benchmark index, if there are two or more world benchmark indicators for a commodity, then there should be no conductivity between these benchmark indicators, while maintaining internal relative independence. Among these three indicators, conductivity and independence are both quantitative indicators. They are confirmed by one-way effect causal measure method.

## 2. One-way Effect Causal Measure Theory

In order to measure the long-term equilibrium and strength of causality of non-stationary macroeconomic time series, Hosoya (1991, 1997) has accurately described the second-order stationary process of non-deterministic trend and the interdependence of internal changes of non-stationary process. Three definitions of causality measures in frequency domain and time domain are given and successfully constructed. The early theory of one-way effect causal analysis is established. On this basis, Yao and Hosoya (2000) further gave the statistics of one-way effect causal measure, solved the problem of computer mechanism of multivariable one-way effect causal measure, and established a new method of using one-way effect causal measure to analyze dynamic economic system. The most important feature of this method is that it can test the significance of causality of arbitrary size of multi-economic variables under non-stationary and stationary cases.

Suppose  $Z_t = (X_t, Y_t)'$  represents  $K$ -dimensional column vectors of non-stationary time series, and the dimensions of  $X_t$  and  $Y_t$  are  $k_1, k_2$  respectively, and  $k = k_1 + k_2$ . The Error Correction model of non-stationary time series is as follows:

$$\Delta Y_t = \alpha \beta' * Y_{t-1} + \sum_{i=1}^{s-1} \Gamma \Delta Y_{t-i} + \mu + \phi X_t + \varepsilon_t \quad (1)$$

In equation (1),  $\alpha, \beta$  are the full rank matrix of the  $k \times r$  order, where  $\beta$  is a vector matrix,  $\Gamma$  is a coefficient matrix,  $\mu$  is a vector of dimensional constants,  $X_t$  is a column vector of exogenous variables,  $\varepsilon_t$  is  $k$  dimensional white noise column vector with a covariance matrix of  $\Sigma$ . After estimating the unknown parameters of Equation (1) using the ordinary least squares, the covariance matrix of the random error term of the model is recorded as  $\hat{\Sigma}$ , and then  $\hat{\Sigma}_{ij} (i, j = 1, 2)$  means  $k_1, k_2$  order block matrix element, The adjoint matrix of  $I_p - (I_p + \hat{\alpha} \hat{\beta}') e^{-i\lambda} - \sum_{j=1}^4 \hat{\Gamma}_j (e^{-ij\lambda} - e^{-i(j+1)\lambda})$  is  $\hat{C}(e^{-i\lambda})$ , a spectrum response function of  $\hat{A}(e^{-i\lambda}) = \hat{C}(e^{-i\lambda}) \hat{\Sigma}^{1/2}$  based on the following equation (2):

$$\hat{f}(\lambda) = \frac{1}{2\pi} \hat{A}(e^{-i\lambda}) \hat{A}(e^{-i\lambda})' = \begin{bmatrix} \hat{f}_{11}(\lambda) & \hat{f}_{12}(\lambda) \\ \hat{f}_{21}(\lambda) & \hat{f}_{22}(\lambda) \end{bmatrix} \quad (2)$$

The frequency-wise measure of one-way effect (FMO) of  $y_{1t}$  to  $y_{2t}$  can be computed. The following formula (3) shows:

$$M_{y_1 \rightarrow y_2}(\lambda | \hat{\theta}, \hat{\varphi}) = \log \left[ \frac{\overline{\det f_{11}}(\lambda)}{\det \begin{bmatrix} \tilde{f}_{11}(\lambda) \\ -\tilde{f}_{12}(\lambda) \tilde{f}_{22}^{-1}(\lambda) \tilde{f}_{21}(\lambda) \end{bmatrix}} \right] \quad (3)$$

where  $\tilde{f}_{11}(\lambda) = \hat{f}_{11}(\lambda)$ ,  $\tilde{f}_{21}(\lambda) = \{-\hat{\Sigma}_{21} \hat{\Sigma}_{11}^{-1}, I_{k_2}\} \Lambda(0) \Lambda(e^{-i\lambda})^{-1} \hat{f}_1(\lambda)$ ,  $\hat{f}_1(\lambda)$  is the initial  $k$  column of  $\hat{f}(\lambda)$ ,  $\tilde{f}_{22}(\lambda) = \{\hat{\Sigma}_{22} - \hat{\Sigma}_{21} \hat{\Sigma}_{11}^{-1} \hat{\Sigma}_{12}\} / 2\pi$ . If the parameter matrix of Equation (1) is rearranged,  $\hat{\varphi}$  is  $n_\varphi = k \times (r + k \times (s - 1)) + k \times (k + 1) / 2$  vector of dimensional, if  $\hat{\varphi} = \text{vec}(\text{vec}(\hat{\alpha}, \hat{\Gamma}), v(\hat{\Sigma}))$ ,  $\hat{\theta} = \text{vec} \hat{\beta}'$ , and then, a nonstationary time series the overall measure of one-way effect (OMO) of a pair  $y_{1t}$  to  $y_{2t}$  is defined as:

$$M(\hat{\theta}, \hat{\varphi}) = \frac{1}{\pi} \int_0^\pi \hat{M}_{y_1 \rightarrow y_2}(\lambda | \hat{\theta}, \hat{\varphi}) d\lambda \quad (4)$$

OMO can be used to indicate the magnitude of the causal strength. The corresponding Wald statistic is:

$$\hat{W} = T \{M(\hat{\theta}, \hat{\varphi})\}^2 / H(\hat{\theta}, \hat{\varphi}) \quad (5)$$

$H(\hat{\theta}, \hat{\varphi})$  is the variance covariance matrix of  $\sqrt{T}\{M(\hat{\theta}, \hat{\varphi}) - M(\theta, \varphi)\}$ ;  $\hat{\theta}, \hat{\varphi}$  are the estimated value of  $\theta, \varphi$ , and the statistic asymptotically obeys the  $\chi^2$  distribution with a degree of freedom of 1. The  $(1 - \alpha)\%$  confidence interval of  $M(\hat{\theta}, \hat{\varphi})$ :

$$(M(\hat{\theta}, \hat{\varphi}) - \sqrt{(1/T)H(\hat{\theta}, \hat{\varphi})} \chi_\alpha^2(1), M(\hat{\theta}, \hat{\varphi}) + \sqrt{(1/T)H(\hat{\theta}, \hat{\varphi})} \chi_\alpha^2(1)) \quad (6)$$

The detailed deduction process for this model can be referred to Yao and Hosoya (2000).

### 3. Empirical Analysis

In order to investigate whether China's crude oil futures price meets the necessary conditions proposed in this paper, this paper uses one-way effect causal measure theory to calculate the price of INE main contract and the current world crude oil benchmark WTI and Brent respectively, and to examine the one-way effect causal relationship between any two price index systems.

#### 3.1. Indicator selection and data sources

China's crude oil futures prices are expressed in terms of INE main contract prices. First, this paper chooses the contract price of SC1809 which is very concerned by all parties in the market. Because one of the pioneering initiatives of Shanghai crude oil futures market is to price and settle accounts in RMB, this paper first uses the RMB price of INE to calculate directly with the US dollar price of WTI and Brent. Second, because crude oil is an important international commodity and international oil prices are priced in US dollars, it is impossible for traders in Shanghai crude oil futures market to ignore the exchange rate of US dollars. In order to consider the influence of these factors, we use the exchange rate of RMB to US dollar to convert the INE RMB price into US dollar price, and then measure the one-way effect causality with WTI and Brent prices under the same currency valuation system.

Because the Shanghai International Energy Exchange Center stipulates that the last trading day of the month before the delivery month shall be the last trading day, and the main contract of SC1809 shall be delivered in September 2018, the sample interval of this paper is determined from March 26, 2018 to August 30, 2018. The variables in the model are defined as follows:  $SC1809R_t$  denotes the daily frequency RMB price of SC1809 main contract in INE market, and  $SC1809D_t$  denotes the daily frequency US dollar price of SC1809 main contract in INE market.  $WTI_t$  represents the daily price of WTI crude oil futures on the New York Mercantile Exchange in the sample range, while  $BRENT_t$  represents the daily price of Brent crude oil futures on the London Intercontinental Exchange, both of which are priced in US dollar.

RMB price data of INE comes from the daily settlement price of Shanghai International Energy Exchange. WTI price of crude oil futures on the New York Mercantile Exchange is

collected on the official website of the U.S. Energy Information Administration. Brent crude oil futures price on the London Intercontinental Exchange is extracted from the CEIC database. The data of RMB exchange rate against the US dollar are from the mid-price data of the official website of the People's Bank of China.

### 3.2. Statistical characteristics and stationarity test of data

According to the stationarity of time series, one-way effect causal measures have different measurement methods, and the precondition of co-integration among variables is that each sequence has the same differential stationarity process, so we first verify the stationarity of the level values and the first-order difference of the selected sequence. This paper uses ADF (Augmented Dickey-Fuller test) method to test. The results are listed in Table 1. It shows that the variables selected in this paper are non-stationary time series under level values, and stable after first-order difference. This shows that all four series of data obey the  $I(1)$  process and satisfy the condition of one-way effect causal measure.

**Table 1.** Stability test of variables.

Variable	Level value series	Stationarity	First-order difference series	Stationarity
$SC1809R_t$	-1.4984 (0.5308)	non-stationary	-9.1470*** (0.0000)	stable
$SC1809D_t$	-1.9743 (0.2977)	non-stationary	-9.5322*** (0.0000)	stable
$WTI_t$	-2.2848 (0.1783)	non-stationary	-11.1239*** (0.0000)	stable
$BRENT_t$	-2.4594 (0.1283)	non-stationary	-11.8295*** (0.0000)	stable

Note: "\*\*\*\*" means rejecting the null hypothesis at the 1% significance level. The values in parentheses below the statistics are the corresponding  $p$  values.

### 3.3. Testing of cointegration relations among variables

It is noteworthy that this paper finds that there is no co-integration relationship between WTI and Brent prices. Although their prices reflect the common trend in the world supply and demand environment, the movement process is relatively independent, and both of them have the function of price discovery that reflects the reality of local futures market transactions.

**Table 2.** Cointegration relationship between variables.

Variable group	Characteristic roots and characteristic vectors		Cointegration rank	Trace statistics
$SC1809D_t$	(0.0809	0.0520)	2-r	
$WTI_t$	0.9956	-0.5610	1	5.6030**
$SC1809D_t$	-0.0941	0.8278	2	14.4590*
$BRENT_t$	(0.0744	0.0335)	2-r	
$SC1809D_t$	0.1168	0.8331	1	3.5720*
$BRENT_t$	0.9932	-0.5531	2	11.6890
$SC1809R_t$	(0.0979	0.0316)	2-r	
$WTI_t$	0.9998	0.9681	1	3.3418*
$SC1809R_t$	-0.0198	-0.2507	2	14.0568*
$WTI_t$	(0.0677	0.0260)	2-r	
$SC1809R_t$	0.9994	0.9923	1	2.7431*



$BRENT_t$	0.0347 (0.0751)	-0.1237 (0.0308)	2 2-r	10.0320
$WTI_t$	0.0870	0.7915	1	2.6900
$BRENT_t$	0.9962	-0.6112	2	13.3300

Note: The "\*", "\*\*" following the trace statistic indicates the rejection of the null hypothesis at the 10% and 5% significance levels, respectively.

### 3.4. One-way effect causality test

Because the two dominant markets of crude oil futures in the world are the New York Mercantile Exchange and the London Intercontinental Exchange, in order to investigate the world position of China's crude oil futures prices, we only need to measure the conductivity and independence between INE, WTI and Brent.

#### 3.4.1. Conductivity test of Shanghai crude oil futures price

Table 3 gives the calculation results of INE's one-way full measure and confidence interval for WTI and Brent. The results show that both RMB and US dollar prices, Shanghai crude oil futures have a significant impact on WTI and Brent oil prices, and have conductivity. INE has attracted intense attention from the New York Mercantile Exchange and the London Intercontinental Exchange, and has had a substantial impact on them. The OMO in Table 3 shows that the one-way effect causal intensity of INE RMB price to WTI and Brent are 24.5 times and 21.5 times as much as that of US dollar price, respectively. It can be seen that the use of RMB valuation in Shanghai crude oil futures trading has greatly enhanced the international influence of INE price, increased the world status of the domestic crude oil futures market, and reflected the foresight at the beginning of the construction of the crude oil futures market in Shanghai.

**Table 3.** One-way effect causality measure of INE to WTI and Brent.

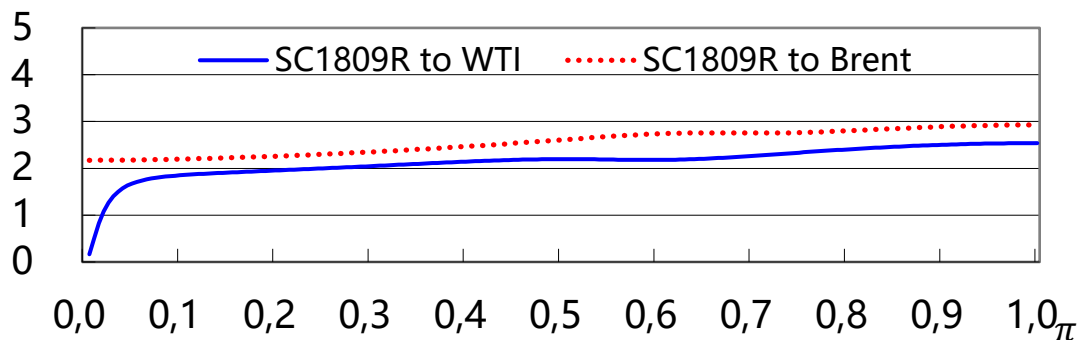
One-way effect causality	OMO	Wald statistic	95% confidence interval
$SC1809D_t$ to $WTI_t$	0.0874	9.5964*** (0.0020)	(0.0321, 0.1426)
$SC1809D_t$ to $BRENT_t$	0.1191	12.0989*** (0.0005)	(0.0520, 0.1863)
$SC1809R_t$ to $WTI_t$	2.1394	7.9175*** (0.0049)	(0.6492, 3.6297)
$SC1809R_t$ to $BRENT_t$	2.5627	7.0765*** (0.0078)	(0.6746, 4.4509)
$WTI_t$ to $BRENT_t$	0.17218	1.3307 (0.2487)	(-0.1204, 0.4647)
$BRENT_t$ to $WTI_t$	0.1661	1.7724 (0.1831)	(-0.0784, 0.4107)

Note: the *Wald* statistics below are in parentheses for their corresponding *p* values, and "\*\*\*\*" denotes the rejection of the null hypothesis without causality at the 1% significance level, respectively.

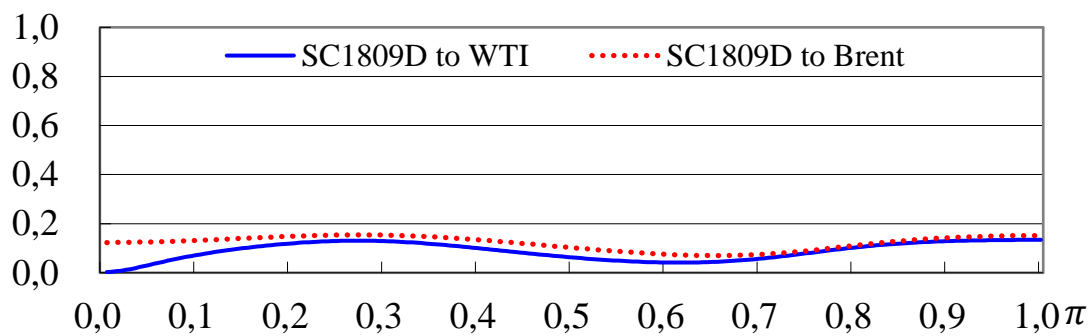
It should be emphasized that, following the fact that there is no co-integration relationship between WTI and Brent, Table 3 shows that there is no causal relationship in any direction between WTI and Brent, indicating that they are not conductive to the other side and that they are mutually independent. It should be emphasized that there are two benchmark index systems of WTI and Brent in the world crude oil, which are recognized by the world market.

Therefore, in this case, there should be no conductivity between them, but an independent index system, which shows the internal independence between the indicators. The results in Table 4 confirm that after decades of baptism in the international crude oil market, both of them have an independent mechanism for generating benchmark crude oil price indicators, which conforms to the existing pattern of the international crude oil market.

Although Table 3 gives the one-way effect causal measure between the three oil price indicators, according to the supply and demand situation of crude oil, there may be complex influence process and mechanism on other crude oil futures markets after the futures price is generated through trader's transaction by purpose of hedge and arbitrage. In order to confirm this problem, we further describe the short, medium and long-term changes of Shanghai crude oil futures price in time. In this paper, the spectrum measures are arranged in Figures 1-4. Different from the time domain analysis method, the spectrum analysis theory regards time series as the superposition of different harmonics, and the product of period and frequency is equal to  $2\pi$ . The horizontal axes in the following graphs represent the spectrum domain, and the long-term causal relationship between variables near the origin  $0.0\pi$  corresponds to infinite number of cycles; the short-term causal relationship near  $1.0\pi$  corresponds to two sample cycles, i.e. the unidirectional causal influence intensity of two-day cycles. Because the spectrum domain has internal symmetry  $(-\pi, \pi]$ , we only draw the cases between  $[0, \pi]$ .



**Figure 1.** Distribution map of one-way spectrum measurement of SC1809 RMB price to WTI and Brent.



**Figure 2.** Distribution map of one-way spectrum measurement of SC1809 Dollar price to WTI and Brent.

Although the operation time of Shanghai crude oil futures market is relatively short, it has grown rapidly to the third largest crude oil futures market in the world. Figure 1 shows that the settlement price of RMB reached by SC1809 main contract has a significant unilateral causal relationship with WTI oil price in both short and medium cycles. The impact process started two days after the price of SC1809 RMB was generated. At first, the impact intensity was the strongest, then gradually attenuated, and finally attenuated to 0. That is to say, WTI is not

affected by Shanghai crude oil futures market and has long-term independence. The difference between Brent and WTI is that, firstly, Figure 1 shows that the RMB price of SC1809 not only has a significant and robust impact on Brent in short and medium cycles, but also maintains its influence in long cycles, indicating that the one-way effect causal relationship between them is relatively stable; secondly, the influence of RMB settlement price of SC1809 main contract on Brent is stronger than WTI oil price, which indicates that the relationship between Shanghai crude oil futures market and the London Intercontinental Exchange is closer than that of the New York Mercantile Exchange. It can be seen from the above that the one-way effect causal measure can not only measure the change of one-way effect causal in time, but also give the strength of causality.

Because the exchange rate of RMB against US dollar in the same period may be a comprehensive reflection of the world's macroeconomic fluctuations and various economic relations, we also calculated the causal relationship between the price of US dollar SC1809 and WTI and Brent. In the short period of the right spectrum domain in Figure 2, the impact of SC1809 price on WTI is the greatest in 2 days (i.e.  $1.0\pi$ ), and then there is a significant causal strength decline in the period of  $0.625\pi$ , i.e. about 3 days. Then it reaches its maximum in the period of  $0.28\pi$ , i.e. 7 days, and finally the long-term effect is completely attenuated to 0. This shows that one of the main factors that WTI crude oil price is independent of INE impact is the US dollar exchange rate. Before 2018, the United States had been the world's largest importer of crude oil. With the increase of domestic crude oil production in recent years, the United States hoped to control oil prices through the dollar exchange rate factor, which objectively made WTI oil price to a certain extent out of the supply and demand situation of the international crude oil market, but only reflected the supply and demand situation in the domestic market of the United States.

In Figure 2, the trend of Brent in short and middle cycle is basically the same as that of WTI. It is shown again that the main factor of this situation is the dollar exchange rate factor, which weakens the influence of INE on Brent oil price. The biggest difference between Brent and WTI is that the long-term impact of INE on Brent oil prices still exists, even in the US dollar pricing scenario. Considering the geographic factors, the most significant difference between Brent and WTI crude oil futures market is that Brent crude oil futures market is located in London, which is the hub of Eurasian crude oil futures market. Its supply and demand are not only directly affected by European countries, but also by Asian crude oil demand. The strong demand for crude oil in China, India and other Asian emerging market countries in the past decade is directly reflected in the price changes of crude oil futures on the London Intercontinental Exchange. It can be seen that as the largest crude oil futures market in Asia, the trading price of Shanghai International Energy Exchange is closely linked with the crude oil futures market in London even if it includes the factor of dollar exchange rate.

Comparing the influence of INE RMB price and US dollar price on WTI and Brent in Figure 1 and Figure 2, we can find that the causal strength of RMB price system is more than 20 times that of US dollar system. This conclusion shows that the US dollar exchange rate has greatly reduced the market influence of INE. Conversely, the Shanghai International Energy Exchange uses RMB to price, which is very helpful to expand the international influence of China's crude oil futures market.

#### 3.4.2. Independence test of Shanghai crude oil futures price

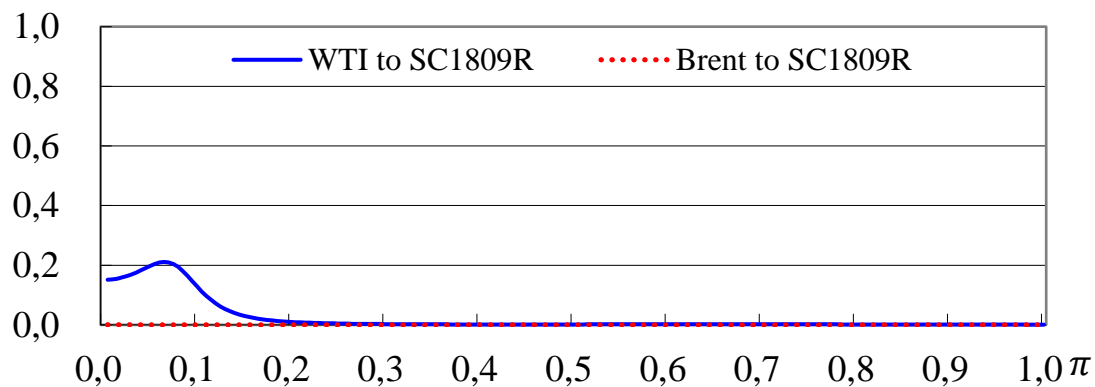
**Table 4.** One-way effect causality measure of WTI and Brent to INE.

One-way effect causality	OMO	Wald statistic	95% confidence interval
$WTI_t$ to $SC1809D_t$	0.3015	2.4863 (0.1148)	(-0.0733, 0.6764)

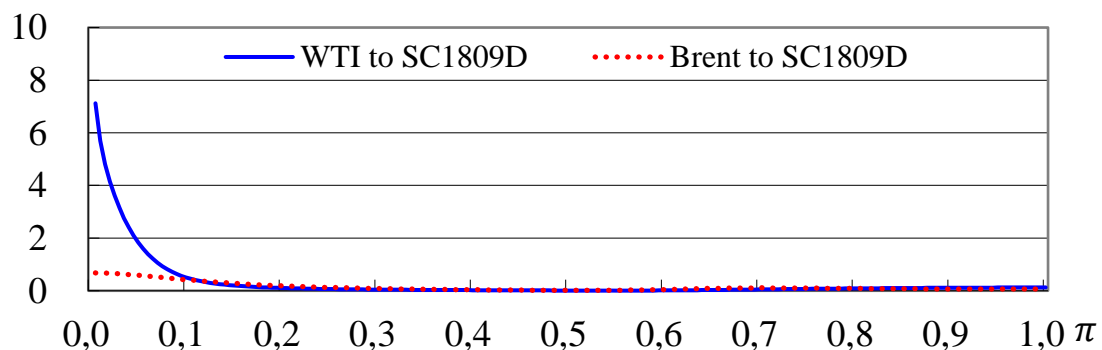
$BRENT_t$ to $SC1809D_t$	0.1403	0.9202 (0.3374)	(-0.1464, 0.4270)
$WTI_t$ to $SC1809R_t$	0.0233	0.5325 (0.4656)	(-0.0392, 0.0858)
$BRENT_t$ to $SC1809R_t$	0.0001	0.9441 (0.3312)	(-0.0001, 0.0002)

Note: the *Wald* statistic is given in parentheses below for its corresponding *p* value.

From Table 4, we can see that the P value corresponding to the Wald statistics of one-way effect causal measure is larger, accept the original hypothesis that neither WTI nor Brent oil price can cause the change of dollar price and RMB price of SC1809 main contract, which indicates that Shanghai crude oil futures price is not affected by the other two. This table shows that although Shanghai crude oil futures have a short listing time, they are not affected by other crude oil futures markets because of their accurate market positioning, reasonable valuation and currency selection, and even withstand the pressure of the fluctuation of US dollar exchange rate. So, according to this conclusion, can we conclude that Shanghai crude oil futures really have independence? Although the one-way effect causal measure of WTI and Brent is not statistically significant for Shanghai crude oil futures price, the one-way effect causal spectrum measure distribution map can give detailed information about the process of their action on Shanghai crude oil futures price and the specific changes in time. Figures 3 and 4 can give us some references.



**Figure 3.** Distribution map of one-way spectrum measurement of SC1809 RMB price to WTI and Brent.



**Figure 4.** Distribution map of one-way spectrum measurement of SC1809 Dollar price to WTI and Brent.

Figure 3 shows that WTI and Brent have no significant impact on the price of Shanghai crude oil futures in the short and medium term, and only have a certain degree of influence over the long term. In line with the conclusion in Figure 1, INE does not affect WTI in the long run, but WTI can affect INE. Similarly, consistent with the conclusion in Figure 1, Brent did not have a significant impact on INE in the long run. Compared with Figure 3, Figure 4 shows that WTI and Brent can influence INE only in the long run with the help of dollar exchange rate factors.

From the above analysis, Table 4 calculates that the independence of INE is essentially short-term independence. In the long run, it may still be affected by WTI and Brent to a certain extent, and this effect is significantly strengthened under the US dollar exchange rate factor. Therefore, the short-term independence of Shanghai crude oil futures in the early stage of operation is essentially another kind of situation - isolation. The difference between isolation and independence is that independence means that the information received from other futures markets is not affected even if it receives information from other futures markets for a long time. However, the isolation is that the Shanghai crude oil futures market is at the end of the information, the information received in other futures markets is limited in the short term, and the number of international traders and trading volume are very small, so it has not been able to have a substantial impact on it.

#### 4. Conclusions

Under the circumstance that commodity futures price determines spot price, China has made a lot of efforts to gain international pricing power for commodities. China established the Shanghai crude oil futures market in 2018 in order to make a Chinese voice on the international stage. The traditional Granger causality test can only judge whether there is causality between two variables, and it can't capture carefully the change of causality and causality intensity in short and medium periods. Therefore, based on the theory of unidirectional causality measure, this paper analyses the causal direction and intensity of crude oil futures prices between the New York Mercantile Exchange, the London Intercontinental Exchange and the Shanghai International Energy Exchange, which are among the top three trading volumes in the world, in order to identify whether the formation mechanism of China's crude oil futures prices has met the necessary conditions for becoming an international benchmark index. The main conclusions of this paper are as follows: First, in a short period of 1-3 days, the RMB and US dollar prices of SC1809 have a strong influence on WTI and Brent oil price indicators; in the long period, the RMB and US dollar prices of SC1809 both have a permanent impact on the price of the Brent oil, indicating that the INE oil price already has the conductivity. Second, in terms of the impact of INE on WTI and Brent, the impact of its RMB price is about 20 times that of the US dollar which shows that US dollar exchange rate factor absorbs INE's market influence to a large extent, thus maintaining the independence of WTI and Brent oil prices, and is also an important factor for them to remain as benchmark indicators of world oil prices.

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# Current Challenges of the Technology Transfer Process

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**Abstract:** Currently, science and technology transfer are considered to be the cornerstones of economic and social progress. The importance of technology transfer is of strategic importance for each state. Therefore, the purpose of this review article is to examine the current issues challenging the process of TT from the perspective of knowledge management. On the basis of the literature review, the authors identified the persisting three issues, significantly affecting the TT process: (i) the ability of a university to identify a target company for a given technology, (ii) the ability of scientists to identify and subsequently locate technologies that someone is interested in, and (iii) slowness and inflexibility of universities in formulating agreements. These issues are discussed in detail in this article.

**Keywords:** technology transfer; knowledge management; non-linear model of TT process

**JEL Classification:** O31; O32; O33

## 1. Introduction

Science and its technologically usable output in developed countries are generally accepted as the main pillars of economic and social progress (Wahab et al. 2011). Especially universities play a unique role in this technology transfer (TT) process as they are able to provide a community of experts with a potential for innovation. The TT from the university to the commercial environment is classified as vertical, while the TT between two commercial entities is classified as horizontal. The vertical transfer, i.e. TT between a university and a commercial firm, is usually defined for the segment of medium-sized companies, i.e. companies with more than 50 and less than 250 employees.

It turns out that one of the preconditions for a successful TT is the existence of an experienced and well-established technology transfer office (TTO) team, which is connected with the question of TT productivity. Productivity is measured using the Maturity Model (Secundo et al. 2016). Alternatively, one can use the European Innovation Scoreboard, which works with 25 indicators, ranging from the number of doctoral graduates, scientific publications, patents, trademarks to research costs, providing innovation indices for each country (Hollanders et al. 2019) – (consult Figure 1. ). In Figure 1, the individual countries are plotted on the horizontal axis and the corresponding innovation indexes are subtracted on the vertical axis. Figure 1 contains two data series of innovation indexes; one, a gray weak bar for 2011 and the other, a stronger color bar, for 2019. For a better orientation, groups of countries are color-coded with regard to their level of innovation, i.e. modest innovator, moderate innovator, strong innovator and innovation leader. The innovation leaders traditionally include Scandinavian countries, followed by Benelux countries.

TT is generally considered to be an extremely important process, improving local economic development, and therefore all the difficulties that have an impact on the productivity of this process are thoroughly examined. The main difficulties of TT in developed countries are the following: (i) the ability of the university to identify the target company for the technology, (ii) the ability of scientists to identify and subsequently locate technologies of interest. Close to these problems is (iii) the slowness and inflexibility of universities in formulating agreements (Decter and Bennett 2003).

The purpose of this article is to examine the current issues challenging the process of TT from the perspective of knowledge management.

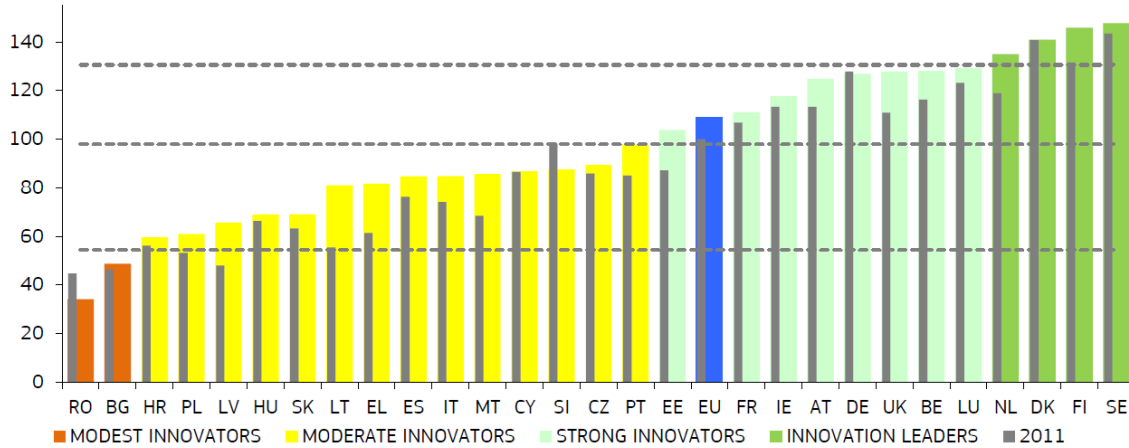


Figure 1. European Innovation Scoreboard: source (Hollanders et al. 2019).

## 2. Methodology

The literature review was chosen to explore current knowledge, obtain and organize dispersed findings to ensure a shared understanding of the subject under investigation.

Only the peer review research articles written in English were detected from scientific databases: Scopus and Web of Science. The time interval for searching in the above mentioned databases was chosen to cover the last five years (from January 2015 to December 2019) of the development of knowledge on the basis of the research topic, i.e. current challenges in the technology transfer process. The articles has to contain definitions of the terms, as well as to provide the information explaining how individual variables were measured. A total of 106 academic articles were obtained. After screening for abstracts and article titles, 63 articles were discarded. After a detailed evaluation, another 32 articles were excluded due to duplications, insufficient data, unclear research intent and language. Alternatively, no link was found to the research question of this study. Finally, 11 research articles were included into this study (Figure 2).

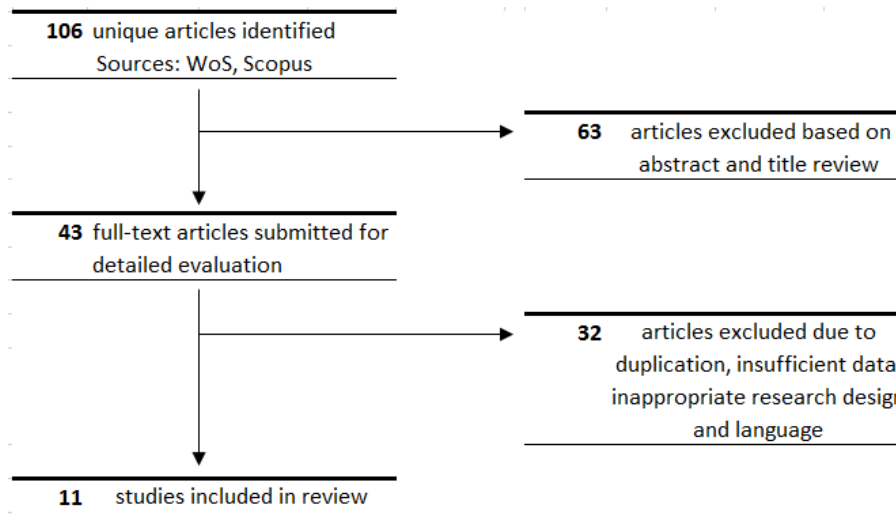


Figure 2. The selection procedure.

## 3. Results

The results are based on a review of 11 scientific articles exploring the relationship between KM and TT. These findings indicate that the difficulties described in the part of Introduction still persist in new roles related to the re-evaluation of the traditional role of universities as producers and knowledge disseminators (Fayolle and Redford 2015). Thus, the authors identified the following three



new changes significantly affecting the TT process: (i) the ability of a university to identify a target company for a given technology, (ii) the ability of scientists to identify and subsequently locate technologies that someone is interested in, and (iii) slowness and inflexibility of universities in formulating agreements.

### *3.1. The ability of a university to identify a target company for a given technology*

The university's ability to identify a target society for a given technology has been explored by many authors in the doctrine of the dependence of the economies of developed countries on knowledge (Iwasaki and Tokunaga 2016), (Siegel et al. 2004). Today's research does not focus on whether or not the TTO should actively participate in commercialization (O'Kane et al. 2015). The key factor seems to be whether we understand the conditions (Omobhude and Chen 2019) in which identification roles need to be fulfilled during the TT process (Roldán Bravo et al. 2019). And the question of the added value of a TTO today is rather in the position of whether or not the existence of a TTO can explain (i) the lack of patent management experience of universities and (ii) the lower value of patents owned by the university compared to the value of patents owned by a commercial entity (Sterzi et al. 2019).

The starting point seems to be to abandon the linear model of TT (Siegel et al. 2004), according to which the recipient of the technology (patent) enters the process at its very end. The replacement with the non-linear TT process (Hall and Rosenberg 2011) is self-evident and makes it possible to investigate the phenomena of proximities (Omobhude and Chen 2019) in the necessary interaction cycles that allow the actors of the TT process to receive and share knowledge (Roldán Bravo et al. 2019). It is beneficial to take time and step aside, i.e. towards the horizontal TT area, where problems addressed here and somewhat remote to the academic community are commonplace in the commercial area (Fredriksson et al. 2019).

### *3.2. The ability of scientists to identify and subsequently locate technologies that someone is interested in*

The key study originated in Singapore (Cheah et al. 2019). The authors of this study conducted a survey among the 30 leading industry leaders in Singapore. The aim of the study was to identify technologies that will enable the manufacturing industry to build new capabilities primarily in areas related to (i) advanced competence and intelligence of customers, (ii) socio-physical quality of service and (iii) integrated strategic decision making (Cheah et al. 2019). The reciprocal iterations of the provider and recipient of the technology, due to their geographical, cognitive, organizational, social or institutional proximity, allow for the effective sharing of both tacit and explicit knowledge (Omobhude and Chen, 2019). This iterative process allows the recipient to identify the technology needed more efficiently than in the linear TT process (Siegel et al. 2004), even in a dynamically changing socio-economic environment (Jiang et al. 2018). The ability of scientists to identify and subsequently locate technologies according to the needs of the recipients is therefore of considerable scientific interest and the level of understanding of the issue is significant. Nevertheless, it is advisable to be inspired by the commercial world of horizontal TT, which seems to provide a deeper insight into the issue of identifying and subsequently locating the technology with the recipient by its provider (Fredriksson et al. 2019).

### *3.3 Slowness and inflexibility of universities in formulating agreements*

The slowness and inflexibility of the university may be related, on the one hand, to the considerable diversity of projects carried out (Sandberg et al. 2015), and on the other, to the unclear identity of the TTO (O'Kane et al. 2015) and the commercial inexperience of academics (O'Kane et al. 2015).

## **4. Discussion and Conclusion**

Firstly, the question of the ability of a university to identify the target company for a given technology needs to be discussed. We have mentioned that the starting point could be to leave the

linear model, which captures the process of technology transfer, including the phase of commercialization of research. It defines the various steps of the phases as follows: scientific discovery; disclosing the invention; evaluating the invention for patenting; patent; technology marketing for companies; arranging a license; and company license (Siegel et al. 2004). The ability to identify the target recipient is indicated by the activity in the process - technology marketing for companies - but it is not clear who will perform the activity. Traditionally, this has been the task of TTO, which involves not only the transfer of technology but also the commercialization of research, which is the process of turning inventions into marketable products (Secundo et al. 2016). Given the identified dual identity of TTOs (O'Kane et al. 2015) and the associated limited commercial capability (Sterzi et al. 2019) discussed below in relation to the slowness and inflexibility of TTOs in concluding agreements, TTO seems not to be an appropriate actor to perform this important activity. Why should it be a departure from a linear process? We argue that, on the basis of our findings, it seems obvious that the European non-linear concept (Hall and Rosenberg 2011) allows the technology provider and the technology acquirer to interact in repeated iterative cycles that begin before the agreement on the implementation of the research (patented academic invention). This interaction is not formal, but it is a creative interaction of the research teams from both the university and the technology recipient (Hall and Rosenberg 2011). Moreover, such a recurring cyclic interaction of various team members between the university and industry makes it possible to exploit different levels of proximity (geographic, cognitive, or social), which has a proven significant impact on the sustainable development of technology (Omohude and Chen 2019).

Secondly, there is a question of the ability of scientists to identify and locate the technologies that someone is interested in. According to the linear model, the ultimate invention, i.e. the product, is largely conceived, created and fine-tuned by a team of inventors with a minimal possibility to influence this process from the position of the recipient. Our findings present an environment and conditions for identifying and subsequently locating the technology for a specific recipient that is directly opposite to the linear TT model. We argue that it is not only possible to identify suitable technologies for the recipient, but it is possible to identify these technologies in the context of the necessary capabilities that the recipient of the technology must have to stand up to its competitive environment (Cheah et al. 2019). In addition, based on the findings, we argue that, from the perspective of sustainable technology development, it is essential to shape and maintain a creative environment (Omohude and Chen 2019) that will allow repeatable technology transfers. The reciprocal iterations of the provider and the recipient of the technology due to their geographical, cognitive, organizational, social or institutional proximity make it possible to create space for the effective sharing of both silent and explicit knowledge (Nonaka et al. 2000).

Finally, the issue of slowness and inflexibility of universities in formulating agreements should be discussed. There are contradictory views on the role of TTOs, which can be defined by extreme positions: (i) TTOs are of strategic importance to universities, especially in the field of commercialization, and (ii) the existence or absence of TTOs on the patenting activities of the university does not change anything. We are forced to take the second extreme view, i.e. the existence or absence of TTOs on the patenting activities of the university does not change anything because based on our findings we can argue that: (i) with regard to the unclear identity of TTOs (O'Kane et al. 2015), there is some "hesitation" on the part of scientists to cooperate with TTOs, leading to a loss of readiness or "slowness" in dealing with potential firms and (ii) The existence or absence of a Technology Transfer Office (TTO) at the time of the patent application does not change the following: (1) universities own inventions of lower technological significance and gain a smaller value from the related patents and (2) universities show a relative lack of experience in patent management.

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# Migration and Entrepreneurship: Proposal of Simulation-Focused Research Methodology

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**Abstract:** In the contemporary word, as throughout of history, people relocate from various reasons such as work travels, family reunions, or natural disaster escape. The relocation itself is usually connected with specific issues. There are various ways of supporting people who migrate provided by governments, or individuals taking multiple points of view on the situation. This is the “top-down” approach. However, if we consider theories about co-production and co-creation, we can argue that people themselves know what the best for them and substitution of this “top-down” approach by the “bottom-up” approach is more than meaningful. This “work-in-progress” paper suggests one of the potential fruitful solution. Entrepreneurship can be one of the ways of improvement of the situation from bottom up. We can call this phenomenon as entrepreneurship of migrants; and social entrepreneurship if certain other conditions are met. A proposal of a research project’s main aim is to search for unifying and transferable patterns in migrant entrepreneurship, especially those in the field of social entrepreneurship, to analyze them and to provide support for their development in any suitable area. There are three main stages suggested and open to discussion and expected to come under scrutiny.

**Keywords:** social entrepreneurship; research project proposal; bottom-up approach; systems modelling; computer simulation

**Classification:** J6; M5

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## 1. Introduction

There are many reasons why a person may relocate. The relocation itself is mostly associated with problems connected with leaving old social networks behind, for example a sense of loss, dislocation, alienation, and isolation, which will lead to processes of acculturation (Bhugra 2004) and acceptance to the society of hosting country might take very long time or might never really happen (Kirtsoglou and Tsimouris 2016). Getting around in a new country could be a complicated job, regardless the reason why person arrive. Security or social policy represent barriers which may contribute to complicated process of adaptation. That is why active citizenship and civil society has to take the lead. In case of strong communities this adaptation process is likely to happen successfully. A weaker and less cohesive community is, harder it becomes. And specific issue is issue of people who are new in the country, community and culture. One of natural ways of sustenance is entrepreneurship. It offers a way to care for yourself and others by doing what one considers to be potentially beneficial also for surroundings (there is a demand). As such, the entrepreneurship is a tool through which people can help themselves. Nevertheless, a careful needs assessment should be done before implementation of any measures to limit or support activities of foreigners. This “work-in-progress” paper could be considered a research proposal in this field. We are proposing research aimed at these situations where an enterprise was a solution of a societal issue by collecting best practices, creation of case studies and further comparative analyses. In addition, the use of computer-aided modelling is proposed to evaluate viability of results of the research. By creating and running models we can simulate changes in a foreigner-directed entrepreneurial ecosystem over the decades, and by that we can assess all the possible pros and cons of proposed changes. This paper proposes and weighs several options for approaches in the computer-aided modelling.

This paper is structured as follows. Next section presents background associated with migration, social economy, entrepreneurship and social entrepreneurship. The following section provides details about proposed research project. The main research problem is defined. Moreover, three main stages which need to be considered thoroughly and discussed are outlined. Methodology that can be applied is also suggested. The last section concludes the paper and proposes next steps which could be conducted to make some progress.

## 2. Background

We can identify a plethora of existing approaches applied to support people who migrate. Help provided by governments, NGOs, and individuals taking multiple points of view on the situation represents the “top-down” approach. Nevertheless, taking into consideration theories of co-production (Cahn 2000; Clement et al. 2017) and co-creation (Sanders and Stappers 2008), we can figure out that people themselves know what is the best for them. Hence, the alternative way of solution emerges, so-called “bottom-up” approach. Also, the Relational Models Theory (RMT) of anthropologist Alan Fiske (Fiske 1992) RMT expresses the notion that human relationships use just four relational models in various combinations no matter the culture-specific environment (Fiske and Haslam 2005). Finally, if we see an organizational unit of human beings as a system, we can apply other systemic theories. And as it would be a human-based system, we can call it a soft system (Válek and Bureš 2018b). One of the most common organizational units of humans which are created with a goal are an enterprises and any type of their organization, such as clusters (Bureš et al. 2012). This leads to a hypothesis that entrepreneurship can be one of the ways of improvement of the situation from bottom up. We can call this phenomenon as entrepreneurship of migrants; and social entrepreneurship if certain other conditions are met. The critical question here is why that is, in some contexts migrants tend to wait for help while in different contexts, they tend to take the solution in own hands; for example by starting of an enterprise. Mainly if the enterprise dedicates itself to helping others in a similar situation, or it provides a solution of other societal issues. Here are few examples of the provision of employment for other disadvantaged groups. For example, one of the most prevalent minorities in the Czech Republic – the Vietnamese (Hüwelmeier 2015), which might employ local Roma people; enterprises run by refugees in order to help own people such as application for logistics support called Shifter; or direct social entrepreneurship such as Armenian social enterprise of handcrafted cosmetics Beauty Products founded by a Syrian refugee employing people in similar situation. This suggests that a co-creating entrepreneurial mind-set might already be present during the foundation of aforementioned enterprises (Shams and Kaufmann 2016) and we should search for its origins and ways to support of their development and growth.

The methodology proposed further is, among others, a combination of RMT, co-production theory, systems dynamics, and systems analysis in the lead with Soft Systems Methodology (SSM) (Checkland 2000) allowing identification of common features in entrepreneurship and social entrepreneurship of migrants and its transferability and applicability in similar contexts.

There are several key concepts that are used in this study and represent the main focus of the proposed project. They are defined and explained below in the remaining part of this section.

By migration in this proposal is meant any trans-national relocation of people no matter the reason. It does not include internal migration within a country. In this sense, a migrant is a person who relocated from the home country to another country. This might also include refugees. At this point, we should also consider directions of the migration as immigration and emigration.

The social economy is often called a “third sector” which is populated by economic bodies which conduct economic activities and are independent on a government, but they differ from profit-based organizations by the fact that their mission is to achieve a social or environmental aim in specific space. These bodies can produce services or goods; they employ people, but also utilize voluntary work (Dohnalová 2006). Therefore, social economy involves both business whose aim is social or environmental and not-for-profit organizations. Non-profits also contribute to the economic situation either indirectly, by influencing various features of an economy such as unemployment, public health, crime rate, etc., or directly as they might be allowed to do business activities, although without profit

as the main aim. The legal framework for non-profit organizations differs from country to country, as non-profits are very diverse, heterogeneous and cover countless of fields of operation of human beings according to what is necessary for the specific local context (Will et al. 2018).

Entrepreneurship is usually understood as a for-profit activity, but in this research, we understand it widely as a sense of an initiative, which leads to organized engagement of people. In this sense, it can involve business activities, but also non-profit organizations. In essence, we talk about both traditional for-profit business and the whole third sector or social economy. Social Entrepreneurship is a specific part of the social economy and can be understood as an entrepreneurial activity, which aims to solve a societal problem. The traditional understanding is that it would be the connection of a business and not-for-profit social activity where profits of the business are used to fund (or co-fund) activity, which raises a common good. Ideally, it would create an autopoietic (Holmgren 2011; Válek and Jašíková 2013) circle of self-funded enterprise, which aim is societal problem-solving. For illustration, here are outlined some of the main features of a social enterprise (Trčka et al. 2014):

- A Social enterprise solves problems/issues of the local community
- A social enterprise is economically sustainable, it creates profit, but invests it back to the enterprise in the form of equipment, education of employees and fulfillment of socially beneficial objectives
- A social enterprise is not discriminating, and it employs disadvantaged people, and by that, it contributes to inclusion
- A social enterprise is aimed to maximal involvement of employees into the decision-making process
- A social enterprise is an open community which innovates and helps in the development of a region where it operates
- A Social enterprise uses local resources and cooperates with local organizations

We can see that even though one of the points is to create a profit, the profit should go back to develop the organization. By that, a social enterprise can be considered a part of the third sector. Social entrepreneurship might be (or not) rooted in a country's legal system. If it is not, the abovementioned roles of social enterprises are adopted by various legal bodies, which then become part of the social economy. According to specific conditions and context, social entrepreneurship can have multiple definitions. Therefore, this research, we would accept the broader definition, as stated in the first line of this paragraph. Deeper international analysis, including legal status, would be part of the Phase I and II of the proposed research.

Bottom Up societal problem solving also known as grassroots (Seyfang and Longhurst 2012) solutions means people themselves can recognize a societal problem and are able to gather around it to solve it. It is very similar to the so-called Communities of Practice (CoP) known from Knowledge Management theory (Lehaney 2004; Lesser and Storck 2001). The process of societal problem solving could be facilitated by the use of an appropriate tool. The tools and approaches often come from the area of complementary economies or system science (Kennedy et al. 2012; Lietaer et al. 2012; Bureš 2017).

Co-production is a phenomenon which happens when people solve an apparent problem by their own initiative and resources (Clement et al. 2017). It is closely related to so-called communities of practice (CoP). CoP is an informal structure in an enterprise (Lesser and Storck 2001). An example from business could be a group copy machine servicemen where each operates individually, but they know who is good in what and they create a network (community) which shares the knowledge, so they know to call whom if they have specific problem, yet the network formed itself around problems which are dynamically changing (Lehaney et al. 2004). The example of co-production can be a neighborhood watch. When people in some area see a rise in the crime rate, the neighbors gather and start to watch each other. Another example could be self-organized kindergarten in an area where there is none. For this research, co-production means when a person in another country finds him/her self in a situation where assistance is needed and the person does not wait for it and solves the situation by own initiative (Cahn 2000; Cahn and Rowe 1998; Clement et al. 2017).

### 3. Methodology

Presented project proposal is based on information gathered from several resources. First, informal interviews with migrants from various countries were carried out. The main aim was to identify the most significant obstacles on the way to adaptation and integration into social and economic structures. Second, analysis of existing studies and reports helped to formulate the main research question. Third, realization of project conducted by KURO, non-profit organization located in Hradec Králové, Czech Republic, provided experience with similar initiatives. Last, personal experience from various countries such as Caucasion nation was included.

### 4. Results

The plan of the research is a search for an answer on a question why in some contexts and areas migrants are able to help themselves by engaging in entrepreneurial activities, especially social enterprises, and in others, they are not. Furthermore, are there transferable elements which would allow us to learn from them in order to be applied in other situations? In order to do that it would be necessary to locate and describe enterprises and social enterprises run by migrants in selected countries, identify their specific features and motives behind their foundation and existence, analyze them by appropriate methodology, identify common points and differences and draw conclusions. In addition, we shall use them as a ground for computer simulations to extract more from the gathered data to be able to do much more informed predictions and recommendations for the application of transferable features of social enterprises into other areas. The last possible step is to use all knowledge gained through the research to create a quality label for those social enterprises who would follow the co-production paradigm; so, solving the societal problem by own initiative.

It also worth to be mentioned that at this stage whole proposed research would focus on immigrants rather than on emigrants. The reason is simple as immigrants are more localized and accessible group, and it is a logical step to start from micro level and then to move to the macro level. With this research finalized, its methodology can be used to study emigrant entrepreneurship as well. Therefore, a word migrant from this point should be understood as an immigrant, and as stated above, might also include refugees.

**The aim of the research is:** to search for unifying and transferable patterns in migrant entrepreneurship, especially those in the field of social entrepreneurship, to analyze them and to provide support for their development in any suitable area.

Objectives of the research:

- To create a literature review as a basis for rigorous research within the topic
- To identify locations with migrant entrepreneurial activity
- To conduct on-site research in selected areas
- To perform a comparative study of this area in search of common features
- To use appropriate methodology to validate the first part of the study
- To conduct interviews to learn about motives and background of starting of a social enterprise instead of having an ordinary business
- To conduct a systems analysis of both ordinary enterprises and social enterprises to find features that transcend both and that would be transferable
- To use results of systems analyses to run more comprehensive computer-based simulations to deepen the understanding of systemic relations

The objective above can be transformed separately to individual research stages. However, as we are at the preparation stage, this granularity would increase complexity, which could decrease understandability and thus potential to discussion. That is why activities are clustered into the main three stages outlined below. Activities which are minor (e.g. identification of locations) or can be considered as an integral part of the research process (e.g. literature review) are excluded. Phases presented below are thus activity-oriented and focused mostly on in-field research and system modelling.

#### *4.1. Phase I. Entrepreneurship of migrants – the search for reasons*

In the first phase, we will search for enterprises run in various countries and contexts, compare them, and try to identify common ground. This phase will be focused on any enterprise run by a migrant. At the very beginning, it would be necessary to create a sound methodology for the on-site research, data, and information collection (questionnaires, interviews) and harmonize it with all partners. The homogeneous approach is the key to the comparability of data and their use in the later stages of this research.

**The methodology** would consist of Literature review to provide theoretical roots for the following research. Theories of entrepreneurship and migration would be in the highest focus, but as the whole research is transdisciplinary and many fields and researchers, as suggested below, will be involved. The following step is the selection of proper areas for the research, so the identification of spaces where migrants are starting an enterprise. That would allow conducting of a study (including inquiries to confirm found data and information) in each of the selected areas. Comparative study of different contexts (geographical, cultural, social, political, etc.) would be next. Interviews and/or questionnaires should be used to validate the results of the comparative study. The last step is a systems analysis done with the help of Soft System Methodology (Checkland 2000) which would identify individual elements in enterprises as in a stochastic soft system and by that allow to synthesize features which are universal and transferable.

#### *4.2. Phase II. Social entrepreneurship of migrants*

At this phase, we would separate enterprises which would fall into our definition of social enterprise. And again, conduct systems analysis to find differences between ordinary enterprises and social ones. This would also involve the broader context of motivations and background surrounding them. This phase develops the previous one with more focus on co-production as it is expected that most of the societal problem solving would be aimed at the migrant target groups.

**The methodology** would mostly use on-site research involving interviews followed by the creation of case studies. Case studies have specific value as a best practice demonstration and can be published to promote the research project, but also would be analyzed in a systemic way to find out common elements and transferability of the result. Furthermore, case studies would have unified frame to allow statistical analyses and computer modeling in the next phase. The systems analysis would show enterprises as a system connected to their environments and identify how various elements are related, connected, and influenced by each other. For example, the connection of people to each other, to governments, the business sector, the non-profit sector, and other entities. How many funds are used, how much manpower, how much of intangible resources are involved. This analysis is a step, and a necessary base, for the following phase of simulations because without knowledge of the structure of a system it would be hard to make reliable simulations and to read their results.

#### *4.3. Phase III. Computer simulations*

At this phase, when all data would be collected and case studies compiled, we would be able to use them for computer-based modeling. The modeling would allow us to use gained data and simulate and predict what would happen if context and resources would change. At this phase, we would be able to gain a deep multi-dimensional understanding of researched phenomena and we would be able to formulate recommendations and re-evaluate further objectives of the research. The simulations will be used also as a second level of validation of results found in phases I. and II. At this stage, we can also conduct various statistical analyses.

**The Methodology** would be focused on causal-loop diagrams and stock and flow simulations of system dynamics. These could be used to simulate both hard and soft systems (Válek and Bureš 2018a).

The causal-loop diagram (CLD) expresses the causal relationship between two variables with positive or negative polarities. The main idea of CLDs is to apply polarities to all identified relations and consequently figure out what type of feedbacks emerge in the system. Positive polarity means that as the first variable increases (decreases), the second variable changes, in the same way, i.e., increases (decreases). Negative polarity expresses the opposite behavior. Once the cycles are closed, the polarity



of feedbacks (loops) can be identified and reveals the behavior of the system. In fact, there are two types of feedbacks, namely balancing and reinforcing feedback (Sterman 2010; Válek and Bureš, 2018a).

From CLDs can be easily created Stock and Flow diagrams (Bureš 2017). CLDs, we can use to simulate systems and predict various systems characteristics and Stock and Flow diagrams are used to simulate "what if" scenarios and system dynamics of a system. As an example, you can simulate a closed society using its resources over a period of time at a specific place, de-forestation, school dropouts, the performance of an enterprise, sub-systems of an enterprise, relations of an enterprise to the outside environment, etc. Software Vensim (Vensim) and Stella Professional (Isee Systems) can be used for purpose.

## 5. Conclusion

To summarize the lines above, it is believed that proposed research could have real scientific merit as it is a previously undiscovered area with the potential to create a methodological background for the whole field of entrepreneurship within migration with societal problem-solving overreach. Aside from that fact, it also has a great practical impact and could positively influence the lives of many as the product of the research can be used by organizations assisting migrants in facilitating better adaptation by creating of an appropriate environment for enterprise development. In addition, it is a research project which does not require massive funding and workforce, partly because of the proposed use of computer simulations, at least at this first stage aimed mostly on immigration which is a testbed for broader research endeavours in the field. Finally, gathered data, information, and materials can involve multiple researchers from multiple areas to make analyses more precise, as necessary are considered Sociologists, Social Anthropologists, Social Workers, and Economists.

It ought to be noted that this is a general proposal, and it will be more specified based on specific needs of funding. The proposed research is inherently international and is based on previous needs assessment among author's international contacts, and although there are many interested subjects it is planned to keep the partnership lean and manageable, but diverse to ensure high-quality results of comparative studies.

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# Statistical Simulation of Life Cycle Cost

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**Abstract:** This paper contributes to literature aiming to improve corporate decision-making policies in times of depressed margins and increased business uncertainty. Starting from a case study based on actual servicing systems, it develops and applies a value-based decision-making model using a combination of life cycle costing and statistical simulation. It is shown that this approach generates meaningful results wherever there are alternative solutions available for component parts of servicing units, differing in a range of functional characteristics and involving risk. In contrast to conventional capital budgeting, such a model provides full assessment of contingent or intangible costs, such as the impacts of device reliability. Simulation results and their reliability can be analyzed using standard statistical methods. Sensitivity analyses are vital for the determination of relevant risk factors.

**Keywords:** capital budgeting; life cycle cost; statistical simulation

**JEL Classification:** M21; C44

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## 1. Introduction

Several industries, including e.g. automotive, logistics and retail, are facing intensive competitive and regulatory pressures, squeeze on margins and business model disruption (KPMG 2019). This makes it more important than ever to pursue rigorous policies and use decision-making techniques with a clear focus on value, and considering exogenous, as well as endogenous uncertainty (Hellemo et al. 2018, Maier et al. 2019). In contrast to conventional capital budgeting, focusing on nonrecurring and time-constrained investments and neglecting systemic feedbacks, various factors of risk can be incorporated into decision-making using statistical simulation combined with life cycle costing.

These two methods are otherwise quite commonly used separately in different contexts, as shown by Dhillon (2010) and Mordechai (2011), respectively. For example, Fulton (2018) compared total life costs of electric and hybrid drive vehicles, Favi et al. (2018) analyzed the design process in shipbuilding and El-Akruti et al. (2016) determined the optimal repair and replacement policies for an electric arc furnace used in the steel industry using life cycle costing, while Vlachý (2018) analyzed the choice in product distribution and Dui et al. (2018) optimized the energy storage capacity for wind farms using statistical simulation.

Their merging allows the temporal and functional normalization of mutually exclusive decisions (through life cycle costing) in the context of dynamic systems (through statistical simulation). Possible applications may then range from assessing decisions in potentially high-growth innovation industries to those relating to choices in product distribution, as shown by Vlachý (2017; 2018). Relevant in the present context is a defining feature of life cycle cost analysis, which may use relative - rather than absolute - valuation when selecting one of several solutions to a particular engineering design, resulting in considerably reduced input data requirements (Norris 2001; Dhillon 2010). This, in turn, facilitates the creation of a relatively simple and robust simulation model (Mun 2015). Furthermore, as explained by Norris (2001) and Kong and Frangopol (2003), and shown by Table 1, life cycle cost analysis may extend the scope of costs above those of Type I (direct) and Type II (indirect), used in conventional costing, to include Type III (contingent) and Type IV (intangible), which are typically relevant in systems featuring operational or strategic risks that can be best assessed using simulation (Vlachý 2009). It may be noted that somewhat less flexible alternatives - that would not be suitable for such a methodological integration - include closed-form analytical solutions and decision trees (Broadie and Detemple 2004).

This paper solves a problem, initially based in logistics, but relevant also for other types of servicing systems. These typically contain various critical components that need to be periodically maintained, renewed or replaced to achieve a particular service standard at optimal cost, as demonstrated in the context of medical devices by Sinclair (2010) and, in more general terms, by Volkman (1997). When taken as individual capital budget decisions, they are thus relatively small, but their overall impact on the system is significant (Chang 2010). A model will be developed that can be further generalized and used for more broadly conceived problem classes. Finally, for the current problem, parametric sensitivities will be tested, addressing the errors-in-variables factor, whose relevance in economic models is discussed in detail by Chen et al. (2015).

Summarily, the study thus aims to improve corporate decision-making, in particular involving situations featuring increased business uncertainty and depressed business margins.

**Table 1.** Description of cost types. (source: adapted from Norris 2001 and Frangopol 2003)

<b>Cost type</b>	<b>Description</b>
Type I (Direct)	Direct costs of capital investment, labor, raw material, waste disposal; may include both recurring and non-recurring costs.
Type II (Indirect)	Indirect costs not allocated to the product or process; may include both recurring and non-recurring costs.
Type III (Contingent)	Contingent costs such as fines and penalties, personal injury or property damage liabilities, production or service disruption, competitive response, etc.
Type IV (Intangible)	Difficult to measure costs, including customer acceptance, customer loyalty, worker morale, community relations, corporate image.

## 2. Methodology

The case that will be solved is defined as follows: An essential component in a handling mechanism can be designed using two alternative technologies (A or B). Their characteristics differ in four life cycle phases, production of the component, its installation, its use in operation, and its disposal including dismounting. Generally speaking, technology A is more sophisticated and expensive, which involves higher costs of production, higher costs of installation, and the need to install an additional control component. It also has a shorter working life and worse reliability (i.e. higher probability of premature breakdown, which is negligible for a Type B component). On the other hand, due to improved controls and enhanced automatization, technology A decreases power consumption and reduces personnel costs.

Several distinct operating assumptions are involved: Type A components can be refurbished, up to two times each, and there are defined costs (including opportunity costs) to each unscheduled service disruption. Each handling mechanism (which is otherwise the same regardless of the technology used in its component that is being evaluated) has a defined annual operating time and handling capacity, as well as a life expectation in terms of handled units. To avoid clearly purposeless component replacements just before the handling mechanism is due for retirement, they will be retained when the handling mechanism's life exceeds a pre-set number of handled units (this parameter is designated  $\xi$ ).

A summary of the model inputs, including the particular values used in the case, is provided in Table 2.

**Table 2.** Model inputs summary.

<b>Parameter [unit]</b>	<b>Description</b>	<b>Value (Type A)</b>	<b>Value (Type B)</b>
$P$ [€]	Component production cost	4,800	4,000
$I$ [€]	Component installation cost	500	400
$C$ [€]	Control device cost	1,500 (only installed once / part of mechanism)	N/A
$\tau$ [units]	Replacement time	175,000	200,000
$D$ [€]	Disposal cost	500	500
$R$ [€]	Refurbishment cost	1,800	N/A
$m$	Maximum number of component refurbishments	2	0
$\xi$ [units]	Maximum framework life for component replacement	900,000	900,000
$X$ [€]	Service disruption cost	900	N/A
$\lambda$ [units]	Mean life expectation of component	250,000	N/A
$\rho$ [units]	Actual component life	stochastic (exponential distribution with parameter $\lambda$ )	200,000

When using life cycle costing, it is vital to determine a suitable functional unit. In the present case, the operation cycle is best defined as a number of processed units, which is a common quotient for the handling mechanism life, as well as for the life determinants its component, and becomes a common measure of service time. Accordingly, 100,000 processed units will be used as the model's functional unit. This also determines the discount rate; given the 8 % annual rate and the annual handling capacity of 160,000 processed units, the discount rate per 100,000 units amounts to  $8 \% \times 100,000 / 160,000 = 5 \%$  per functional unit.

While all life cycle costs of Type B components are determined solely by deterministic Type I and Type II costs - and would thus be easy to assess using conventional budgeting techniques - a fundamentally different approach needs to be taken with the Type III costs involved in the use of Type A components and comprising statistically random processes describing the reliability of the component. Its life cycle costs will therefore be assessed using statistical simulation as illustrated by Figure 1.

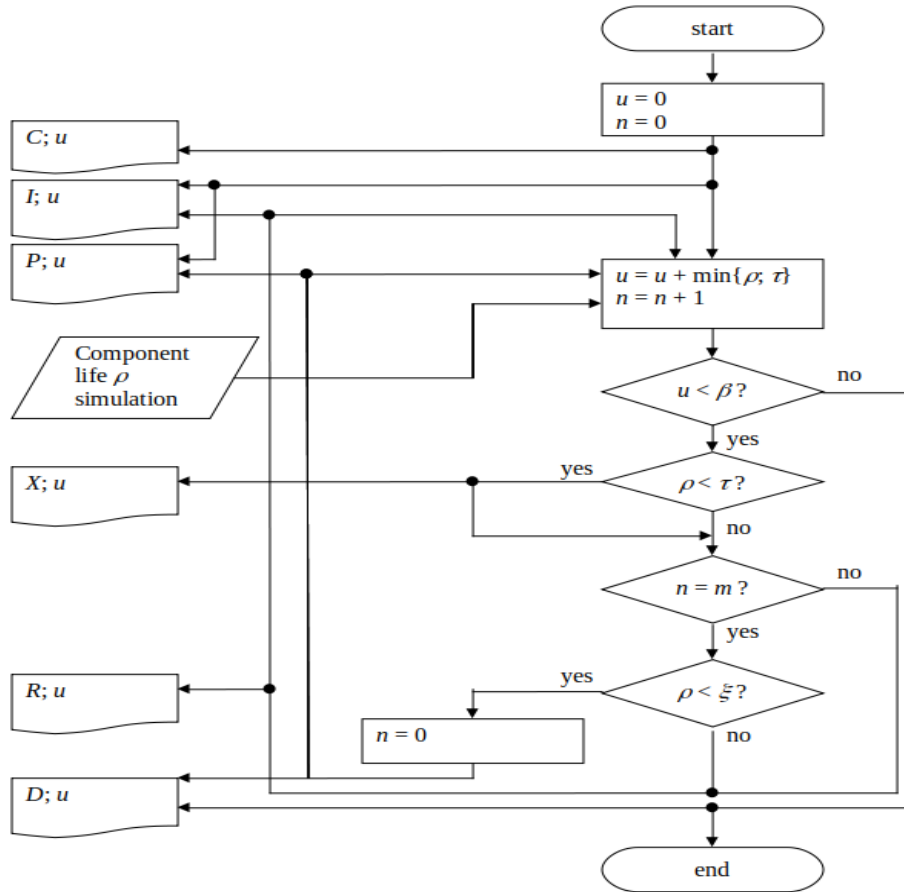


Figure 1. Life cycle simulation run process diagram for Type A component.

### 3. Results

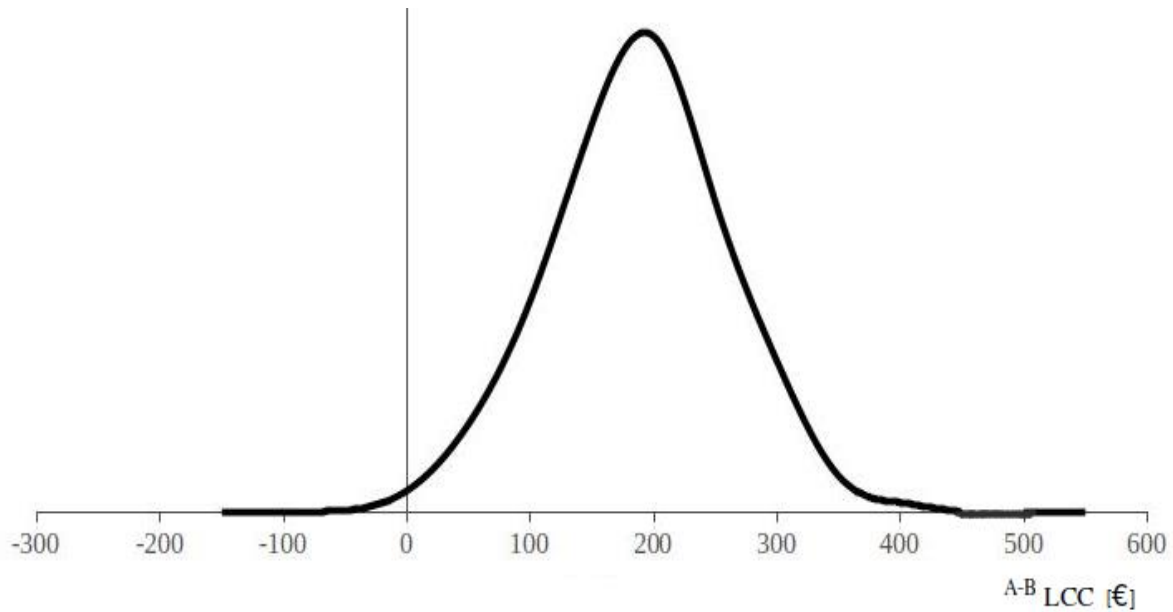
Decision-making will be based on the functional unit life cycle cost differential of component Type A over Type B, which subtracts the non-operating functional unit costs of the two component types and adds their functional unit operating costs differential as in Equation (1).

$${}^{A-B}LCC = {}^A\text{NOC} - {}^B\text{NOC} + {}^{A-B}\text{OC} \quad (1)$$

Using the values listed in Table 1, the non-operating cost per functional unit (i.e. 100,000 processed units) of a Type B component is  ${}^B\text{NOC} = \text{€ } 2,550$ .

The operating costs differential consists of energy savings and personnel cost savings. Both are in favor of Type A components (this implies a positive value of  ${}^{A-B}\text{OC}$ ). The differential assessment also requires a forecast of the wholesale energy price, which will initially be presumed to be € 60 / MWh. As each of the savings parameters uses different units of measure, they need to be standardized to the functional unit. Power consumption savings then amount to  $60 \times 1 \times 100,000 / 10,000 = \text{€ } 600$  per functional unit and personnel savings to  $1,200 \times 100,000 / 160,000 = \text{€ } 750$  per functional unit, totaling  ${}^{A-B}\text{OC} = \text{€ } 1,350$ .

The non-operating costs per functional unit of Type A components are generated by statistical simulation, resulting in a random distribution of the functional unit life cycle cost differential between the two component types as illustrated by Figure 2.



**Figure 2.** Distribution of the component's life cycle cost differential.

Significantly, the distribution mean is € 153 and its fifth percentile is € 9, which means that the more advanced Type A component outperforms Type B at a 95 % confidence level, and should therefore be preferred.

#### 4. Discussion

The model has been subject to sensitivity analyses in respect to key input parameters and potential operating adjustments. Two parameter forecasts seem critical in terms of potential variable volatility or insufficient information: the exogenous energy price and the endogenous mean life expectation for a Type A component.

Sensitivity analysis clearly indicates that the operating risk due to a potentially shorter component mean life is the more significant one of the two. Even in the rather extreme case of energy prices decreasing by 30 % (i.e. if the price fell down to € 42 / MWh), the use of Type A components would still be merited, while just a moderate increase of the break-down rate resulting in a mean life expectation of 218,000 processed units (down from 250,000 units) would be sufficient to reconsider such a decision.

Conveniently, simulation can also be used to adjust the terms of operation, and thus suggest a means of mitigating this risk. Increasing the scheduled replacement times of the Type A components from 175,000 processed units to 200,000 processed units (assuming there would be no regulatory restrictions to such a mode of operation) would result in a highly positive mean cost differential favoring Type A even under the assumption of its reduced mean life expectancy.

#### 5. Conclusions

Using a case study in the logistics servicing domain, this paper illustrated the applicable potential of combining life cycle costing techniques with statistical simulation in the context of servicing operations and the selection of alternative technological solutions in replacement chain situations. In particular, such an approach makes good sense when the technologies under consideration involve operationally dependent contingent costs, such as the breakdown frequencies analyzed herein. Other applications may similarly involve e.g. servicing time measures or processing feedbacks.

In contrast to conventional capital budgeting, much broader scope of functional system characteristics may be considered within the framework of this methodology, and it is thus viable to integrate aspects of financial and operational analysis in a single decision-making framework. Even though such models are generally suitable for use by industry practitioners, the results must be

carefully assessed in terms of input parameters' sensitivities, as well as correct interpretation, which seems to be its main limitation.

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# Economic Analysis of the Chemical Industry of the Czech Republic in the Period of Economic Growth

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**Abstract:** The chemical industry accounts for less than 1 % of the Czech Republic's industry, and this percentage has been decreasing due to the growth of other industries. Despite this, it has an important position, especially in terms of input producer for other areas of industry and agriculture. The percentage of employees and their wages in the chemical industry has been increasing recently. In the period of economic growth, the growth of the chemical industry has been recorded in all important indicators - value added, profit, sales and investment. Foreign trade in chemical products has a long-term negative balance in the Czech Republic. The article discusses the situation in the chemical industry of the Czech Republic over the last eight years from the economic point of view compared with the industry as a whole, the outputs of the financial analysis of the chemical industry compared with the manufacturing industry. There are also described the challenges and problems the chemical industry is currently facing. These include slowing economic growth, the emergence of new technologies known as Industry 4.0, the lack of workers in the labour market, the changing demands of workers and the increasing demands for accountability and sustainability of business activities.

**Keywords:** chemical industry; economic indicators; Czech Republic

**JEL Classification:** L65; O14

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## 1. Introduction

The production of chemicals and chemical preparations is one of the most advanced industries in the Czech Republic (CZ). It has a long history and occupies a very important position in the economy of CZ since its products are used in all areas of the economy, especially in other sections of the manufacturing industry such as manufacture of plastics and rubber, textile industry, electronics industry, construction, pulp and paper industry and automotive industry. The chemical industry is a supplier of resources for many industries and is very closely linked to them (Ministry of Industry and Trade CZ 2019a).

According to the standard classification of economic activities CZ NACE, the chemical industry belongs to Section C - Manufacturing Industry, Division 20 Manufacture of chemicals and chemical products. This Division is divided into 6 groups:

- 20.1 Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms;
- 20.2 Manufacture of pesticides and other agrochemical products;
- 20.3 Manufacture of paints, varnishes and similar coatings, printing ink and mastics;
- 20.4 Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations;
- 20.5 Manufacture of other chemical products;
- 20.6 Manufacture of man-made fibres.

The CZ NACE 20 Chemical Industry division is also closely related to the CZ NACE 21 Pharmaceutical Industry, CZ NACE 22 Rubber and Plastics Industry and CZ NACE 19.2 Manufacture of refined petroleum products. In addition to chemical companies, the chemical industry is also

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assessed from the point of view of products, namely products of the chemical industry according to the standard classification of products CZ-CPA classified in Section C - Products and services of manufacturing industry, Division 20 Chemicals and chemical products, including subcontracting.

Of the above-mentioned groups, CZ 20.1 is the dominant group in the chemical industry, i.e. the basic petrochemical industry, manufacture of inorganic and organic chemicals and polymers. This group includes the ten largest chemical companies in CZ. Large enterprises clearly dominate in the CZ NACE 20 group; in 2017, they accounted for 67 % of sales, 63 % of value added and employed 54 % of employees working in the chemical industry (Ministry of Industry and Trade CZ 2018)

The economic situation in the chemical industry is influenced by the development of the economy as a whole. In the last 15 years, after the economic growth until 2009, the economic crisis has been particularly important. The situation in the chemical industry until the end of 2010 was assessed by Kraus and Spicka (2013). As a result of the economic crisis, the chemical industry has seen a reduction in the number of employees, a decrease in return on equity and assets and minor fluctuations in the foreign trade balance and other indicators of financial analysis, but overall, the authors evaluate the development of the chemical industry in times of crisis positively as chemical industry companies managed to deal with the crisis relatively quickly and well.

The assessment of further development from the point of view of the Ministry of Industry and Trade of CZ and the Association of Chemical Industry is more or less positive. According to an analysis of the Ministry of Industry and Trade of CZ, sales development after the crisis year 2009 decreased to a minimum and then gradually started to increase until 2012. After that it decreased slightly again in 2013, followed by another period of sales growth until 2016. In 2017 and 2018, it is, in particular, increasing sales, the number of workers in the chemical industry and wage growth that are positively assessed, but this gradually decreases productivity growth year-on-year. It positively evaluates the increase in return on equity and risk reduction. It is already in this period a shortage of technically educated workers was identified. These analyses also highlight the decreasing interest in chemistry. Interest in workers with this qualification also started to increase in other related branches of the manufacturing industry. (Ministry of Industry and Trade CZ 2018; Ministry of Industry and Trade CZ 2019a; Association of Chemical Industry 2019a)

A similar course of development of the chemical industry can also be observed at European level. In 2009, there was a significant drop in production by more than 20 %. However, production was resumed in the years to come, although the chemical industry in the European Union (EU) did not reach pre-crisis production levels until 2018. However, since 2015 it has been steadily increasing. Foreign trade in products of the chemical industry in the EU has a balance opposite to the one in CZ, exports has long prevailed over imports. Also, in this area there was a decrease in 2009, more significantly in imports than in exports, but since 2010, both imports and exports have been increasing and, in both cases, they have already reached the pre-crisis levels in 2010. Consumption of chemical products in the domestic European market also declined in 2009, subsequently consumption started to grow until 2012, but unlike the foreign balance, which had a continuously rising character in consumption, there was a slight decline, peaking in 2016. In the subsequent period, consumption again increased to EUR 133 billion in the first quarter of 2019. (Cefic 2019) The chemical industry at EU level provides 1.14 million jobs with 28,330 companies operating within it (Ministry of Industry and Trade CZ 2019a). Within the European Union, it is Germany (28.6 %), France (13.6 %), Italy (9.8 %), the Netherlands (9.6 %), Belgium (7.3 %), Spain (7.2 %), United Kingdom (6.7 %) that have the largest share of production. The rest of the EU accounts for 17.2 % of production, and as a whole, the chemical industry ranks the fourth in the EU with the highest turnover. Labour productivity in the EU chemicals industry is by 77 % higher than the EU manufacturing industry average and has been rising over a long period. Investments in the chemical industry are also growing; in 2015, the chemical industry was the largest investor in the manufacturing industry, with investments amounting to EUR 45.5 billion, outperforming the automotive industry. On the other hand, the overall share of the EU chemicals industry in total GDP is only 1.1 % (Cefic 2018). Workforce in the EU chemical industry is more skilled, educated and better paid, with wages 50 % higher than the EU manufacturing industry average (Association of Chemical Industry 2019a).

Globally, the chemical industry noted a turnover of EUR 3,475 billion in 2017 versus EUR 3,360 billion in 2016 in the period of growth. The global market is expected to double by 2030. Worldwide, China ranks first with EUR 1,293 billion in turnover, followed by the EU with EUR 542 billion and NAFTA (North American Free Trade Agreement) with EUR 519 billion (Ministry of Industry and Trade CZ 2018; Ministry of Industry and Trade CZ 2019a).

The aim of the article is to analyse the current situation of the chemical industry in CZ to the extent corresponding to the classification of economic activities of CZ NACE 20 in the basic parameters of economic and financial analysis and, based on the observed trends, to identify the current challenges and problems the chemical industry is facing today and in the future or can take advantage of.

## 2. Methodology

The article includes analysis of statistical data at national level. From the producers' point of view, the data taken into consideration relate to CZ NACE 20; from the product point of view, they relate to CZ CPA 20. The period under review is based on the availability of data from 2010 to 2018, whereas data for 2018 is based on Ministry of Industry and Trade CZ estimates only. At the same time, primary data were collected through participation in conferences in the chemical industry, round tables with personnel managers of the chemical industry, study of analysis and studies in the chemical industry. Based on the synthesis of obtained information, the outputs of the article were processed.

## 3. Results

### 3.1. Chemical industry CZ NACE 20 until 2019

In the period under consideration 2010 to 2018, as can be seen from Table 1, there were between 1742 and 1851 entities operating in the chemical industry, corresponding to less than 1 % of all entities operating in industry. This percentage has been declining, even though the total number of entities in the chemical industry varies. This can be seen as a consequence of the growing total number of entities in the industry.

**Table 1.** Number of entities in the CZ-NACE 20 and its share in industry.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of entities in the CZ-NACE 20	1,742	1,819	1,837	1,765	1,761	1,762	1,754	1,793	1,851
Share in industry	0.98 %	0.99 %	0.98 %	0.97 %	0.94 %	0.93 %	0.92 %	0.92 %	NA

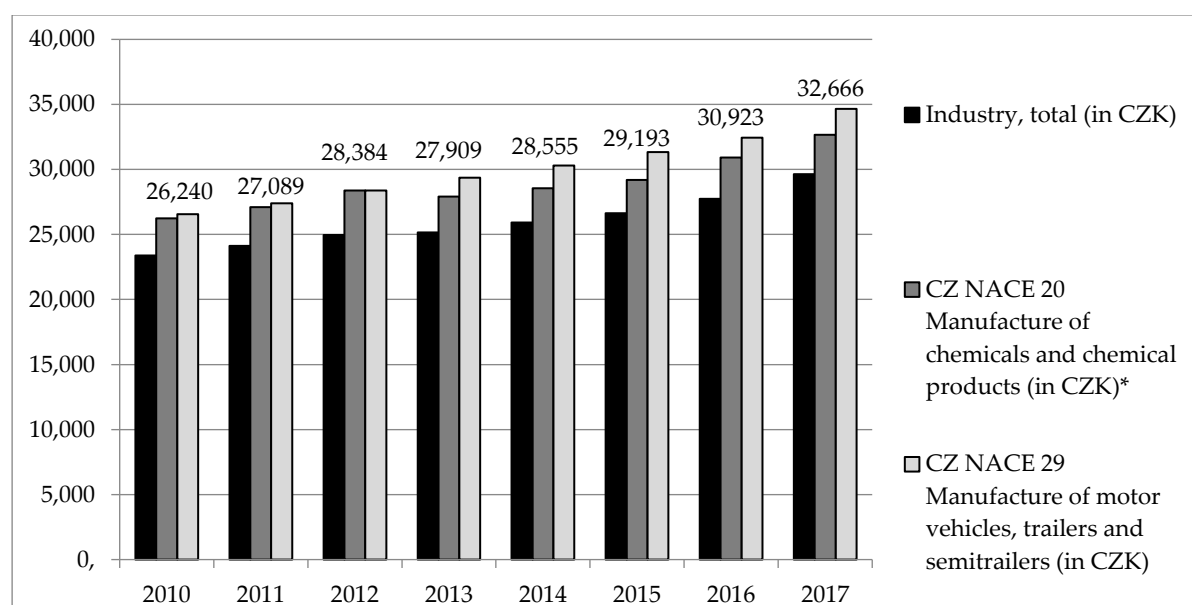
In addition to changes in the number of entities operating in the chemical industry, the number of persons employed also changed in the period under review. The development of the number of persons employed and the percentage of all persons employed in industry is shown in Table 2.

**Table 2.** Number of employees in the chemical industry at the end of the fourth quarter of each year and their percentage in industry.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Number of employees in the CZ-NACE 20	29,583	29,011	28,906	28,805	29,321	30,171	30,856	31,676	32,979
Share of number of persons employed in industry	2.3 %	2.2 %	2.2 %	2.3 %	2.2 %	2.2 %	2.3 %	2.3 %	2.4 %

While the percentage of employees in the chemical industry in the number of all the employed did not change substantially, the total number of persons employed in the chemical industry increased, especially in the final years. However, wage growth was much more significant. Wages increased by a quarter from CZK 26,240 to CZK 32,666 between 2010 and 2017. As can be seen from Figure 1, they did

not reach the level of wages in the automotive industry, which is the driving force of the Czech economy, but they were above average in industry (see Figure 1).



**Figure 1.** Comparison of wages in chemical industry, automotive industry and industry as whole.(Czech Statistical Office 2019a)

\*presented numbers are wages in CZ NACE 20 Manufacture of chemicals and chemical products

If we look at the development of the chemical industry in terms of economic benefits (Table 3), namely sales, value added and profit, we find that all of these indicators saw a significant increase in their value.

**Table 3.** Selected economic indicators of chemical industry.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Value added (millions of CZK)	30,584	31,808	31,616	28,774	36,638	41,967	34,104	49,996	51,367
After-tax Profit/Loss (millions of CZK)	8,900	6,177	9,115	6,594	11,143	16,474	15,142	22,655	17,759
Sales (millions of CZK)	152,791	169,835	178,624	171,577	186,573	171,392	165,843	191,745	274,797
Industry Added Value Share	3.2 %	3.2 %	3.1 %	2.8 %	3.2 %	3.6 %	2.8 %	4.0 %	NA
Industry After-tax Profit/Loss Share	3.5 %	2.3 %	2.8 %	2.3 %	3.7 %	5.0 %	4.9 %	7.0 %	NA
Industry Sales Share	3.4 %	3.5 %	3.5 %	3.3 %	3.5 %	3.1 %	3.0 %	3.2 %	NA

However, this increase was accompanied by two significant declines in 2013 and 2016. With the increasing value of these indicators, with the exception of sales, their share in industry increased (see Table 3).

Increasing sales and profits were also reflected in investments. Investments increased at a time of rising profits and conversely, when profits fell, so did the amount of invested funds. In both indicators (profit/loss, investments), there is generally an increasing trend in the period under review. Along with investments, there was also a steady increase in the assets of chemical enterprises in the

period under review (see Table 4). In terms of the ratio of assets and investments to the industry as a whole, there is a decline between 2010 and 2014, followed by a relatively fast increase.

**Table 4.** Net assets and investments of chemical industry and their share in industry in total.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
Net assets (millions of CZK)	146,209	149,841	150,681	151,435	152,342	154,711	171,483	188,126	202,358
Investments (millions of CZK)	8,232	6,983	6,256	7,449	7,315	11,468	14,371	14,237	12,628
Industry net assets share	3.4 %	3.4 %	3.4 %	3.3 %	3.2 %	3.2 %	3.5 %	3.7 %	NA
Industry investments share	3.1 %	2.6 %	2.3 %	2.8 %	2.6 %	3.9 %	5.1 %	4.4 %	NA

CZ is generally an exporter rather than an importer. In the field of chemical products, however, the opposite is true and imports of these products prevail.

**Table 5.** Export and import of chemical industry products (CZ-CPA 20) from the national point of view.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2017
Import (billion CZK)	117.5	136.9	146.5	152.1	166.9	150.3	140.8	160.5	160.5
Export (billion CZK)	171.1	202.8	213.6	226.2	252.2	254.7	260.3	270.0	270.0
Balance (billion CZK)	- 53.6	- 65.9	-67.1	- 74.1	- 85.3	- 104.4	- 119.5	- 109.5	- 109.5

As can be seen from Table 5, which shows the import and export of chemical products in the national concept, the import of chemical products prevailed over their export in all the monitored years. Moreover, this difference (balance) increases (except for 2017) from year to year. Despite the fact that exports increased by more than a third between 2010 and 2017. This difference is mainly due to the fall in exports in 2015 and 2016.

**Table 6.** Share of exports and imports of chemical products (CZ-CPA 20) in the total exports and imports of CZ from the national point of view.

Year	2010	2011	2012	2013	2014	2015	2016	2017
Share of exports of chemical products in total exports of CZ	5.0 %	5.3 %	5.4 %	5.5 %	5.3 %	4.6 %	4.3 %	4.6 %
Share of imports of chemical products in total imports of CZ	7.3 %	7.9 %	8.0 %	8.4 %	8.4 %	8.1 %	8.3 %	8.1 %

From the nationwide trade balance point of view, exports of chemical products grew faster than total exports of CZ until 2013 (a drop in the share in total exports). Since then, the growth was slower (up to 2017). As can be seen from Table 6, imports of chemical products make up around 8 % of all imports to CZ.

### 3.2. Financial analysis of chemical industry in the Czech Republic

Four indicators (ROE, Net turnover/Assets, Liquidity L3 and Interest-bearing resources (IBR)/Assets) from the INFA methodology used by the Ministry of Industry and Trade of CZ for financial analysis were selected for the financial analysis of the chemical industry. The values and

development of these indicators in chemical enterprises were subsequently compared with the results for the manufacturing industry of which the chemical industry is a part. ROE (Return on Equity) was used as profitability indicator calculated as (Ministry of Industry and Trade CZ 2019c):

$$ROE = \text{Profit/Loss for the accounting period} / \text{Equity} \quad (1)$$

This indicator tells us what profit the company generates from CZK 1 of its equity. The values of this indicator for the chemical and manufacturing industries are shown in Table 7. This shows a greater volatility in the profitability of chemical enterprises. While manufacturing industry values ranged from 12 % to 17 %, chemical industry values ranged from 8.92 % (2011) to 21.03 % (year 2015).

**Table 7.** Selected financial indicators of the chemical and manufacturing industries.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018
ROE CZ-NACE 20	12.4 %	8.9 %	12.6 %	9.7 %	16.5 %	21.0 %	16.1 %	20.4 %	14.5 %
ROE manufacturing industry	12.7 %	13.0 %	12.4 %	12.5 %	16.3 %	16.9 %	14.8 %	14.9 %	12.5 %
Net turnover/Assets CZ-NACE 20	1.15	1.23	1.37	1.27	1.35	1.21	1.12	1.11	1.43
Net turnover/Assets manufacturing industry	1.41	1.45	1.48	1.43	1.48	1.51	1.42	1.46	1.52
IBS/ Assets CZ-NACE 20	60.3 %	57.3 %	59.1 %	55.0 %	55.2 %	60.7 %	60.0 %	63.7 %	65.1 %
IBS/Assets manufacturing industry	58.7 %	57.6 %	59.3 %	58.7 %	58.9 %	59.9 %	59.2 %	58.3 %	60.3 %
L3 CZ-NACE 20	1.28	1.28	1.3	1.25	1.33	1.49	1.42	1.62	1.51
L3 manufacturing industry	1.4	1.38	1.46	1.45	1.53	1.57	1.59	1.56	1.59

Source: (Ministry of Industry and Trade CZ 2019b)

Net turnover/assets were used as an indicator of turnover. As can be seen from Table 7. Thus, in all the years under review, turnover was higher in manufacturing industry as a whole than that in chemical enterprises.

The interest-bearing resources (IBS)/Assets ratio was used to assess the indebtedness. It tells us what part of the assets is financed from interest-bearing resources. In the case of indebtedness, as in the case of turnover, there is a markedly greater volatility in chemical enterprises. In addition, Table 7 shows that after the decline in the indebtedness of chemical enterprises below 60 % between 2011 and 2014, it rose to 65.09 % in 2018.

The last indicator used is the liquidity indicator L3. It is constructed as (Ministry of Industry and Trade CZ 2019c):

$$\text{Liquidity L3} = \text{Current Assets} / (\text{Short-term Liabilities} + \text{Short-term Bank Loans}) \quad (2)$$

This liquidity indicator shows how many times current assets exceed short-term liabilities and short-term loans. Both in the chemical industry and in the manufacturing sector, a gradual increase in liquidity can be observed with some exceptions. It is faster in chemical enterprises, where this indicator was generally lower.

### 3.3. Challenges and problems of the chemical industry in the Czech Republic

Based on the collection of data from literature, studies by professional associations and consulting firms, statistical data, scientific and industry conferences and meetings in chemical industry enterprises, the challenges and problems that the chemical industry is facing in the present and near future have been identified:

- Economic development (slowdown of economic growth) and growth of world competition;

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- IT development mainly Industry 4.0 and its use in the chemical industry;
  - Raising sustainability requirements for business activities and environmental protection;
  - Research, development and innovation;
  - Trends in production (changes of raw material costs, product portfolio and the market situation)
  - Labour market situation, demographic trends, labour shortages, pressure on wage growth and the young generation's approach to participation in the work process;
  - Education;
    - Chemical and related fields in the education system in CZ;
    - Training of workers in the chemical industry.

On the one hand, these challenges and problems brings high investment demands (deployment of Industry 4.0 technologies, reducing energy and waste, changing technologies to increase sustainability and establish a circular economy), on the other hand, they can provide solutions to these problems - the onset of robotization can, in certain areas, eliminate problems related to the lack of job applicants in the labour market, reduce input material costs, optimize energy consumption, etc.

There are a number of good practice examples in all the above areas. The leader in the implementation of Industry 4.0 in the chemical industry in CZ is the company Rakona of Procter & Gamble, which intensively deals with new solutions for automated production lines and tries to introduce Industry 4.0 elements into the management of the entire business. As a result of these changes, the company has ranked among the TOP 9 companies best prepared for the upcoming changes related to Industry 4.0 (World Economic Forum 2018).

#### Economic development

Both CZ and neighbouring countries have been experiencing strong economic growth for several years. However, current indicators and forecasts suggest that this growth is hitting its limits in demand, limited labour force and is beginning to slow down. The problem for the Czech market is mainly the slowdown of the German economy, whose development is important for Czech exports. Germany is also a dominant partner for the chemical industry, both in terms of exports and imports. Exports to Germany accounted for 22 % in 2017 and 21 % in 2018 (Ministry of Industry and Trade CZ 2018, Ministry of Industry and Trade CZ 2019a). Potential trade barriers in the form of tariffs or the intensification of trade relations between America, especially the USA, China and the EU could also be a problem for the future. Brexit is also a potential danger for the Czech economy and the chemical industry, which can also destabilize the economic situation on the continent. Brexit is already causing uncertainty about its final form and deadline. Further political developments in the case of the conflict of interests of Prime Minister Andrej Babis may also cause problems for a significant part of the chemical industry of CZ.

However, assuming even a modest growth in manufacturing in the EU, a stable situation can also be expected in the chemical industry. Globally, EU sales are growing, but its world market share is gradually declining to the benefit China. The reason is massive investment in the region and high competition on world markets. Strict safety conditions (protection of workers' and consumers' health and environmental protection), pressure to reduce energy intensity, more efficient use of resources and the introduction of environmentally friendly technologies also play a significant role in the EU chemical industry. (Ministry of Industry and Trade CZ 2019a).

#### IT development mainly Industry 4.0

Industry 4.0 is the term for the fourth industrial revolution. Industry 4.0 is based on industrial IT integration, which is associated with real-time or near-real-time data processing, information sharing and continuous communication. The basic elements and procedures included to Industry 4.0 are usually integration, automation, digitalization and related terms digital factory and digital twins, robotization, cyber-physical systems, internet of things, internet of services, internet of people, virtual and augmented reality, additive production in form of 3D print, cloud computing, big data and

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business intelligence, machine learning systems, artificial intelligence and technology blockchain (Marik et al. 2016).

The use of Industry 4.0 elements in the chemical industry is very wide. Deloitte (2016) assumes it could be generally applicable practices, such as supporting business or economic operations to increase productivity, building smart factories, streamlining supply chains and improving the performance of existing assets. The use of Industry 4.0 elements directly in chemical industry technologies is called Chemistry 4.0 or Chemicals 4.0. Due to the high investment intensity of the introduction of new technologies, a rather gradual start is expected (Wehberg 2015). In the chemical industry there is expected to utilize Industry 4.0 tools for infrastructure maintenance and predictive maintenance management (internet of things, monitoring of technologies, monitoring data analysis etc.) to reduce energy consumption, reduce waste, reduce maintenance costs and reduce risks. It is also expected to use digital twins in the form of digital images of technologies, products, manufacturing processes that can be modified, optimized, monitored using data models, but also used for simulations during training. As volumes of collected production data increase, intensive use of data analysis, artificial intelligence and self-decision algorithms is expected (Palisek 2018; Deloitte 2016; Gilchrist 2016).

An expected benefit will also be in the elimination of routine, dangerous or health-threatening or strenuous activities. Demand for less and highly skilled workers is expected to increase, which can bring about labour market polarization and wage differentiation (National Observatory of Employment and Training, National Training Fund 2017)

#### Increasing sustainability requirements for business activities and environmental protection

At EU level, the long-term priorities include environmental protection, the effort of sustainable development and the reduction of climate change. Within the chemical industry, the EU has achieved a significant reduction in greenhouse gas production since 1996. Similarly, production of other substances affecting the environment has been reduced (Cefic 2018). At European level, Member States are thus succeeding in increasing production while reducing emissions. This support is based on European legislation, which gradually reflects the EU's international environmental commitments (e.g. REACH regulation). However, this positive trend also entails higher investment demands and, in comparison with world producers, mainly from China, it increases costs and thus reduces competitiveness.

In addition to the environmental legislative framework at European and national level (Tetrevova et al., 2017), there are also voluntary activities promoting responsible corporate behaviour in the environmental field. Responsible Care is a voluntary activity focused on sustainable development and social responsibility in the chemical industry. Established in 1986 in Canada, this activity brings together 64 national associations and over 200 global chemical companies. At present, there are 79 member organizations of the Association of Chemical Industry of CZ (Association of Chemical Industry of CZ 2019a; Association of Chemical Industry of CZ 2019b) that adhere to these commitments. Furthermore, there is the Association of Corporate Social Responsibility, which seeks to increase competencies in the area of corporate social responsibility and promote sustainable development policy, the Business Leader Forum, which supports responsible business environment, the Zeleny kruh association and many other organizations working in CZ (Association of Corporate Social Responsibility CZ 2019; Business Leader Forum 2019; Zeleny kruh 2019).

The demand for sustainability is reflected in the scope of innovation and investment; in this area we can find research and focus especially at the European level on circular economy and waste-free economy, efficient use of resources, searching for new energy sources, reducing energy intensity etc. However, the focus of sustainability in the chemical industry is directed not only to technology but also to the social dimension of sustainability. For more information see (Cefic 2017).

#### Research, development and innovation

Research, development and innovation in the chemical industry are funded from two basic sources - business sources (accounting for the majority of sources of financing) and public sources,



either national or foreign. Research and development were carried out by 85 to 100 companies between 2010 and 2017 and their number increased steadily. Table 8 gives an overview of the volume of funds invested in research and development between 2010 and 2017.

**Table 8.** Expenditure on research and development in the chemical industry of CZ

Year	2010	2011	2012	2013	2014	2015	2016	2017
Volume of business sources (millions of CZK)	808	820	856	982	1,059	1,027	836	1,021
Volume of national public sources (millions of CZK)	99	79	87	90	78	84	47	51
Volume of foreign public sources (millions of CZK)	56	112	15	55	47	55	23	29
Total (millions of CZK)	962	1,011	958	1,127	1,183	1,166	906	1,101

Source: (Ministry of Industry and Trade CZ 2019a)

At the level of national public sources, most often used are programmes of the Ministry of Industry and Trade of CZ (IMPULS, TIP, TRIO) and Technology Agency of CZ (Alfa, Centra kompetence, Delta, Epsilon, Zéta), Ministry of Defence (Development of Operational Capabilities of Armed Forces of CZ), Ministry of Education and Physical Education of CZ (EUREKA CZ), Ministry of the Interior of CZ (Security Research CZ 2015–2022, Security Research Programme of CZ 2010–2015), Ministry of Agriculture of CZ (VAK, KUS, ZEMĚ). Within the Operational Programs of the European Funds, 120 projects from the Operational Programme Enterprise and Innovation for Competitiveness directed to the chemical industry CZ\_NACE 20 were approved between 2015 and October 2018 with the total planned support of CZK 1.72 billion, of which CZK 0.77 billion came from the EU funds. The focus of the projects is mainly on strengthening research and development capacities and introducing business innovations, cooperation of research institutions and enterprises. Chemical industry enterprises are also involved in projects at EU level, 4 companies participate in Horizon 2020 projects (Ministry of Industry and Trade CZ 2019a). However, these resources are time-limited, being linked to the existing programming period 2014-2020. With the onset of the next programming period 2021–2027, efforts are being made to prepare support so that it is seamlessly linked to the existing programming period, and information on the preparation of conditions for the next programming period implies that R&D support will again be one of the priority areas of support. Research, development and innovation are conditioned not only by sufficient financial resources, but also by a sufficient number of qualified workers, researchers and innovation implementation experts.

#### Trends in production (changes of raw material costs, product portfolio and the market situation)

The situation in the chemical industry is also affected by the development of price of raw materials, which, together with the economic growth, are fluctuating (i.e. the price of crude oil in 2010 \$ 79/barrel, in 2012 \$ 112.3/barrel, in 2016 \$ 42.8/barrel and in 2018 \$ 71.5/barrel (OECD, 2019)). Development of prices and export of chemical product have been affected also by releasing of the CZK rate by Czech National Bank in 2017. Based on the requirements of customers there are also changes in product portfolio, it does not concern too much heavy chemistry products, but rather applied chemistry products, mainly in accordance with the commercialization of research and innovation output in form of new products of material chemistry (nanomaterials, biochemical product etc.). Together with the expansion of products, the approach to customers is individualized. Furthermore, it can be stated that the concentration of business groups operating in the chemical industry has been strengthened in the form of several important players providing production mainly in the field of heavy chemistry. On the other hand, the number of entities operating in the chemical

industry is growing in connection with the expansion of the products offered and their production (see Table 1). (Choudhury, 2019)

### Labour market situation

The labour market in CZ is currently showing a low unemployment rate and a large excess of job offers. As of 31 October 2019, the number of job seekers in CZ was 196,518 while the number of job vacancies was 337,453, the unemployment rate as of that date was 2.7 % (Ministry of Labour and Social Affairs CZ 2019), one of the lowest unemployment rates in Europe.

This situation poses problems for chemical industry companies in recruiting new qualified employees and also puts increased pressure on wage growth. To ensure production, companies use measures such as more active promotion of jobs in CZ and abroad, recruitment of agency workers and foreign workers, intensive cooperation with secondary schools and universities focused on the training of chemistry specialists, recruitment of less qualified workers and providing them with training or long-term education. It is not only the economic situation and growth, but also the demographic development, with more people leaving the labour market (due to retirement) than those who enter it, that have a significant impact on the situation. In addition, the youngest generation (the so-called Generation Z) has different ideas about getting involved in the work process (demands for greater flexibility in the work process, emphasis on wellbeing, employer's credibility in environmental care and higher wage demands). For more information see (Kostalova and Bednarikova 2019).

### Education

Changes in employee requirements are also expected in the chemical industry as a result of technological changes. In this context, the chemical industry companies are expected to impose requirements on the adequately qualified staff as well as increased training of existing staff in relation to these changes. A greater degree of multidisciplinary will be required, not only in the natural sciences - chemistry, biology, physics, but also in technical fields, especially information and communication technologies. Requirements for soft skills such as language skills, communication skills, teamwork, etc. will also increase. (Kostalova and Bednarikova 2019) The education of qualified future employees in the chemical industry is mainly provided by secondary vocational schools specializing in chemistry and three universities/faculties (Faculty of Chemical Technology, University of Pardubice, University of Chemistry and Technology Prague and Faculty of Chemistry, Brno University of Technology). At least in universities (with the exception of the Faculty of Chemistry, Brno University of Technology) in recent years, the number of chemistry students has been decreasing (see Table 9). Therefore, chemical companies should turn their attention to the young generation and raise their awareness of the need for qualified workers, job security, and career advancement opportunities (Lostakova et. al. 2018).

**Table 9.** Development of the number of students at chemical faculties of Czech universities

<b>Year</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
Faculty of Chemical Technology, University of Pardubice	1,657	1,514	1,500	1,426
University of Chemistry and Technology Prague	4,358	4,189	4,155	3,917
Faculty of Chemistry Brno, University of Technology	1,077	1,206	1,124	1,133
<b>Total</b>	<b>7,092</b>	<b>6,909</b>	<b>6,779</b>	<b>6,476</b>

Source: Brno University of Technology 2019, University of Chemistry and Technology Prague 2019, Faculty of Chemical Technology, University of Pardubice 2019

At all chemical-technology faculties, we can see a strengthening of cooperation with practice, from both sides; on the part of schools with the aim of increasing the interconnection of teaching with

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practice and offering graduates good employment, on the part of employers with the aim of attracting new qualified workers and thus partially solving the problem in the labour market.

Examples of cooperation with practice from universities and secondary schools as well as examples of massive increase in qualifications of chemical industry employees, e.g. through comprehensive training programmes at company level, in cooperation with universities, etc., can be found in available resources (Kostalova and Bednarikova 2019; Association of Chemical Industry 2019; Ministry of Industry and Trade CZ 2018, Ministry of Industry and Trade CZ 2019a)

In the foreseeable future, the challenge is to open up education at these faculties to foreign students, to offer study in English and to stabilize or increase the number of students and thus the offer of graduates for the Czech chemical industry, in addition to excellent language skills.

#### 4. Recommendation

Given the above-mentioned situation in the chemical industry, economic development and expected changes, chemical industry companies as well as other entities related to this industry can be recommended to:

- Monitor developments not only on the Czech and European markets, but also on the global market and look for new opportunities;
- Strengthen multidisciplinary, familiarize themselves with the technological developments represented by Industry 4.0 and introduce innovations to increase productivity, replace routine and unsafe work, technologies to improve monitoring and data analysis to optimize production, reduce energy consumption, use resources more efficiently and increase occupational safety and health and environmental protection;
- Use the available resources to finance research, development and innovation and to introduce technological investments, without limiting themselves to support at national level and rather to try to reach sources of support from the European level more often;
- Emphasize the sustainability of production, focus on and implement measures leading to higher corporate social responsibility, environmental protection, implementation of circular economy principles;
- Invest in education, expand cooperation with secondary schools and universities;
- Expand the offer of branches of study especially at universities in English and thus increase the number of students and graduates.

#### 5. Conclusions

The paper analysed the situation of the chemical industry in CZ. The area under assessment was from the producers' point of view CZ NACE 20 and from the product point of view CZ CPA 20. Like other areas of manufacturing industry in CZ, this area was affected by the economic crisis and subsequently strengthened significantly in the period of economic growth. The development in the chemical industry is now mainly affected by the labour market situation and demographic developments, technological developments and the advent of Industry 4.0, and the expected slowdown in economic growth, which may subsequently lead to the recession of a national or European or global economy, as the case may be. Based on the analysed data, the article presents measures that should help to use open challenges and solve existing problems of the chemical industry in CZ.

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# The Approach to Servitization in the Czech Manufacturing Companies

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**Abstract:** Nowadays servitization is an essential part of strategic marketing. Companies can build up a wide portfolio of conventional services, develop/acquire new services or offer advanced services closely connected with the product in the way they provide their customers with ability rather than with a physical value. Unlike foreign professional literature, term servitization appears in the Czech professional literature sporadically only. It is possible to assume that insufficient cognizance of servitization also shows in the practice of manufacturing companies, i.e. that the service potential is not fully exploited. In this paper a research hypothesis that servitization is applied by manufacturing companies in the Czech Republic as a marketing tool rather than as a way to a change in their strategic focus has been constructed and discussed. The paper outcomes were drawn up based on the analysis, comparison, and synthesis of the information obtained (i) from a targeted research into the professional literature (ii) through an analysis of web pages of 165 selected companies from the point of view of services they offer and (iii) personal experience from interviews conducted at manufacturing companies. The outcomes then should help to identify the opportunities for servitization in manufacturing companies in the Czech Republic.

**Keywords:** servitization; services; manufacturing companies; differentiation of the offerings to customers

**JEL Classification:** M210; M31

## 1. Introduction

Manufacturing companies are facing a lot of changes in the market environment. In particular, these include globalization, increasing competitiveness of developing countries, and saturation of the market, new technologies, growing customer responsiveness, and changes in the customer demand. The growing competition pushes down profit margins, which requires new income flows and leads, together with commoditization and acceleration of the product innovation cycle, to the fact that more and more manufacturing companies are starting to be interested in connecting their manufacturing activity with provision of customer services. As recent research suggested: The manufacturing companies have a positive reputation with their customers especially thanks to their individual approach to customers and to the flexibility and quality of their services (Jelinkova et al. 2018). They are thus shifting closer and closer to services and some of them so intensively that they are transforming into service providers. Services are understood not only as a strong marketing tool, but they are also becoming a strategic target of a lot of manufacturing companies. A service provided by a manufacturing company is mostly specifically focussed on a particular customer. So, it can be considered as a unique solution to a specific problem. Services provided in the B2B market are much more complex and require administration of a larger number of parameters to ensure their flawless provision and achievement of the desired outcome than those provided in the B2C market (Jackson et al. 2000).

Companies can build up a wide portfolio of conventional services, develop/acquire new services or offer advanced services closely connected with the product in the way they provide their customers with ability rather than with a physical value. In the case of successful implementation, services become a source of income and profits, they make sure the customers are satisfied and they support

the company growth. This transition from a product-oriented business model to a service-oriented business model is called servitization.

Servitization was first applied in the USA as early as in the 1990s. It has been developing since then, and nowadays it is an essential part of strategic marketing (Baines et al. 2009). Until the end of the 20th century, its content was associated with integration of products and services aiming to fulfil marketing targets, i.e. a marketing approach to servitization. Nowadays, it is associated with a change in the company's strategic focus, i.e. a strategic approach to servitization (Pistoni and Songini 2018). It did not develop until after 2000 (Park et al. 2012).

On a worldwide scale, 38% of the manufacturing companies can be classified as servitised. In general, "maintenance and support „and „ retail and distribution „are the most commonly provided services (Mastrogiacomo et al. 2019). Therefore, servitization is a frequent issue among foreign experts. However, unlike foreign professional literature, this term appears in in the Czech professional literature sporadically only (Friedel 2019; Kaňovská 2018). It is possible to assume that insufficient cognizance of servitization also shows in the practice of manufacturing companies. This can also be demonstrated on the outcomes of the conducted own online questioning and the analysis of web pages of selected 49 foundries in the Czech Republic: only a third of the respondents have encountered servitization; 70% of the respondents stated, after they had been briefly explained what servitization is, that they understand it, and 40% stated they were already applying this strategy; the companies offer a wide portfolio of mainly conventional services, and only some of them offer advanced services closely connected with a product in cooperation with other supply chain entities (Vlckova and Balasova 2019).

Although as many as 45% of 2652 manufacturing companies in the Czech Republic engage in services and 2% of the companies have transformed into service providers (Mastrogiacomo et al. 2019), it is possible to assume that the service potential is not fully exploited. This presumption also supports the results from personal interviews conducted at manufacturing companies mainly in the frame of diploma thesis guidance, e.g. (Balasova 2019). It is possible to expect that the offerings of Czech manufacturers are mostly at the basic or medium levels of the provided services, i.e. for the time being, the companies only endeavour to offer a wide range of conventional services, or they are trying to develop/acquire new services. Most companies still do not offer advanced services closely connected with the product in the way they provide their customers with ability, rather than with a physical value. Therefore, a research hypothesis has been constructed as follows: Servitization is applied by manufacturing companies in the Czech Republic as a marketing tool rather than as a way to a change in their strategic focus.

The following targets were determined to verify this hypothesis (i) to conduct a targeted research into the professional literature aimed at the possible approaches to servitization placing an emphasis on changes in business models applied by manufacturing companies (ii) to conduct an analysis of web pages of randomly selected companies operating in the Czech Republic from the point of view of the services they provide/mention. The outcomes then should help to identify the opportunities for servitization in manufacturing companies in the Czech Republic.

## **2. Methodology**

The paper was based on both primary and secondary sources. The secondary sources mainly included foreign professional literature, expert studies, websites of the randomly selected companies from various industry (textile, chemical, petrochemical, rubber, food, engineering, metallurgical, woodworking and construction industry) and information acquired at international conferences. The primary sources the paper drew on were the personal experience from interviews conducted at manufacturing companies in 2018 and 2019 mainly in the frame of diploma thesis guidance. The paper outcomes were drawn up based on the analysis, comparison, and synthesis of the obtained information.

### 3. Results

#### 3.1. *The marketing approach to servitization*

The marketing approach to servitization is associated with the first interpretations of the term of servitization, where addition of services to products is associated with an increase in the customer value (Vandermerwe and Rada 1988; Kryvinská et al. 2014), with a decrease in the difference between traditional activities of the manufacturer and the service provider (Tellus institut 1999), with the trend of adding more and more service elements to the product offerings (Desmet a kol. 2003). Therefore, the main aim is to differentiate the offerings for customers, whose different possibilities were identified by (Pistoni and Songini 2018). At the same time, they emphasize that products and services can be separated in the mentioned possibilities and sold separately:

- The seller offers for sale a compound package of more products and/or services for more favourable prices compared to the prices of separate components; so-called bundling.
- Mainly B2B market companies sell components as the system selling, e.g. hardware and software. It is a sort of package that should provide the customer with such a combined offer that they would hardly obtain in another way.
- The manufacturer supplements their products with a set of complementary, i.e. presale, sale, and after-sale services; so-called product service.
- Full service represents an offer of a complex package of products and/or services, which satisfies the customer needs and wishes relating to a particular event or problem (Stremersch et al. 2001). It is closely associated with the systems selling. For example, when offering a maintenance service with a delivered facility, the supplier providing the “systems selling” only cooperates with the managers of the customer’s maintenance centre, while when providing the “full service” they cooperate, in addition to the above, with the purchase department and with the customers corporate management.
- Offering of the service package includes supporting facilities, facilitation of the product application, information, explicit services (sense experiences, e.g. taste of food) and implicit services (psychological values, e.g. comfort), e.g. sale of wireless internet connection sold as a package including a wi-fi router, installation, information about how to look after the device, hi-speed connection (explicit service), a nonstop line for breakdown notification (implicit service). Unlike the bundling, the product-service combination is not a question of choice. The company does not give the customer another choice.
- The last stated offer differentiation possibility is the installed base service. The offer consists of a number of products or services, which are supported with complementary, particularly after-sale services relating to the processes required by the end user for the period of the product lifetime. (Pistoni and Songini 2018; Oliva and Kallenberg 2003). For example, when selling a printer, the manufacturer offers the end user services relating to its operation.

#### 3.2. *The strategic approach to servitization*

The strategic approach to servitization relates to creation of a new form of corporate organization, structure, culture, and managerial controlling systems. This change is usually accompanied by implementation of new technologies and transformation of operating processes in the way to ensure development of the necessary employee knowledge and skills. Therefore, servitization represents innovation of corporate capabilities and processes aiming to make a shift from selling products towards selling a product-service system (hereinafter referred to as the PSS), which better creates the customer and supplier value (Kryvinská et al. 2014). At the same time, companies transform from a product-dominant logic (only goods and information flow between the manufacturer and the customer, the emphasis is placed on product ownership and services are understood as a special type of products) into a service-dominant logic (to integration of the manufacturer’s and the customer’s resources and to mutual information sharing, the manufacturer helps the customer to achieve their targets, the emphasis is placed on services bringing benefit to the customer) (Eggert et al. 2018; Weijiao



et al. 2018). This results in creation of new business models, which extend the existing product offerings through related services (Aas et al. 2018; Jing Hua Li et al. 2015; Visnjic et al. 2012):

- Solutions represent the effort to solve a customer-specific problem by adaptation and integration of products, services, and software (Raddats et al. 2019). For example, City Bank creates, through integration of banking products, counselling, and mobile/computer applications, a complex offering to suit the permanently changing client needs all around the world (Miller et al. 2002).
- Integrated solutions also interconnect products and services in accordance with customer needs, but it is not limited to the use of electronic facilities (Pistoni and Songini 2018).
- PSS focuses on sale of functions that are so-called dematerialized rather than on sale of material products. It aims to fulfil specific requirements of individual customers (Manzini and Vezzoli 2003). There are 5 PSS variations in total (Kryvinská et al. 2014; Neely 2008):
  - Integration-oriented PSS, where manufacturing companies focus on services through vertical integration, i.e. on extension of the activity of e.g. retail and distribution, financial and/or advisory services, services in the area of real estate, transport services. The product ownership is still transferred to the customer. For example, they are companies in the crude oil industry that extract, refine, and manufacture petrol and, in addition to that, they provide a huge infrastructure for distribution and retail.
  - Product-oriented PSS provides extra services directly relating to the product, e.g. its design and development, installation and implementation services, maintenance and support services, advisory or operational services.
  - Service-oriented PSS represents integration of services into the product itself. Its ownership is however still transferred to the customer. They are, for example, smart traffic systems integrating information and telecommunication technologies into traffic engineering.
  - When PSS is usage-oriented, there is a shift to services delivered through the product, whose ownership is not transferred. The manufacturing company no longer sells its products but their functions through modified distribution and payment systems, e.g. leasing, periodical payments.
  - Goal-oriented PSS aims to replace a product by a service. It is, for example, the voice message service, which has replaced the need to own a recording device.
- Functional sales also focus on selling functions (e.g. an offer to wash your linen instead of offering a washing machine). However, this represents a comprehensive solution satisfying the identified customer's need with respect to the whole product or service lifetime, from a design and manufacturing to a service (Aurich et al. 2006). The supplier decides which products they will use to ensure the function, unlike leasing, where the products are specified by the customer (Sundin and Bras 2005).
- Function product is the output of a functional sale, also called the "total care product." It is used, for example, in aviation, processing, and medical industries. It is associated with different payment options. (e.g. payment for hours of its usage, periodically per year, for performance of the facility or for the provided function, e.g. for a supplied energy (Alonso-Rasgado and Thompson 2006). For example, it can also be a coffee machine if a company pays its provider for the number of coffees made, and the ownership of the coffee machine is not transferred.
- Integrated product and service engineering specifies the properties of a functional product to direct at the functions delivered to the customer and at full integration of different elements into corporate offerings to meet the customer needs better (Pistoni and Songini 2018). For example, a manufacturer provides and installs their machines at the customer's manufacturing plant; that uses them and pays the supplier for the produced quantities. If the customer does not need to produce, the supplier takes the machine back. The supplier tries to make sure that the customer uses the machines as long as possible and that they are operated with a low failure rate or with not very frequent repairs (Lingegård et al. 2012). This relationship between the customer and the supplier is also called leasing.

Many authors link implementation of servitization with transition of manufacturing company to some other PSS variant (Tukker 2004; Kryvinská et al. 2014). This transition is recommended to be

realised successively, i.e. from realization of PSS with the lowest accent on services, eventually from already in company established PSS to the realization of particular PSS variants which are more and more orientated on services (Neely 2008). It is suitable to manage individual steps of implementation of servitization as a project (Kostalova and Tetrevoa 2016).

### 3.3. Services presented on the main web pages of manufacturing in the Czech Republic

If companies want to support their growth through services, it is necessary to present their services to their customers. One of the possibilities is their presentation on web pages. The current trends in services offered by manufacturing companies in the Czech Republic were identified through an analysis of 165 web pages from the point of view of services they offer. The following variables were surveyed: the company size from the point of view of the number of employees, the type of the offered service: on the main web page (marked as the first level presentation), after clicking a tab open (second level presentation), and together with offering a product (with a product). One of the conditions of successful servitization is also creation of an independent service innovation department (Motwani et al. 2006). Therefore the existence of such department was additionally monitored variable. Table 1 shows the outcomes of an analysis of presented services by their location on web pages of the researched companies.

**Table 1.** The frequency of the companies by level presentation of the offered service.

<b>Presented services</b>	<b>Absolute Frequency</b>	<b>Relative frequency</b>
No	49	30%
Yes	116	70%
First level	96	58%
Only first level	20	12%
Second level	86	52%
Only second level	10	6%
Both level	76	46%
With a product	87	53%
Only with a product	10	6%
All three levels	65	39%

Table 2 shows the structure of companies according to the level of presentation of the services offered and according to the existence of the innovation department.

**Table 2.** The frequency of the companies by level presentation of the service and by innovation department.

<b>Innovation department</b>	<b>Yes</b>	<b>No</b>	<b>Total</b>
<b>Presented services</b>			
Yes	50	66	116
No	12	37	49
Total	62	103	165

Table 3 shows the outcomes of an analysis of presented services and independent service innovation department by their location on web pages structured by size of the researched companies.

**Table 3.** The structure of the companies by the level presentation of the offered service and by their size.

Companies	Relative frequency	Presented services	First level presentation	Second level presentation	With a product	Innovation department
Small-sized	22%	73%	59%	46%	35%	24%
Medium-sized	37%	66%	57%	57%	59%	30%
Large-sized	41%	73%	58%	51%	57%	52%
Total	100%	70%	58%	52%	53%	38%

#### **Services presented on the main www page (first level presentation):**

- customer support centre, customer centre, product advisory centre, efficient service provider in the area of logistics, development and facility management, help with projects, counselling, expert consultations, tailored formulas, seller services, manuals, instructional videos,
- school for foremen, service school,
- databases, publicly accessible expert information service,
- research and development, test laboratories, custom measurement, part supplies according to drawings, transfer of technologies,
- manufacturing: contract, custom-made, according to specific customer requirements,
- e-shop, factory shop,
- payment after delivery, free shipping, money-back guarantee, product exchange, complaints,
- service: comprehensive, technical, technological, general overhauls, customer support with failures, spare parts,
- complementary customized services, comprehensive logistics services, vendors' services, product packaging, industrial park, reliable delivery.

From the point of view of the servitization status, it is interesting to study presentations of the sets of offered services by individual companies. Only one service was presented by 17 companies. More than 2 services were presented by 24 companies, out of which the most widely presented offer was that of IDIADA CZ. Their Development Department offers a wide portfolio of services from draft designs, through conceptual designs, to construction for serial production verified through technical simulations for automotive, machinery, and consumer industry customers.

Another 4 companies presented their services generally as follows: We can adapt to your requirements and find a tailored solution. We will adapt to your needs and we offer you complementary services within the area of business.

#### **Services after click opening (second level presentation):**

- customer support centre, service center, counselling, technical support, hotline, call centre, online customer support and assistance, social counselling, manuals, instructions, assembly procedures, consultations, seminars, documentation,
- courses and training, classroom and training technology rental, instructional videos, virtual tour, special tours, inspections and measurement at the customer's premises, excursions, special events, training department, environmental centre,
- calculators (medical, thermal insulation), draft solution, calculations, analyses, putting into operation, draft design, refinement, automation of manufacturing, application, implementation, new technical solutions, complete installation, electrical assembly - including an electrical safety report, custom manufacturing,
- research and development, constructional solution and development of the whole product only after its implementation,
- measurement, testing, metrological centre, laboratory (testing, application, environmental, for building materials), sample testing, product adjustments, expert opinions, diagnostics, defectoscopy, quality management, quality control,

- service – complete, nonstop, presale, sales, after-sale, guarantee and post-guarantee, fire, technological, technical, coloristic, craftsmen; services to improve product quality, unplanned service intervention, regular service maintenance, repairs, overhauls, refurbishment, prepaid service, comprehensive product after-sale care,
- logistic service, supplying, waste disposal,
- spare parts manufacturing, diagnostics, failure solutions, maintenance, aids rental,
- information (about raw materials, products, orders), textile database, technical informatics, remote data monitoring,
- e-shop, specialized shops,
- financing, loan, insurance,

What are interesting from the point of view of the servitization level are the presented offerings of comprehensive services by two companies:

Paramo Pardubice: chemically friendly cleaning of machining technology circulatory systems, including pumping out of the used machining fluid, and arrangement of its disposal.

TOS Kuřim: Purchase of a machine from our portfolio means for us commencement of a long-term partnership with the customer. We are ready to respond flexibly to the customer's initiatives. We are aware of the fact that nonstop operation of a machine and its long lifetime is the key factor for the customer.

#### **Services connected with the product:**

- counselling and consultations, customer support, technological support, hotline,
- provision of tests, conducting laboratory and operational tests, sample testing, technical condition assessment, remote diagnostics, measurement, adjustment, declaration of properties, analyses,
- cleaning and disinfection, supplies of spare parts, repairs, inspections,
- supplies of products with appurtenances necessary for their installation, installation, shipping, order monitoring,
- technical support, machine operation, disposal of chemical substances, refurbishment, recycling,
- possibility of choosing by parameter, product in a lot of packages,
- services related to product development, development and manufacturing according to the customer's requirements, turn-key solutions, tailored formulas, development of mixtures, development of product, project design and implementation, drawing up technological procedures,
- cooperation,
- sample manufacturing
- service and repair, comprehensive technical support services, sample books, production of samples, spare parts
- special flavors, cooling boxes, drinks machines,
- logistics, logistic support.

Among the more complex offers of services presented with the product include: cleaning and disinfection of the machining space, analyses of lubricants and production of oils and fluids according to the customer's requirements.

#### **4. Discussion and Conclusions**

From the point of view of the relevance of the outcomes of the conducted analysis, it is necessary to point out that presentation of services was researched on the companies' web pages only. Therefore, it is theoretically possible that a company offering services with their products, does not necessarily present them on their web pages, or we might not have found them. However, if a company perceives services at least as a marketing tool leading to an increase in the company's profits and its growth, then the company most likely presents these services on their web pages. The outcomes are also affected by the fact that it is random sampling. However, the randomly selected set of companies from

different industry areas is large enough to present the situation in the Czech Republic, and it was possible to formulate a relevant conclusion about the created hypothesis from the outcomes.

Tab. 1 shows that 70% of the monitored companies present the offered services on their web pages, and 55% of the companies present them on the main page. This score can also be understood as a slight increase in the applied services compared to 2016, when the conducted research identified 45% companies dealing with services.

Tab. 1 shows that 70% of the monitored companies present the offered services on their web pages, and 55% of the companies present them on the main page, 52% on the second level of presentations and 53% with the product. 24% of the companies present their services at one level only and 39% at all three levels. Apparently, if a company offers services, they very probably present them at as many places as possible. Tab. 2 shows that 63 (38%) of the companies presented an independent service innovation department on their web pages, which is a condition of successful servitization. Therefore, we can assume that about a half of the companies presenting their services don't have an independent service innovation department (66 from 116) and they are at the beginning of the process of servitization only. From Table 3, we can assume that website presentation of services does not depend on the company's size. In all the cases it reaches about 70%.

The analysis of the contents of the services implied that the largest variety of services can be found after clicking open some of the tabs on the main website page. However, with respect to the expected transition to the service-oriented business model, following the pattern of successful foreign companies, companies should present the services they offer on the main page as much as possible.

The content analysis also implied that companies in the Czech Republic are particularly trying increase the customer value and thus differentiate their offerings through the services. All the possibilities specified in Chapter 3.1 were identified, except for bundling. The thing is that companies mostly present/offer conventional services, or they develop new services that can be, with some exceptions, separated from the product and sold separately, i.e. product service, systems selling, full service, service package and installed base service. Companies exceptionally offer advanced services closely connected with the product in the way they provide the customer with ability rather than with a physical value, i.e. integrated solutions, PSS and function product. The Integrated Product business model and service engineering was not identified in any of the monitored companies, i.e. an offer of leasing was not identified. The fact that the number of companies offering more advanced services is decreasing gradually also affirms that manufacturing companies switch to a higher rate of services gradually and that most companies are still in the phase of integration of services into products aiming to fulfil marketing targets.

These outcomes testify in favour of the set hypothesis, i.e. that the companies mostly take a marketing approach to servitization, i.e. that companies have only sporadically reached the strategic approach to servitization. However, it is these companies can be a suitable example for other manufacturing companies in the Czech Republic showing how to find opportunities for servitization.

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# Influence of Imprecision on Credit Risk Assessment - Case Study

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**Abstract:** Credit risk is encountered in many situations that do not solely refer to loan granting process. In fact, the sophistication of nowadays global economy and the variety of utilised financial tools result in the existence of credit risk practically in any trade transaction. Therefore, credit risk assessment process is complex and is performed in many successive steps which cover multiple criteria. The importance of the problem on one hand calls for strictly analytical methods, however, on the other, also for a method which enables intuitive decision-making, imprecision and inaccurate linguistic ranks based on experts' personal experience. The paper presents the utility of Simple Additive Weighting method in a preceding phase of credit risk assessment. That step includes the preferences of experts on the significance of vital criteria burdened with imprecision, inaccuracy and linguistic labels. The presented illustrative example shows the importance of acknowledging experts' knowledge and perception of various linguistic, imprecise criteria. Therefore, the order scale is utilized.

**Keywords:** credit risk assessment; linguistic methods; SAW method; imprecision

**JEL Classification:** C02; C35; C38; G40

## 1. Introduction

Credit risk is understood as a probability of a borrower to default or to fail to fulfil their contractual obligations. An efficient management of credit risk improves banks' performance (Wójcicka-Wójtowicz 2018). Credit risk analysis is run in separate steps. Those steps usually cover a scrutinized analysis of borrowers' financial statements and are vital to a quantitative understanding of entity's condition. However, we must realise that the final decision is taken by a group of experts (higher level managers). Furthermore, each expert has their own preferences, scope of knowledge and life and business experience. Moreover, each of them expresses their preferences in real language using labels like "better/worse", "more/less", "higher/lower" etc. and still each of them can do it in a different manner or to a different extent. Consequently, we face a problem of an inaccurate and imprecise information. Yet, they can also use their experience not only to assess the current standing of the company but also to evaluate future projections of the borrower's business. Any existing collateral and future forecasts of the chosen industry are essential indicators in credit risk assessment. It is also not infrequent, that assessed features can be conflicting or excluding one another. The final decision can be consistent with the recommendation or it can reject the recommendation.

To utilise experts' opinions and preferences the weights (real numbers) of chosen groups of criteria are implemented. Moreover, each individual criterion within a given group is also given a weight. In this manner the experts' knowledge and professional experience is taken into consideration.

Furthermore, the main subject of the paper is the assessment of potential debtors, basing on chosen criteria, and the analysis is carried out by the means of multiple attributes decision-making approach based on Simple Additive Weighting (SAW) method which can deal with qualitative dimensions. The utilization of SAW provides experts with a support system allowing them to reach final decision based on linguistic, imprecise criteria. Also, Oriented Fuzzy SAW (OF-SAW) method (Piasecki and Roszkowska 2018) can be applied for solving the problem of evaluating the condition of the potential debtor. The proposed system integrates fuzzy set theory and SAW method to evaluate the available alternatives.



The paper is organized as follows. Section 2 presents the overview of credit risk assessment methods. Section 3 outlines the basic facts on Ordered Fuzzy Numbers (OFN), general linguistic approach to the borrowers' evaluation and the implemented OF-SAW method. Section 4, being the main part of the research, shows the conducted case study implementing the weights for groups and individual criteria. The numerical example illustrates the procedure of the proposed SAW method and contributes into the understanding of the process of borrowers' evaluation. Finally, Section 5 presents the main findings of this research and possible future research directions.

## 2. Credit Risk Assessment Techniques - Overview

Banks can use various approaches to classify the borrowers. The methods, which are most widely used in credit risk assessment and the evaluation of borrowers, usually belong to a group of parametric methods such as linear discriminant analysis, regression analysis, credit scoring and non-parametric methods such as neural networks, expert systems or support vector machines, machine learning etc. All these methods have their limitations. Amongst those limitations we can enlist misclassification and indirect discrimination, variations from market to market, problems with accommodating changes, assuming a specific normality or homoscedasticity that are often violated in real world or model selection on trial and error process (Grace and Williams 2016).

Under Basel Capital Accord (1998) banks had to develop their Value-at-Risk methodology. In the scope of this approach that originated from standard and reduced models (so-called "new approach") we can find well-known models of rating agencies, consulting firms and other financial institutions, such as MKMV (originally proposed by Merton), CreditMetrics (introduced by RiskMetrics Group) and Credit Suisse Financial Product's CreditRisk+ or McKinsey's CreditPortfolioView, etc. These models, and their modifications, are constantly used by banks. However, it must be stressed that they are mostly successful in the USA due to calibration data used for their creation (more in Gordy 2000).

However, there is frequently a problem with applying those methods (no available data for non-quoted company on their market asset value) or with their ultimate efficiency due to their assumptions or strictly quantitative character of data which can lack the overall big picture.

Within the area of credit risk assessment and debtors' ratings there are also many modifications and extensions. A review on financial risk assessment (including credit and bankruptcy risks) can be found in Chen et al. (2016).

The new models and approaches appear as a result of the shortcomings of existing models. The significance of experts' knowledge and experience, as well as other qualitative factors in credit risk assessment and debtors' classification, are recognised as increasingly influential and helpful in decision-making process. In (Grace and Williams 2016) neural network and fuzzy logic systems for credit risk evaluation was developed and their performances were evaluated based on prediction accuracy metric. The conclusion was that despite comparable results, the fuzzy inference system could be easily understood by any user, however, the decisions made by the neural network system is not easily understood by the user, and in this case the user has no choice than to accept the output given by the neural network as the most appropriate output without any explicit reasoning. Also, in (Dadios and Solis 2012) a hybrid fuzzy logic and neural network algorithm (HFNN) to solve credit risk management problem is tested. It is shown that HFNN model can solve credit risk management problem and is capable of self-learning similar to the traditional neural network. It can also generate the rules behind the discrimination of each account subjected to it and in this manner, it behaves much like a traditional fuzzy logic system.

## 3. Methodology

### 3.1. Ordered fuzzy numbers - basics

Objects of any considerations may be given as elements of a predefined space  $X$ . The basic tool for an imprecise classification of these elements is the notion of fuzzy sets introduced by Zadeh (1967). Any fuzzy set  $\mathcal{A}$  is unambiguously determined by means of its membership function  $\mu_{\mathcal{A}} \in [0,1]^X$ , as follows

$$\mathcal{A} = \{(x, \mu_A(x)); x \in \mathbb{X}\} \quad (1)$$

From the point-view of multi-valued logic (Łukasiewicz 1922/23), the value  $\mu_A(x)$  is interpreted as the truth value of the sentence " $x \in \mathcal{A}$ ". By the symbol  $\mathcal{F}(\mathbb{X})$  the family of all fuzzy sets in the space  $\mathbb{X}$  is denoted.

The ordered FNs were intuitively introduced by Kosiński et al. (2002) as an extension of the FNs concept. Ordered FNs usefulness follows from the fact that it is interpreted as FNs with additional information about the location of the approximated number. A significant drawback of Kosiński's theory is that there exist such Kosiński's numbers which, in fact, are not FNs (Kosiński 2006). For this reason, the Kosiński's theory was revised by Piasecki (2018). If an ordered FN is determined with use of the revised definition, then it is called Oriented FN (OFN). The OFN definition fully corresponds to the intuitive Kosiński's definition of ordered FNs.

In this paper, the analysis is restricted to the case of Trapezoidal OFNs (TrOFN) defined as fuzzy subsets in the space  $\mathbb{R}$  of all real numbers in the following way.

Definition 1: (Piasecki 2018) For any monotonic sequence  $(a, b, c, d) \in \mathbb{R}$ , TrOFN  $\overrightarrow{Tr}(a, b, c, d) = \overrightarrow{T}$  is the pair of the orientation  $\overrightarrow{a, d} = (a, d)$  and a fuzzy subset  $\mathcal{T} \in \mathcal{F}(\mathbb{R})$  determined explicitly by its membership functions  $\mu_{\mathcal{T}} \in [0, 1]^{\mathbb{R}}$  as follows

$$\mu_{\mathcal{T}}(x) = \mu_{Tr}(x|a, b, c, d) = \begin{cases} 0, & x \notin [\min\{a, d\}, \max\{a, d\}], \\ \frac{x-a}{b-a}, & x \in [\min\{a, b\}, \max\{a, b\}], \\ 1, & x \in [\min\{b, c\}, \max\{b, c\}], \\ \frac{x-d}{c-d}, & x \in ]\min\{c, d\}, \max\{c, d\}]. \end{cases} \quad (2)$$

The symbol  $\mathbb{K}_{Tr}$  denotes the space of all TrOFNs. Any TrOFN describes an imprecise number with additional information about the location of the approximated number. This information is given as orientation of OFN. If  $a < d$  then TrOFN  $\overrightarrow{Tr}(a, b, c, d)$  has the positive orientation  $\overrightarrow{a, d}$ . For any  $z \in [b, c]$ , the positively oriented TrOFN  $\overrightarrow{Tr}(a, b, c, d)$  is a formal model of linguistic variable "about or slightly above  $z$ ". If  $a > d$ , then OFN  $\overrightarrow{Tr}(a, b, c, d)$  has the negative orientation  $\overrightarrow{a, d}$ . For any  $z \in [c, b]$ , the negatively oriented TrOFN  $\overrightarrow{Tr}(a, b, c, d)$  is a formal model of linguistic variable "about or slightly below  $z$ ". Understanding the phrases "about or slightly above  $z$ " and "about or slightly below  $z$ " depends on the applied pragmatics of the natural language. If  $a = d$ , then TrOFN  $\overrightarrow{Tr}(a, a, a, a) = \llbracket a \rrbracket$  describes un-oriented real number  $a \in \mathbb{R}$ .

Kosiński has introduced the arithmetic operators of dot product  $\odot$  for TrOFNs in a following way:

$$\beta \odot \overrightarrow{Tr}(a, b, c, d) = \overrightarrow{Tr}(\beta \cdot a, \beta \cdot b, \beta \cdot c, \beta \cdot d) \quad (3)$$

In (Piasecki 2018), the sum  $\boxplus$  for TrOFNs is determined as follows

$$\begin{aligned} & \overrightarrow{Tr}(a, b, c, d) \boxplus \overrightarrow{Tr}(p - a, q - b, r - c, s - d) = \\ & \begin{cases} \overrightarrow{Tr}(\min\{p, q\}, q, r, \max\{r, s\}) & (q < r) \vee (q = r \wedge p \leq s) \\ \overrightarrow{Tr}(\max\{p, q\}, q, r, \min\{r, s\}) & (q > r) \vee (q = r \wedge p > s) \end{cases} \end{aligned} \quad (4)$$

Let us consider the pair  $(\overrightarrow{\mathcal{K}}, \overrightarrow{\mathcal{L}}) \in \mathbb{K}_{Tr}^2$  represented by the pair  $(\mu_{\mathcal{K}}, \mu_{\mathcal{L}}) \in ([0, 1]^{\mathbb{R}})^2$  of their membership functions. On the space  $\mathbb{K}_{Tr}$ , the relation  $\overrightarrow{\mathcal{K}} \overline{GE} \overrightarrow{\mathcal{L}}$ , is introduced, which reads:

$$\text{"TrOFN } \overrightarrow{\mathcal{K}} \text{ is greater than or equal to TrOFN } \overrightarrow{\mathcal{L}} \text{"} \quad (5)$$

This relation is a fuzzy preorder  $\overline{GE} \in \mathcal{F}(\mathbb{K}_{Tr}^2)$  defined by its membership function  $\nu_{GE} \in [0, 1]^{\mathbb{K}_{Tr}^2}$  (Piasecki 2019; Piasecki et al. 2019). From the point of view of the multivalued logic, the value  $\nu_{GE}(\overrightarrow{\mathcal{K}}, \overrightarrow{\mathcal{L}})$  is considered as a truth-value of the sentence (5). In (Piasecki 2019), it is shown that for any pair  $(Tr(a, b, c, d), Tr(e, f, g, h)) \in \mathbb{K}_{Tr}^2$  we have

$$v_{GE}(\overrightarrow{Tr}(a, b, c, d), \overrightarrow{Tr}(e, f, g, h)) = \begin{cases} 0, & 0 < \alpha - \gamma, \\ \frac{\alpha - \gamma}{\alpha + \delta - \beta - \gamma}, & \alpha - \gamma \leq 0 < \beta - \delta, \\ 1, & \beta - \delta \leq 0 \end{cases} \quad (6)$$

where

$$\alpha = \max\{a, d\} \quad (7)$$

$$\beta = \max\{b, c\} \quad (8)$$

$$\gamma = \min\{e, h\} \quad (9)$$

$$\delta = \min\{f, g\} \quad (10)$$

Therefore, for any pair  $(Tr(a, b, c, d), [e]) \in \mathbb{K}_{Tr} \times \mathbb{R} \subset \mathbb{K}_{Tr}^2$  we get

$$v_{GE}(\overrightarrow{Tr}(a, b, c, d), [e]) = \begin{cases} 0, & \max\{a, d\} < e, \\ \frac{\max\{a, d\} - e}{\max\{a, d\} - \max\{b, c\}}, & \max\{a, d\} \geq e > \max\{b, c\}, \\ 1, & 0 \leq c - f. \end{cases} \quad (11)$$

### 3.2. Linguistic approach

Credit risk managers and analysts realise that any credit granting decision is threatened by unpredictable default risk. To limit the potential losses, they evaluate borrowers in terms of many criteria.

Any borrower attributes can be evaluated by means of numerical values. By its very nature of things, each such assessment is an imprecise information. Therefore, when dealing with the imprecise information, the use of linguistic assessments may be more useful. Following (Herrera and Herrera-Viedma 2000), it can be said that an application of imprecise linguistic assessments for decision analysis is very beneficial because it introduces a more flexible framework which allows us to represent the information in a more direct and adequate way when it is difficult or impossible to express it precisely. However, by means of ranking systems, the qualitative concept can be translated into a quantitative one.

In the first step of any linguistic approach, the imprecision granularity should be determined, i.e., the cardinality of the linguistic term set used for showing the information. The imprecision granularity indicates the capacity of distinction that may be expressed. The knowledge value is increasing with the increase in granularity. The typical values of cardinality used in the linguistic models are odd ones, usually between 3 and 13. It is worth to note that the idea of granular computing goes from Zadeh (1997) who wrote "fuzzy information granulation underlies the remarkable human ability to make rational decisions in an environment of imprecision, partial knowledge, partial certainty and partial truth." Also, Yao (2004) pointed out that "the consideration of granularity is motivated by the practical needs for simplification, clarity, low cost, approximation ...". For review variety of application linguistic models in decision-making see for example (Herrera and Herrera-Viedma 2000).

In general (Herrera and Herrera-Viedma 2000), any linguistic value is characterized by means of a label with semantic value. The label is an expression belonging to a given linguistic term set. Finally, a mechanism of generating the linguistic descriptors is provided.

In credit risk assessment, all linguistic assessments are linked with Tentative Order Scale (TOS) given as a sequence

$$TOS = \{Bad, Average, Good\} = \{C, B, A\} = \{V_1, V_2, V_3\} \quad (12)$$

Any element of TOS is called a reference point and can be enlarged by intermediate values. For this purpose, the following orientation phrases can be used:

- "much below" described by the symbol " - -",

- “below” described by the symbol “-”,
- “around” described by the symbol “~”,
- “above” described by the symbol “+”,
- “much above” described by the symbol “++”.

Any order label is determined as a composition of reference point and orientation phrases. The set of all order labels is called Extended Order Scale (EOS). In Table 1, TOS and EOS proposed for credit risk assessment are presented.

In information sciences, natural language word is considered as a linguistic variable defined as a fuzzy subset in the predefined space  $\mathbb{X}$ . Then, these linguistic variables may be transformed with the use of fuzzy set theory (Zadeh 1975). From decision making point view, the linguistic variable transformation methodologies are reviewed in (Herrera et al. 2009).

Let us assume that each reference point  $V_j$  is represented by the number  $j \in \mathbb{N}$ . On the other side, the semantic meaning of any orientation phrase is imprecise. For this reason, any order label may be considered as imprecise approximation of its reference point. Thus, each order label from applied EOS should be represented in the real line  $\mathbb{R}$  by FN (Chen and Hwang 1992). For convenience of future calculations, this representation can always be restricted to representation by trapezoidal FN. Moreover, the observation is made that orientation phrases determine the orientation of FN representing approximated reference point. Therefore, any order label can be represented by TrOFN. This approach is more faithful than representation of order labels by trapezoidal FN. On the other hand, an omission of information about order labels’ orientation causes unbelievable assessment of borrowers (Piasecki et al. 2019 b). For these reasons, all order labels will be represented by TrOFNs. The family of all TrOFNs representing considered EOS will be called Numerical Order Scale (NOS). In credit risk assessment task, NOS is used. All applied order scales are presented in Table 1.

**Table 1.** Tentative Order Scale.

TOS	EOS	Semantic meaning	NOS
<b>C</b>	C--	much below Bad	$\overrightarrow{Tr}\left(1, 1, \frac{3}{4}, \frac{1}{4}\right)$
	C-	below Bad	$\overrightarrow{Tr}\left(\frac{5}{4}, 1, \frac{3}{4}, \frac{2}{4}\right)$
	C~	around Bad	$\overrightarrow{Tr}\left(\frac{2}{4}, 1, 1, \frac{6}{4}\right)$
		Bad	$\overrightarrow{Tr}(1, 1, 1, 1)$
	C+	above Bad	$\overrightarrow{Tr}\left(\frac{3}{4}, 1, \frac{5}{4}, \frac{6}{4}\right)$
	C++	much above Bad	$\overrightarrow{Tr}\left(1, 1, \frac{5}{4}, \frac{7}{4}\right)$
<b>B</b>	B--	much below Average	$\overrightarrow{Tr}\left(2, 2, \frac{7}{4}, \frac{5}{4}\right)$
	B-	below Average	$\overrightarrow{Tr}\left(\frac{9}{4}, 2, \frac{7}{4}, \frac{6}{4}\right)$
	B~	around Average	$\overrightarrow{Tr}\left(\frac{6}{4}, 2, 2, \frac{10}{4}\right)$
		Average	$\overrightarrow{Tr}(2, 2, 2, 2)$
	B+	above Average	$\overrightarrow{Tr}\left(\frac{7}{4}, 2, \frac{9}{4}, \frac{10}{4}\right)$
	B++	much above Average	$\overrightarrow{Tr}\left(2, 2, \frac{9}{4}, \frac{11}{4}\right)$
<b>A</b>	A--	much below Good	$\overrightarrow{Tr}\left(3, 3, \frac{11}{4}, \frac{9}{4}\right)$
	A-	below Good	$\overrightarrow{Tr}\left(\frac{13}{4}, 3, \frac{11}{4}, \frac{10}{4}\right)$
	A~	around Good	$\overrightarrow{Tr}\left(\frac{10}{4}, 3, 3, \frac{14}{4}\right)$
		Good	$\overrightarrow{Tr}(3, 3, 3, 3)$

A+	above Good	$\overleftarrow{Tr}\left(\frac{11}{4}, 3, \frac{13}{4}, \frac{14}{4}\right)$
A++	much above Good	$\overrightarrow{Tr}\left(3, 3, \frac{13}{4}, \frac{15}{4}\right)$

### 3.3. Simple additive weighting method - overview

To assess the potential debtor, we must have an evaluation template. This template distinguishes all borrower's attributes which are taken into consideration. The process of determining evaluation template is an important part of credit risk analysis, as well as constructing a scoring function, which is utilised in the pre-evaluation phase. Because borrowers are often characterized by several contradictory criteria, the multi-criteria techniques are useful for building borrower-scoring function. The most popular techniques used for multi-criteria evaluation is the Simple Additive Weighting (SAW) method (Mardani et al. 2015). The SAW method is a scoring method based on the concept of a weighted average of criterion ratings. In the considered task of a credit risk evaluation, the individual criterion ratings are expressed by TrOFNs. For this reason, SAW method linked with TrOFNs is needed. Such SAW method should be equipped with scoring function determined on the space  $\mathbb{K}_{Tr}^n = \mathbb{K} \times \mathbb{K} \times \dots \times \mathbb{K}$ .

The SAW method is also called Simple Multi Attribute Rating Technique. In (Piasecki and Roszkowska 2018) Oriented Fuzzy SAW (OF-SAW) method is modified in a way that it is compatible with the revised theory of ordered FNs (Piasecki 2018). In this case, criterion ratings are given as TrOFNs. Below, the OF-SAW method is adapted to the needs of assessing a single borrower.

The intention is to evaluate a borrower characterized by attributes record  $\mathcal{A} \in \mathbb{A}$  where  $\mathbb{A}$  is an anticipated set of potential borrowers. For this case OF-SAW method can be described by the following procedure:

Step 1: Define a multi-criteria evaluation problem by criteria set  $\mathbb{D} = \{C_1, C_2, \dots, C_n\}$ .

Step 2: Determine the weight vector

$$w = (w_1, w_2, \dots, w_n) \in (\mathbb{R}_0^+)^n \quad (13)$$

where

$$w_1 + w_2 + \dots + w_n = 1. \quad (14)$$

and  $w_j$  is the weight of the criterion  $C_j$  denoting the importance of this criterion in considered evaluation problem

Step 3: For each evaluation  $C_j$  ( $j = 1, 2, \dots, n$ ), determine its scope  $Y_j$ .

Step 4: Determine the evaluation template

$$\mathbb{Y} = Y_1 \times Y_2 \times \dots \times Y_n \supset \mathbb{A} \quad (15)$$

Step 5: Define the NOS  $\mathbb{O} \subset \mathbb{K}_{Tr}$ .

Step 6: Define the evaluation function  $\mathcal{X}: \mathbb{Y} \times \mathbb{D} \rightarrow \mathbb{O} \subset \mathbb{K}_{Tr}$  in such way that the value  $\mathcal{X}(\mathcal{A}, C_j) \in \mathbb{O}$  is equal to evaluation of attributes record  $\mathcal{A}$  from the point-view of the criterion  $C_j$  ( $j = 1, 2, \dots, n$ ).

Step 7: Determine the scoring function  $\overrightarrow{SAW}: \mathbb{Y} \rightarrow \mathbb{K}_{Tr}$  given for any  $\mathcal{A} \in \mathbb{Y}$  by the identity

$$\begin{aligned} \overrightarrow{SAW}(\mathcal{A}) &= \\ &= (w_1 \odot \mathcal{X}(\mathcal{A}, C_1)) \boxplus (w_2 \odot \mathcal{X}(\mathcal{A}, C_2)) \boxplus \dots \boxplus (w_n \odot \mathcal{X}(\mathcal{A}, C_n)) \end{aligned} \quad (16)$$

For a given evaluation template  $\mathbb{Y}$ , any classical scoring method of credit risk assessment can be presented as a pair  $(f, L)$  (Mays 2001; Anderson 2007) where:

$f: \mathbb{Y} \rightarrow \mathbb{R}$  is a given scoring function,

$L \in \mathbb{R}$  is a predetermined level of acceptance of a credit/loan application.

Let us consider a credit application of a borrower characterized by attributes record  $\mathcal{A} \in \mathbb{A}$ . If the following condition is fulfilled

$$f(\mathcal{A}) \geq L \quad (17)$$

then the application is acceptable (Mays 2001; Anderson 2007).

In this section to assess the creditworthiness it is suggested to use a scoring function  $\overrightarrow{SAW}: \mathbb{Y} \rightarrow \mathbb{K}_{Tr}$ . Therefore, it is also suggested to extend the inequality (16) into a following form

$$\overrightarrow{SAW}(\mathcal{A}).\overrightarrow{GE}. \llbracket L \rrbracket \quad (18)$$

The fulfilment of the above inequality is tantamount to a sentence:

$$\textit{Credit application based on attributes record } \mathcal{A} \textit{ is acceptable} \quad (19)$$

Then the value  $v_{GE}(\overrightarrow{SAW}(\mathcal{A}), \llbracket L \rrbracket)$  is truth-value of the sentence (19). For this reason, we interpret the value  $v_{GE}(\overrightarrow{SAW}(\mathcal{A}), \llbracket L \rrbracket)$  as a degree in which the considered credit application is acceptable. Therefore, the value

$$\textit{accept}(\mathcal{A}, L) = v_{GE}(\overrightarrow{SAW}(\mathcal{A}), \llbracket L \rrbracket) \quad (20)$$

will be called the acceptance degree (acceptance level). This value can be a significant premise for the credit committee to take a final decision to grant the funding.

#### 4. Numerical Example – Case Study

The data was collected from two experts in the banking field who are active members of a credit assessment committee with a long business experience in that field (the personal data of experts and any data concerning the Bank as well as any enterprise and decision-making actions involved in the process, are subject to confidentiality). The research was conducted in the following steps:

Step 1. Prepare an appropriate assessment form (template).

During the process of template preparation, experts were to indicate a criteria which they considered vital for credit risk assessment of potential borrower. The lists of chosen criteria were compared. Eventually, 16 criteria, which appeared in case of both experts, were chosen and applied. Those criteria are qualitative and positive for selecting a good potential debtor amongst the analysed ones and ranking them. The introduced method is used in a case study. The chosen criteria are presented in Table 2.

Step 2. Incorporate weights of the criteria

In the research basing on the experts' professional knowledge the criteria were divided into 5 groups (see Table 2). Each group was given a ranking grade (a rank) of a real number ranging from 1 to 5 where 1 meant "the least important group" and 5 meant "the most important group". The weights of each group were calculated as a quotient of the given rank (respectively 1, 2, 3, 4 or 5) and the sum of the ranks (15). This way the least important group had the weight 1/15 and the most important group was given the weight of 5/15. Also, each individual criterion within a given group was attributed a weight depending on their significance. The ranks (respectively {1,2}, {1,2,3} or {1,2,3,4} – depending on the group) show the importance of the individual criterion in its group. Accordingly, 1 meant "the least important", while the highest value indicated "the most important" criterion. The weights of each criterion in a given group were calculated as a quotient of the given rank (respectively 1, 2, 3 or 4) and the sum of the ranks (10). This way, the least important criterion in group with ranks {1,2,3,4} had the attributed weight of 1/10 and the most important criterion in that group was given 4/10, In other groups it was respectively 1/6 and 3/6 for {1,2,3} and 1/3 and 2/3 for {1,2}.

All incorporated weights (for groups and criteria) are presented in Table 2. Groups of criteria are presented from the most important to the least important.

**Table 2.** Weights for groups and criteria.

rank of the group (1-5) / weight of the group	criteria / (weight in the group)	weights of an individual criterion (within the groups)
5 / 0,333	risk of the market / (0,4)	0,133
	risk of the trade / (0,3)	0,1
	risk of the supplier / (0,1)	0,033
	risk of the customer / (0,2)	0,067
4 / 0,267	diversification of the product / (0,333)	0,089
	diversification of the sale markets (0,5)	0,133
	diversification of the supply market (0,167)	0,044
3 / 0,2	prospects of business / (0,5)	0,1
	quality of suppliers / (0,167)	0,033
	quality of customers / (0,333)	0,067
2 / 0,133	clean criminal record of the Board members / (0,1)	0,013
	clean criminal record of a chairperson / (0,2)	0,026
	experience of the Board members / (0,3)	0,04
	experience of a chairperson / (0,4)	0,053
1 / 0,067	operations range – Poland / (0,667)	0,044
	operations range – abroad / (0,333)	0,022

Step 3. Set the acceptance level.

The acceptance level was established in “a middle point between reference points ‘Average’ and ‘Good’ “. The experts were given that information.

Step 4. Experts fill in the form.

The experts express their individual, professional opinion on the specific criterion in relation to an analyzed enterprise by attributing that criterion to a single rank of EOS.

Step 5. Transform the experts’ evaluations into NOS.

The evaluations given by each expert were transformed into NOS.

As experts can have different preferences and different professional experience, the obtained results reflect the differences in perception of the importance of qualitative features in case of assessing the same entity. Therefore, as a final assessment, the mean SAW value, representing common opinion of both experts, was calculated (Table 3).

**Table 3.** Values of scoring SAW function.

Enterprise	Evaluations		
	SAW by Expert 1	SAW by Expert 2	Mean SAW
A	$\vec{Tr} \left( \frac{68}{32}, \frac{73}{32}, \frac{77}{32}, \frac{85}{32} \right)$	$\vec{Tr} \left( \frac{130}{64}, \frac{130}{64}, \frac{133}{64}, \frac{147}{64} \right)$	$\vec{Tr} \left( \frac{135}{128}, \frac{138}{128}, \frac{144}{128}, \frac{157}{64} \right)$
B	$\vec{Tr} \left( \frac{125}{64}, \frac{133}{64}, \frac{140}{64}, \frac{151}{64} \right)$	$\vec{Tr} \left( \frac{149}{64}, \frac{152}{64}, \frac{157}{64}, \frac{176}{64} \right)$	$\vec{Tr} \left( \frac{267}{128}, \frac{280}{128}, \frac{304}{128}, \frac{329}{128} \right)$

In the next step, for each assessed value of SAW scoring function the acceptance degree values are calculated (20). Due to the fact that the acceptance level is represented by “a middle point between reference points ‘Average’ and ‘Good’“, it is assumed that the acceptance level is given as

$$L = \frac{1}{2} \cdot (2 + 3) = \frac{5}{2} \tag{21}$$

Here, we utilize the relationship (11). All values acquired in this manner are presented in Table 4.

**Table 4.** Acceptance level (by each expert and Mean SAW).

	Acceptance degree		
	by Expert 1	by Expert 2	of Mean SAW
<b>Enterprise A</b>	0.385	0.125	0.000
<b>Enterprise B</b>	0.215	0.750	0.375

The values presented in Table 4 allow to formulate the following findings:

- credit application of Enterprise A is accepted at medium level by Expert 1;
- credit application of Enterprise A is accepted at a low level (weak acceptance) by Expert 2;
- credit application of Enterprise A is not accepted by experts' team;
- credit application of Enterprise B is accepted at a low level (weak acceptance) by Expert 1;
- credit application of Enterprise B is strongly accepted by Expert 2;
- credit application of Enterprise B is accepted at medium level by experts' team.

The final decision of granting the credit (loan) is up to the credit committee. The committee can take into consideration the opinions presented above. The fact, that experts' knowledge is often underappreciated, yet, it can significantly influence final decision must be, eventually, noticed and methods of behavioral finance combined with a "soft" approach such as OFNs and linguistic techniques must be developed and implemented.

## 5. Conclusions

Credit risk assessment is a complex process. Credit risk managers try to mitigate the effects of the credit risk threat by utilising various techniques of borrowers' assessment. Those techniques influence the final decision of granting the funding or rejecting the application. In decision-making process there is a number of stages which consist of numerous criteria. Also, ordering the decision alternatives is an important part of the whole decision-making analysis which takes place before making a final decision. The nature of the problem enables intuitive decision-making, imprecision and inaccurate linguistic ranks based on experts' personal experience.

The calculations, conducted in a numerical example presented in the paper, show the utility of SAW method in case of a credit risk assessment and the order scale is described by oriented fuzzy numbers (OFN).

The presentation and estimation of the acceptance level should be a subject of further research.

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# A Decade of System Dynamics Modelling for Tourism: Systematic Review

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**Abstract:** Global rapid growth of tourism requires innovative methods of exploration of its complexity. Researchers and stakeholders can benefit from computational modelling approaches, including system dynamics models. A systematic review of system dynamics models in tourism following the PRISMA guideline was undertaken. The review was focused on which tourism-related topics were studied, what were the purpose and the temporal scale of models, what main variables and diagrams were used. Scientific databases were searched to identify contributions from 2010-2019; finally, 46 publications were selected as relevant. Thematically, the papers focused on marine tourism, negative impacts of tourism, sustainable tourism, low-carbon economies, decision making, and policy making, and planning for tourism in a broad sense. From the modelling perspective, stock and flow diagram and causal loop diagrams were presented in most of the papers, while systems archetypes were rarely used. System dynamics models have the potential to support research in the field of tourism. The number of papers grows significantly, and the attention of researches moves from case studies to sustainable tourism, negative impacts of tourism and how to manage them.

**Keywords:** tourism; system dynamics model; systematic review

**JEL Classification:** Z30; Z32; C39

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## 1. Introduction

Tourism was defined as the temporary, short-term movement of people to destinations outside the places where they normally live and work and their activities during the stay at each destination. It includes movements for all purposes (Beaver 2002). Nowadays, tourism is a highly important part of an economy: according (WTTC 2019) the Travel and Tourism sector accounted for 10.4% of global GDP and 319 million jobs, or 10% of total employment in 2018. On the other hand, tourism is accompanied with negative externalities such as overcrowding, a decline of living standards of locals, high demand for goods and services, pollution and devastating of natural resources, and more. Human society and tourism can be understood as a complex system and the process taking place in it. Therefore, it is possible to apply various computational modelling approaches including models of system dynamics.

System dynamics (SD) helps us to understand the nonlinear behaviour of complex systems over time (Forrester 1961, 1969). To achieve this, models are developed using stocks, flows, internal feedback loops, table functions, and time delays. These artefacts are composed of two main types of diagrams: Stock and Flow Diagram (SFD) and Causal Loop Diagram (CLD). Typically, CLP captures cardinal variables of the system and defines relationships between them. A Systems Archetypes is a universal type of CLD, well applicable in most domains. SFD capture the dynamics of systems, it might be used for predicting the future behaviour of the system, evaluating scenarios, testing extreme settings, boundary testing or sensitivity analysis.

## 2. Methodology

A systematic review following the PRISMA guideline. It was managed in order (1) to map the decade of system dynamics modelling in tourism and (2) to identify new research opportunities. Three questions were sought:

1. Which tourism-related topics have already been studied using the system dynamics modelling approach?
2. What were the purpose and the temporal scale of models?
3. What modelling platforms and what system dynamics diagrams were applied?

The search was undertaken using the scientific databases (Scopus, Scinapse, Google Scholar, LENS). The review includes full texts published in English. The search was conducted in September-December 2019. We included articles published within a decade (2010-2019). The selection criteria and data collection strategy focused on two main topics: *system dynamics* and *tourism*. Cross-searching was carried out using search terms *tourism*, *system dynamics model*, *system dynamics approach*, *system thinking*, *stock and flow diagram*, *causal loop diagram*, *system archetype* (few queries are presented in Table 1).

**Table 1.** Search in databases.

Database	Query	Results
Scopus	TITLE-ABS-KEY ( "system dynamics" AND "tourism" ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )	67
Scinapse	"system dynamics" and "tourism"	40
Google Scholar	allintitle: tourism "system dynamics"	37
LENS	( Title: ( tourism "system dynamics" ) OR ( Abstract: ( tourism "system dynamics" ) OR ( Keyword: ( tourism "system dynamics" ) OR Field of Study: ( tourism "system dynamics" ) ) ) ) (Filtering: journal articles)	87

Abstract and keywords of papers were screened to reject papers we identified as not fulfilling our inclusion criteria. Full-text papers were included if they satisfied eligibility criteria as follow: tourism-related theme (e.g. including management of tourism, destination management, development of tourism, negative impacts of tourism, and/or complexity of tourism, tourism case studies) and application of system dynamics modelling (including systems archetypes, stock and flow diagram, causal loop diagram, and/or system dynamics equations).

We used bibliometric networks for meta-analyses. We chose VOSviewer as software for quantitative synthesis. We focused on the change of keywords related to tourism over time. For that, the keywords related to system dynamics were extracted. VOSviewer allowed us to use overlay visualization, which captures the timeline of selected variables. Items for meta-analysis were extracted from Scopus records.

## 3. Results

### *Study selection*

We identified 231 results from scientific databases. After removing duplicates, we get 128 papers, from which 61 papers were passed to the stage of full-text assessment for eligibility (the rest of 15 full-text papers were rejected). Finally, we obtained 46 papers suitable for both qualitative and quantitative synthesis. The whole process is shown in Figure 1.

Studies selected are presented in Table 2 in descending order by date of publication. The majority (70%) of studies were published within the last five years (2015-2019), more than one third (39%) of papers were published 2018-2019.

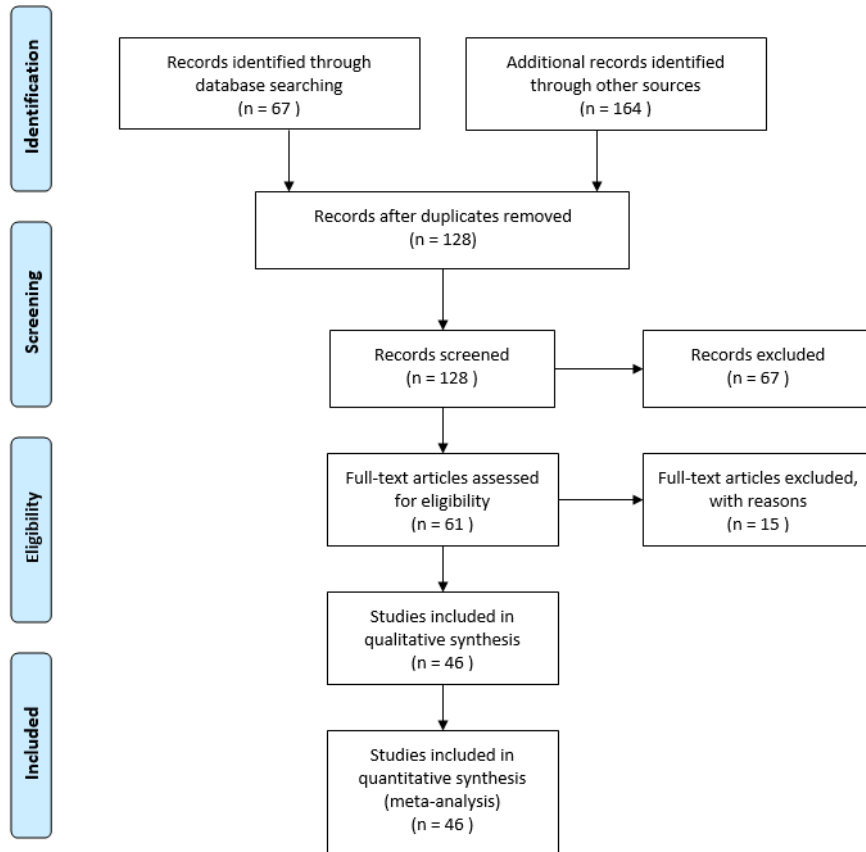


Figure 1. PRISMA flow diagram.

### Results of individual studies

The largest proportion of papers focus on sustainable tourism. Typically, authors tested the impact of different protentional policies on the state of the environment and ecotourism demand, see e.g. (Aliani et al. 2018).

(Zhang et al. 2015) explore sustainable tourism in Tibet under different scenarios up to 2050 through CLD and SFD, outputs of the simulation are employment caused by tourism, the value of tourism enterprise, pollution, and the number of visitors.

(Nguyen and Bosch 2013) identify key variables of sustainability in a touristic area in the Cat Ba Biosphere Reserve Vietnam; for that purpose, authors created CLD and applied systems archetypes such as *fixes that fail* (tourism development), *tragedy of the commons* (carrying capacities in tourism), *shifting the burden* (international aid).

(Xing and Dangerfield 2011) focus on the sustainability of mass tourism within island economies. Authors created complex SFD aimed at transport, number of visitors, water and energy supply, waste, and accommodation capacities. Outputs of the simulation are the prediction of the total number of visitors, the impact of tourism on prices, the requirement of new accommodation capacities for 720 months under different scenarios. (Widhianthini 2017) aim at sustainable planning of touristic villages in Bali in cooperation with local institutions, simulation outputs are the prediction of areas of paddy fields, settlements, green space, and sacred places up to 2030 under several scenarios.

(Nugroho et al. 2019) focus on the sustainability of marine protected areas in the case study of Pieh marine park. Their first SFD captures renewable resources, non-renewable resources, and pollution, while CLD shows relationships between main factors of the marine park (fish population number of visitors, pollution, condition of coral reef). The main SFD connects the main variables of the marine park. The simulation was developed to predict fish and coral populations and pollution up to 2040 under different scenarios.

Similarly, (Vugteveen et al. 2015) study the socioecological system in the Dutch Wadden Sea region through the model of sustainable fisheries and the model of tourism. The touristic sub-model shows variables measuring the number of visitors, their satisfaction, proportions of fauna and flora, investments in tourism, and sustainability.

(Alcalá et al. 2015) focus on the sustainability of groundwater in an agricultural and touristic area, with the case study of Amtoudi Oasis in Morocco. Their CLD captures the hydrological-economic model and water management. The output of the simulation is the prediction of the number of visitors and the local population for the next 100 years.

Few papers discuss tourism in general; for example (Lu et al. 2019) analyse ecological system security in the case study of the coastal tourist city of Dalian in China. CLD shows relationships between variables related to tourism, economics, and the environment. SFD mainly focuses on GPD, the number of visitors, and population size. Outputs of the simulation are the prediction of the number of visitors, income from tourism, and marine pollution up to 2028 under three different scenarios.

Other papers study seaside tourism. (You et al. 2018) focus on landscape changes in coastal areas of South Korea. SFD was used to show changes in areas of a coastal sand dune, coastal grassland, coastal forest in relation to tourism infrastructure up to 2054. The authors created two different scenarios: the first one focuses on the erosion of land and the value of ecosystem services. The second scenario was modified to address the impact of the landscape plan and its impact on ecosystem services.

(Chiu et al. 2019) created a system dynamics model to simulate land use of the Chiku coastal zone in Taiwan. The model focuses on the long-term period, and the main goal of the model was to analyse and to improve regional carbon balance. Outputs of the simulations are the prediction of land use, population, tourism, and carbon dioxide absorption and emissions up to 2065.

(Shen 2019) analyses recreation opportunities of Long Island Marine Stone Forest Park. The model was validated through a data survey. The output of the simulation was the prediction of the number of visitors up to 2025.

Only a minority of papers use system dynamics for decision making. (Tan et al. 2018) created a decision support system based on the system dynamics model of sustainable tourism, with the case study of the coastal zone in Cijing Kaohsiung in Taiwan. Both CLD and SFD show main forces related to tourism and pollution in the coastal zone. Outputs of the simulation are the tourism area, number of visitors, size of local population, state of ecosystem, and economic value index under different scenarios. Outputs of the simulation suppose to improve the decision making of stakeholders.

Negative impacts of tourism were studied by (Phan et al. 2016; Koenigstein et al. 2016; Walsh and Mena 2014). For example (Phan et al. 2016) analysed the conservation status and viability of the critically endangered Cat Ba Langur, CLDs show the conservation status of the monkeys, forest habitats and species population, and the international help.

The impact of ocean warming on the Barents Sea region was described by (Koenigstein et al. 2016): system dynamics model focuses on changes in ocean life and its impact on fisheries, tourism, and recreation, the output of the simulation is a prediction of the amount of the biomass inside an area such as Herring, Seals, and Krill, up to 2075 under different scenarios. Furthermore, the authors predict economic, political, and environmental factors.

Some papers explore waste production caused by tourism. (Estay-Ossandon and Mena-Nieto 2018) studied municipal solid waste generation in touristic islands with an application on a case study of the Balearic Islands. The study predicts the solid waste production by locals and visitors up to 2030 under several scenarios.

(Kapmeier and Gonçalves 2018) explore the waste production through the case study of Maldives. SFD shows economic growth and environmental pollution; the main variables were the number of visitors, amount of waste, and tourism demand and supply. Furthermore, the waste sub-model was processed in detail. Outputs of the simulation are the prediction of tourists per year, revenue per year, and the amount of waste per year up to 2050 under several scenarios.

Table 2. Studies selected

Citation	Domain	Purpose	Results, outputs, variables	Temporal scale	Scenarios	Platform	SD artefacts
1 (Brennan et al. 2019)	Seaside tourism	Increase literacy	Visitors, accommodation	30 Years	No	sd.js	CLD, SFD
2 (Yin et al. 2019)	Planning	Study the safety of overcrowded areas	Identification of feedback loops	Not specified	No	Vensim	CLD
3 (Nugroho et al. 2019)	Sustainable tourism	Improve the effectiveness of sustainability area	Number of visitors, pollution	2003-2040	No	Vensim	CLD, SFD
4 (Chiu et al. 2019)	Seaside tourism	Simulate land use	Land use	2000-2070	Yes	Vensim	CLD
5 (Lu et al. 2019)	Tourism in general	Analyse ecological system security	Number of visitors, income, pollution	2001-2028	Yes	Vensim	CLD, SFD
6 (Shen 2019)	Seaside tourism	Analyse the potential of the destination	Number of visitors	2013-2025	No	Not specified	CLD
7 (Cheng et al. 2019)	Destination management	Find out the possibility of land use	Land use	2011-2025	No	Vensim	SFD
8 (Novani et al. 2019)	Tourism in general	Improvement of tourism	Number of visitors, their satisfaction	2013-2023	Yes	Powersim	CLD
9 (Haraldsson and Ólafsdóttir 2018)	Destination management	Analyse destination and visitors	Identification of feedback loops	Not specified	No	Not specified	CLD
10 (Aliani et al. 2018)	Sustainable tourism	Predicate future of ecotourism	Population, infrastructure	2005-2025	Yes	MapSys	SFD
11 (You et al. 2018)	Seaside tourism	Show change in the landscape	Land use	2014-2054	Yes	Stella	SFD
12 (Tegegne et al. 2018)	Destination management	Show image of Ethiopia	Number of visitors	Not specified	No	Vensim	CLD, SFD
13 (Estay-Ossandon and Mena-Nieto 2018)	Waste production	Show main producers	Waste production	2000-2030	Yes	Vensim	SFD
14 (Kapmeier and Gonçalves 2018)	Waste production	Analysed the waste production	Number of visitors, waste production	1979-2050	Yes	Vensim	SFD
15 (Bempah 2018)	Destination management	Analyse tourism in the national park	Number of visitors, income, land-use	2008-2029	Yes	Powersim	CLD, SFD

16	(Mona 2018)	Tourism in general	Study visitors of Cape Town	Number of visitors	2015-2055	No	Stella	SFD
17	(Sampedro et al. 2018)	Island tourism	Study the food-supply system in Galapagos	Tourism, labor, consumption	2012-2037	Yes	Vensim	SFD
18	(Tan et al. 2018)	Sustainable tourism	Decision support system	Number of visitors, population size	30 years	Yes	Stella	CLD, SFD
19	(Widhianthini 2017)	Sustainable tourism	Sustainable planning	Land use, water use	2009-2030	Yes	Powersim	SFD
20	(Matthew et al. 2017)	Low carbon policy	Analyse the impact of low-carbon law	Electricity use	2005-2050	Yes	Vensim	CLD
21	(Phan et al. 2016)	Negative impacts	Analyse the state of endangers animal	Identification of feedback loops	Not specified	No	Vensim	CLD, archetypes
22	(Koenigstein et al. 2016)	Negative impacts	Analyse the Barents Sea area	Amount of ocean creatures	2015-2075	Yes	Stella	CLD, SFD
23	(Halioui and Schmidt 2016)	Tourism in general	Analysis of tourism sector in Tunisia	Recognition of feedback loops	Not specified	No	Vensim	CLD
24	(Jere Jakulin 2016)	Agritourism	Decision Support System	Number of visitors, level of agritourism	Not specified	No	Powersim	CLD, SFD
25	(Alcalá et al. 2015)	Sustainable tourism	Analyse the state of underground water	Number of visitors, population size,	100 years	Yes	Not specified	CLD
26	(Zhang et al. 2015)	Sustainable tourism	Planning sustainability in Tibet	Number of visitors, employment	2000-2050	Yes	Vensim	CLD, SFD
27	(Vugteveen et al. 2015)	Sustainable tourism	Analyse the Dutch Wadden Sea region	Number of visitors, fauna, flora	Not specified	No	Vensim	CLD, SFD
28	(Li et al. 2015)	Destination management	Analyse the impact of new infrastructure to tourism	Number of visitors, production	2000-2018	Yes	Vensim	CLD, SFD
29	(McGrath* et al. 2015)	Sustainable tourism	Decision Support System	Land use	Not specified	Yes	Powersim	CLD, SFD
30	(Ran 2015)	Sustainable tourism	Minimize the harmful effects of tourism	Number of visitors, water consumption	1990 - 2100	Yes	Stella	SFD
31	(Vojtko and Volfová 2015)	Sustainable tourism	Analyse sustainable regional tourism	Identification of feedback loops	Not specified	No	Vensim	CLD

32 (Provenzano 2015)	Destination management	Analyse tourism in Sicily	Identification of feedback loops	Not specified	No	Powersim	CLD
33 (Walsh and Mena 2014)	Negative impacts	Analyse threats to the national park	Number of visitors, land use,	Not specified	No	Not specified	SFD
34 (Ropret et al. 2014)	Destination management	To improve tourism in Slovenia	Identification of feedback loops	Not specified	No	Other	CLD
35 (Luo et al. 2014)	Low carbon policy	Analyse the impact of decarbonization on tourism	Carbon emission	2013-2025	No	Vensim	CLD, SFD
36 (Liao et al. 2014)	Sustainable tourism	Analyse the impact of sustainability on tourism	Number of visitors, quality of the environment	2000-2100	No	Vensim	CLD, SFD
37 (Hsiao and Hsu 2014)	Agritourism	Forecast need of human recourses	Number of staff	120 months	Yes	Vensim	CLD, SFD
38 (Asasupakit and Thiengburanathum 2014)	Decision making	Decision Support System	Identification of feedback loops	Not specified	No	Vensim	CLD, SFD
39 (Lee and Lin 2014)	Sustainable tourism	Decision Support System	Number of visitors, touristic area	30 years	Yes	Stella	CLD, SFD
40 (Nguyen and Bosch 2013)	Sustainable tourism	Leverage points for sustainability	Recognition of feedback loops	Not specified	No	Vensim	CLD, archetypes
41 (Soufivand et al. 2013)	Destination management	improve cultural heritage sector performance	Number of visitors, quality of services	2012-2020	Yes	Powersim	CLD, SFD
42 (Xing and Dangerfield 2011)	Sustainable tourism	Analyse mass tourism	Visitors, accommodation	720 months	Yes	Vensim	CLD, SFD
43 (Semeniuk et al. 2010)	Destination management	Analyse animal ecology and human behaviour in Stingray	Population size+	25 years	Yes	Stella	CLD, SFD
44 (Jiang et al. 2010)	Destination management	Analyse investment into transportation infrastructure	Accessibility of destination	2008 - 2027	Yes	Vensim	CLD, SFD
45 (Xuke Wang 2010)	Urban tourism	Analyse the urban tourism industry	Feedback loops	Not specified	No	Vensim	CLD, SFD
46 (McGrath 2010)	Decision making	Decision Support System	Impact on transport	Not specified	No	Powersim, Vensim	CLD, SFD



A couple of papers study low carbon policy in destinations. For example, in (Luo et al. 2014) the CLD aims at main factors of decarbonization, economical operation, and development of the destination, SFD focuses on tourism and areas related to environment and socioeconomic variables. The output of the simulation is the prediction of the decarbonated level and attractiveness of the destination.

(Matthew et al. 2017) investigated the impact of new low-carbon laws on islandic touristic area in Azorean island of São Miguel, CLD aims at the consumption and generation of electricity in the closed area. Outputs of the simulation are the prediction of consumption of electricity up to 2045 under several scenarios within the different growth of tourism.

Destination management was studied e.g. by (Tegegne et al. 2018), where the system dynamics model was designed to show the destination image of Ethiopia. Authors provided CLD of visitors, products, market, level of infrastructure, level of service, and wealth distribution.

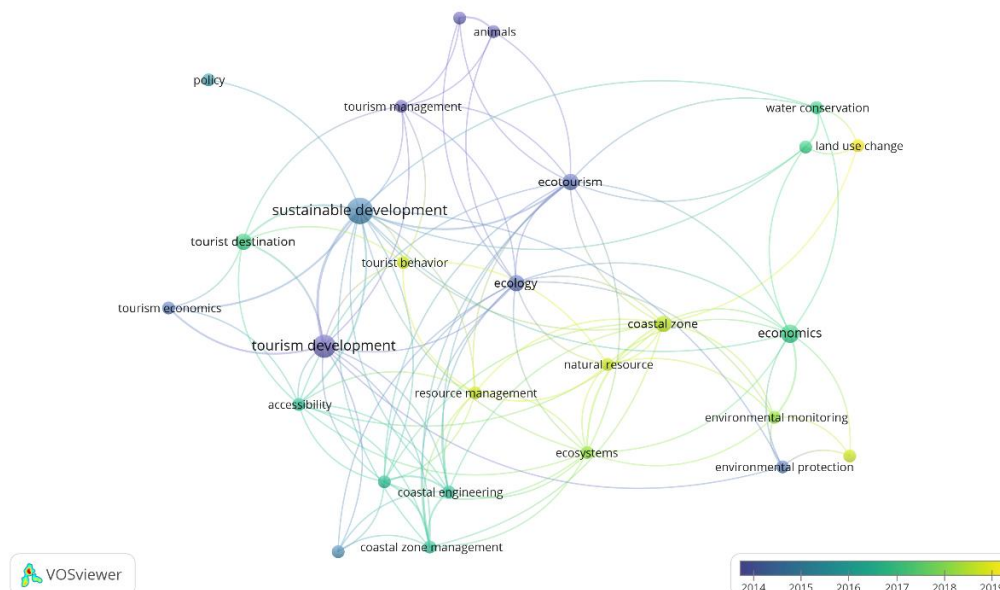
(Li et al. 2015) analyse the impact of new infrastructure. Here authors present a case study of Xidi and Hongcun in China: their CLD aims at the accessibility of destinations and behaviour of visitors, then they created SFD based on the CLD and finally, they specified case studies with two scenarios (competition vs. cooperation of two destinations when constructing road infrastructure). The output of the simulation is the prediction of the probability of the visitor's choice of destination up to 2018 under different scenarios.

(Semeniuk et al. 2010) focus on wildlife tourism. It deals with the population of the stingray and its impact on the number of visitors, with scenarios for the next 25 years under different destination management scenarios.

(Ropret et al. 2014) modelled innovations in Slovenian tourism within the SiPlan model, which aimed at the development of destinations.

### Synthesis of results

We applied a bibliometric method in order to provide an overview of the change of central topics in indexed keywords of selected papers. Terms without relevance to tourism were excluded from the list of keywords. The result of the analysis indicates a change in the main topics over time. Before the decade, papers mainly focused on the positive impact of tourism on economics and how to attract tourists. After that, the focus splits into two main categories: sustainability (sustainable development, ecotourism, environmental protection, and conservation of natural resources) and image of the touristic destination (including investments and land-use). The latest papers aimed at the negative impact of tourism and how to address this issue (e.g., water management, land-use change, environmental monitoring, natural resources, and tourism behaviour), see Fig. 2.



**Figure 2.** The bibliometric network of keywords.

We identified 46 papers addressing the application of system dynamics on tourism between 2010-2019 (Fig. 3). We found the main topics of system dynamics models: seaside tourism, sustainable tourism, low-carbon economies, destination management, decision making, planning, negative impacts of tourism and tourism in general (some papers might belong to several categories) (Fig. 4). The main implementation platforms were Vensim, Powersim and Stella (see Fig. 5).

Typically, a combination of CLD and SFD was used (23 papers, 50%), followed using SFD only (10 papers, 22%) and CLD only (11 papers, cases 24%). Systems archetypes in combination with CLD rarely appeared (2 papers, 4%).

The temporal scale of scenarios varies from 8 to 110 years; most of the models work with the about 30-year horizon (Fig. 6). In 16 papers, the temporal scale was not specified.

The results of the quantitative synthesis indicate the shift in the scope: while early papers were focused on the impact of tourism on economics and tourist attraction, in later papers sustainability and investment in touristic areas were explored. The interest in coastal zones tourism is significant.

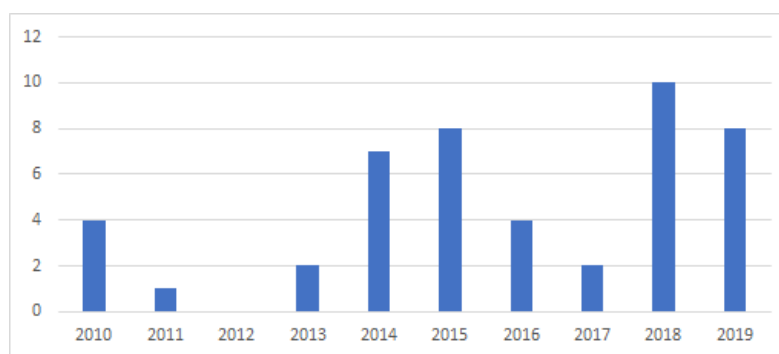


Figure 3. Number of publications per year.

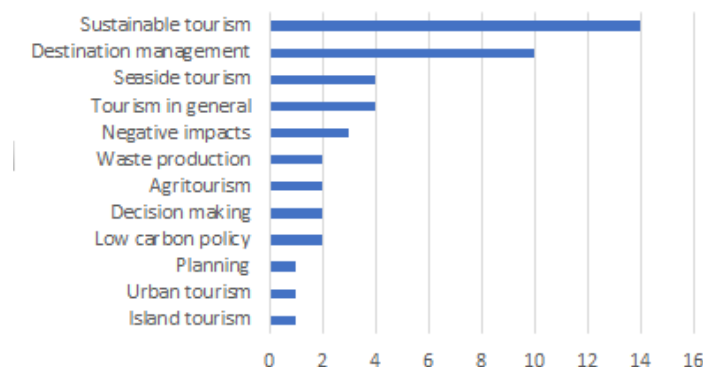


Figure 4. Number of publications per domain.

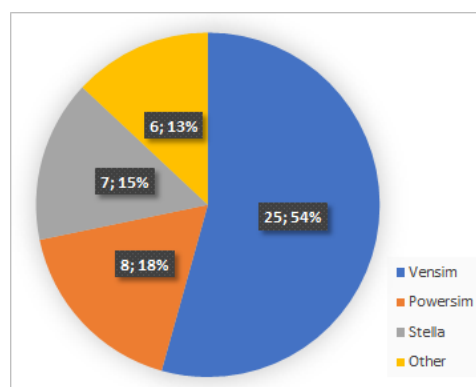


Figure 5. Implementation platforms.

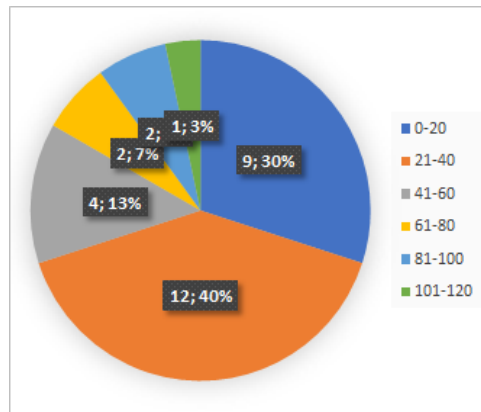


Figure 6. Temporal scale (range of years in simulation).

#### 4. Discussion

System dynamics models and outputs of simulations, in general, might help to monitor the current state of area e.g., capture hidden feedback loops, analysed current strategies and verified their outputs. In the view of future development system dynamics might bring new strategies for dealing with negative externalities or/and bring new visitors, verify the new strategies and draw a prediction of outputs of selected strategies; thus, it may be used for decision making.

Touristic areas might be divided into two groups; the overcrowded areas or areas with negative externalities from tourism; and areas with lack of tourists.

Application of system dynamics on tourism might be useful for the first group, e.g., national parks, populated areas with historical parts, a sports centres in populated areas, areas with endangered species — overall, almost all areas with negative externalities caused by tourism. Tools of system dynamics may capture hidden feedback loops such as unknown reasons for the popularity of the area, negative externalities, the behaviour of tourists. Furthermore, system dynamics may analyse current policies (e.g., law and strategies to low negative externalities from tourism) and predicate future state with the application of current policies. Nextly system dynamics might create new strategies to deal with problems caused by tourism and predicated their impact on a future state. Outputs of system dynamics might be used by e.g., decision management of the area, Council, and curator of area.

The main goal of the second group of touristic is to bring new tourists. For the purpose system dynamics tools might find hidden loops, which cause a lack of tourism, analyse current policies and predicate a future number of tourists. Secondly, system dynamics might create new policies, which can bright new tourists, predict outputs of application of these policies e.g., number of tourists, income to the area, and state of the area. The outputs of system dynamics might be used by Council, and local companies.

#### 5. Conclusions

Our systematic review shows the potential of system dynamics models for decision making and planning in tourism, finding externalities caused by tourism, and predicting positive and negative impacts of tourism. Our further research may lead to the development of general system dynamics models of sustainable tourism in protected areas. Another direction of future research might lead to the application of system dynamics modelling in case studies, namely creating models for future policy makings/decision making in order to change the extent of tourism in certain destinations.

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# Research on the Preference of OECD Climate Aid Donors—Based on OECD Climate Aid Funds Data from 2000 to 2017

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**Abstract:** When climate change affects countries around the world, one of the most important issues in the negotiations under the United Nations Framework Convention on Climate change is the flow of funds to deal with climate change. However, it can be found that there are few studies on the preference of the climate-aid funds. As a result, based on the climate aid funds data of OECD donors from 2000 to 2017, this paper analyzes the preferences of donor countries in providing climate aid funds from seven points of view, and explores the reasonableness of preferences. The results show that the most preferred countries in the donor countries are India. The most preferred regions are Asia, the most preferred income groups are low- and middle-income countries, the most preferred industries are transport and storage, the main purpose of climate aid funds is to mitigate climate change. In addition, the preference of climate aid funds for countries and uses is not reasonable to a certain extent. In the current economic environment, donor countries should invest more climate aid funds in countries with poor ability to combat climate change, balance the proportion of climate funds in mitigation and adaptation, and increase donations to climate adaptation.

**Keywords:** OECD; climate aid funds; donor preferences; reasonableness

**JEL Classification:** F21; F35

## 1. Introduction

There is no doubt that climate is an important part of the ecological environment and an important guarantee for sustainable development. The development of human beings and the production of various economic activities cannot be separated from atmospheric resources, climate change will have an important impact on the ecosystem and human society. Since the 20th century, many scientific studies have shown that the global climate is changing dramatically, which has never happened in history (Li Sheng, 2012 / 50). In early November 2014, the United Nations Intergovernmental Panel on Climate change (IPCC) released the IPCC Fifth Assessment report in Copenhagen. The report pointed out that since the 1950s, many observed changes have been unprecedented in decades or even thousands of years, mainly as follows: the atmosphere and ocean have warmed, the amount of snow and ice is decreasing, the sea level is rising, and the concentration of carbon dioxide in the atmosphere has reached its highest level in the past 800,000 years. According to the World Meteorological Organization, the global average surface temperature in 2018 is about 14.68 °C, nearly 1 °C higher than the pre-industrial baseline. It is the fourth hottest year since the temperature record, and there have been 20 hottest years in history in the past 22 years. IPCC released a report on 8 October 2018, which pointed out that if climate warming continues at its current rate, global temperatures are expected to rise by 1.5 degrees Celsius between 2030 and 2052 compared with pre-industrial levels.

Looking at the performance of these climate change, we can make it clear that global warming has become a reality. This fact will also affect the natural ecosystem and social and economic activities, such as crop production reduction, frequent natural disasters, economic downturn and a series of problems, and even affect human health and human living environment. To this end, governments have now addressed climate change as an important issue and have taken various measures to deal with climate change (Li Sheng, 2012 / 54 / 57). From 1988, the United Nations Environment Programme (UNEP) and

the World Meteorological Organization (WMO) jointly promoted the establishment of the United Nations Intergovernmental Committee on Climate change (IPCC) to the birth of the United Nations Framework Convention on Climate change (UNFCCC) in 1992, the adoption of the Kyoto Protocol in 1997, and the climate change conference in Copenhagen in 2009, the international community is constantly taking action to combat climate change (Global Climate Governance and China's Strategic Choice, Li Sheng, 2012). After years of exploration and development, under the joint efforts of the whole world, the United Nations Organization has constructed a fair and reasonable international climate system, established the principles for solving climate problems, formulated a scientific and authoritative assessment report and made a series of structural and institutional arrangements around climate change (Chen, 2012).

When countries begin negotiations under the United Nations Framework Convention on Climate change (UNFCCC), the benefit of different countries is the core focus of the negotiations, one of which is the financing of climate change. At the 2009 Climate change Conference in Copenhagen, developed countries pledged to provide \$100 billion a year to developing countries to help countries reduce greenhouse gas emissions by 2020. That is called the Green Climate Fund. Developed countries are expected to contribute \$30 billion between 2010 and 2012, as required by the Copenhagen and Cancun agreements to help the most vulnerable developed countries, such as the least developed countries, small island developing States and African countries, carry out adaptation projects. In addition, long-term funds of \$100 billion per year should be provided between 2013 and 2020 to help developing countries deal with climate change. On November 30, 2015, the 21st Conference of the parties to the United Nations Framework Convention on Climate change was held in Paris, which led to the Paris Agreement after two weeks of difficult negotiations. Although the agreement has made a significant contribution to climate change mitigation and adaptation, there are still many problems that have not yet been solved. The core question is how developed countries share the money to deal with climate change, that is, who will pay for it, how much, to whom and where will it be spent to really achieve the goal of climate aid. These key issues have not yet been resolved in the Paris Agreement. Therefore, the implementation and use of \$100 billion is still difficult.

## **2. Methodology**

OECD has been trying to count climate-related development funds since 1998, and has formed a complete set of statistical principles and methods. The statistical results presented in this database can show the scale, structure and characteristics of this kind of capital flow in all donor countries of OECD, and have become the basic data for the study of this kind of international capital flow. This paper uses the relevant data of recipient countries to analyze, the available data is 2000-2017 data, so this paper will use 2000-2017 climate aid funds data from seven angles to analyze their preferences.

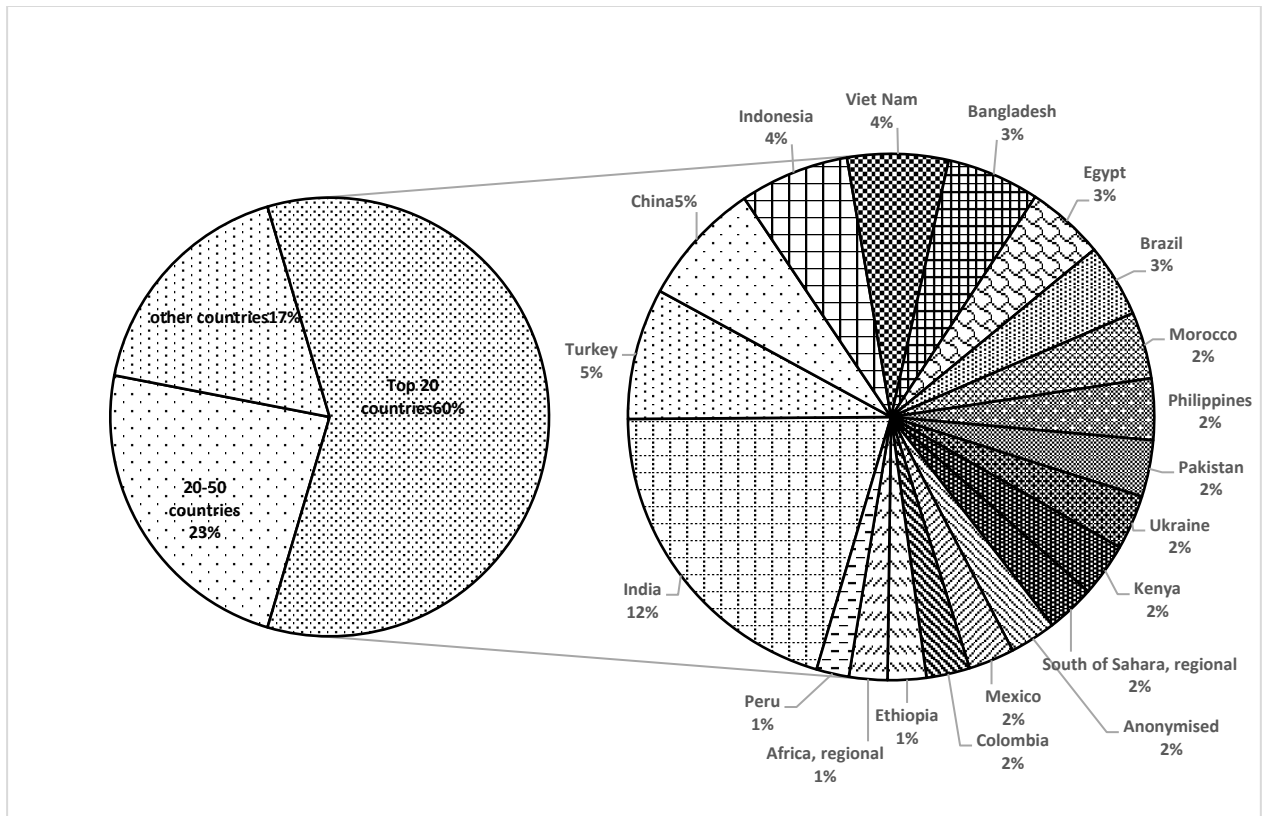
Generally speaking, this paper will focus on the following two parts to carry out the study of climate aid funds preference. The first part will use the OECD 2000- 2017 funds data for climate aid, through an analysis from seven points of view, including recipients (countries), recipient regions, recipient income groups, recipient industries, climate change targets, financial instruments used and the use of funds to explore the donation preferences of OECD donors. The second part will analyze the reasonableness of climate finance preference from the countries and industries preferred by climate aid donors.

## **3. Results**

Based on the climate aid funds data of OECD donors in 2000-2017, this paper will explore the donation preferences of OECD donors in seven points of view by analyzing the climate aid funds provided by all donor countries as following.

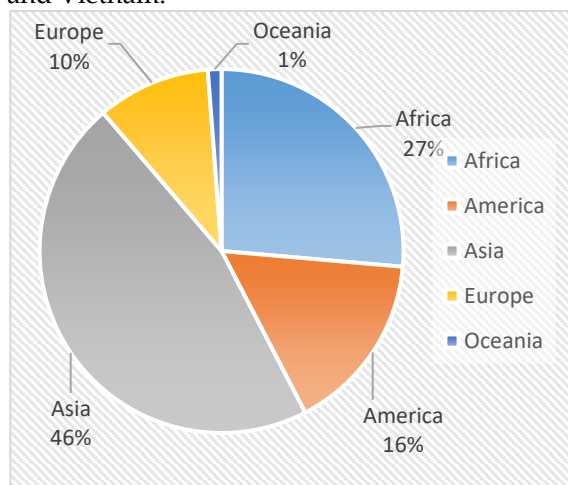


### 3. 1. Analysis of donor preferences

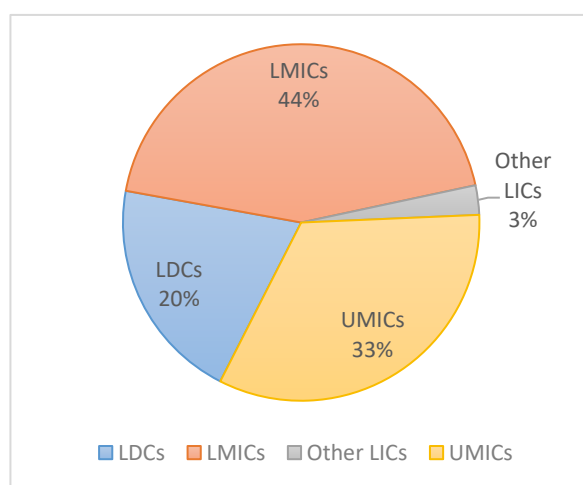


**Figure 1.** Recipients of climate aid funds, 2000-2017.

As can be seen from the left half of figure 1, donors are significantly preferred in providing climate aid to recipient countries, with the top 20 receiving climate aid fund accounting for 60 percent of the total climate aid fund in 2000-2017, proving that most of the donor countries donated to the top 20 countries, while the right half of figure 1 shows the top 20 countries receiving the most donations. As can be seen from the figure 1, even in the top 20 countries, there is a clear preference, that is, only 5 countries of the top 20 countries in 2000-2017 received more than 3 percent of climate aid funds (excluding 3 percent). They are India (12%), Turkey (5%), China (5%), Indonesia (4%) and Viet Nam (4%). India is no doubt the preferred country for donors. In general, donors have a recipient preference for climate aid funds, the most preferred are India, followed by Turkey, China, Indonesia and Vietnam.



**Figure 2.** Regions of the recipient of the climate aid funds, 2000-2017.



**Figure 3.** Income groups of the recipients of the climate aid funds, 2000-2017.

As can be seen from figure 2, donor countries in 2000-2017 have a clear preference for recipient regions in providing climate aid funds, with Asia receiving 46 percent of the total climate aid funds, followed by Africa, the Americas, Europe and Oceania, which accounted for 27 percent, 16 percent, 10 percent and 1 percent of the total climate aid, respectively. So Asia is the preferred region for donors, and Asia received 3 percent more climate aid funds in 2000-2017 than America and Africa combined. In general, donors have a regional preference for climate aid funds, with preference for Asia, Africa and America.

As can be seen from figure 3, donor countries have a clear preference for income groups of the recipients in providing climate aid funds in 2000-2017. Low-income countries and regions received 44 percent of the total climate aid funds, followed by middle-and high-income countries and regions and least developed countries and regions, receiving 33 percent and 20 percent of climate aid funds, respectively. While other low-income countries accounted for the least, with only 3 percent. Therefore, from the point of view of the amount of funds, low-and middle-income countries and regions are the most preferred income groups in donor countries, followed by middle-and high-income countries and regions. In general, donor countries have a preference for the income groups of the recipients in the provision of climate-aid funds, with a preference for middle-and low-income countries, middle-and high-income countries and regions and the least developed countries and regions.

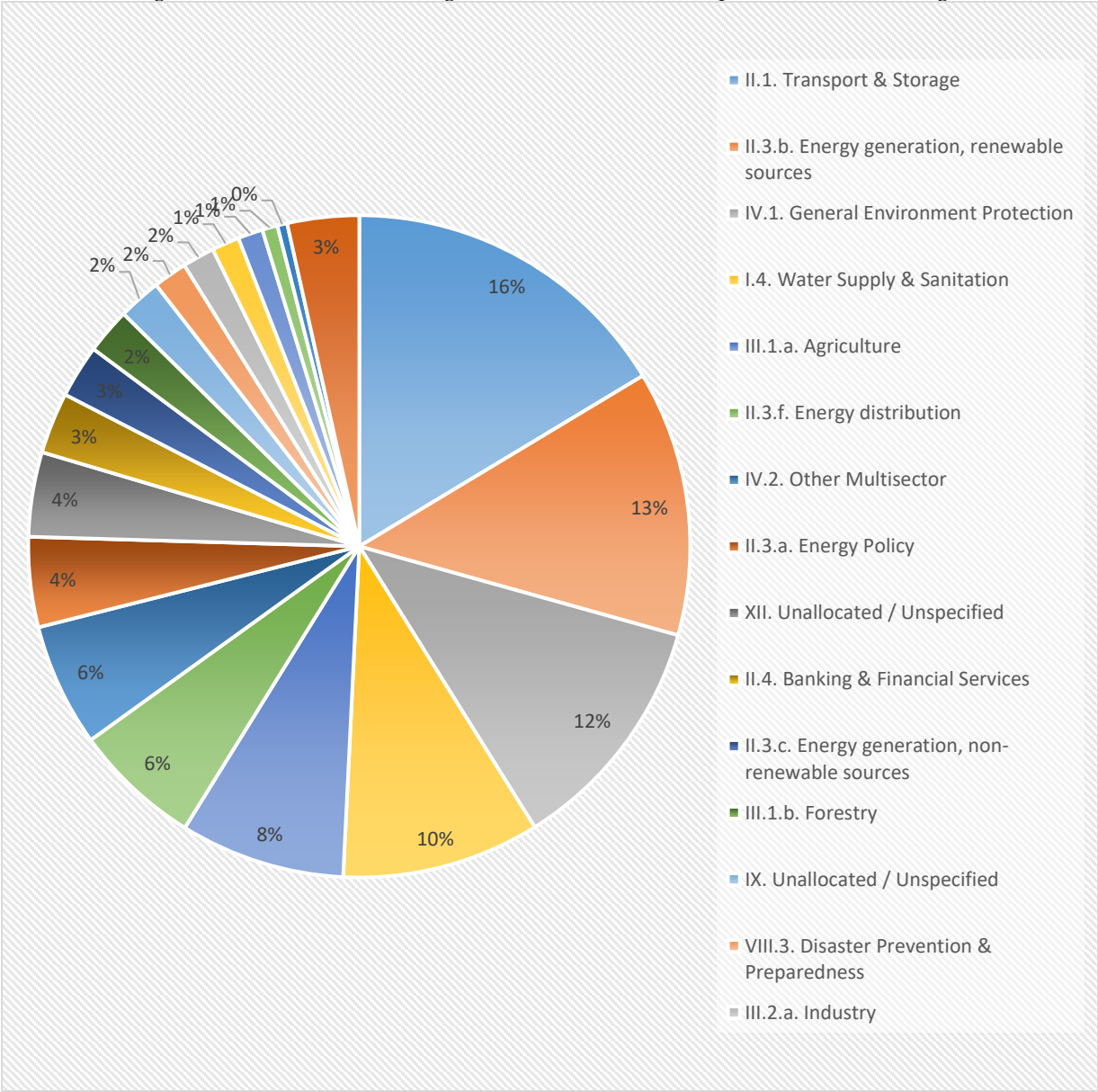


Figure 4. Recipient industries of climate aid funds, 2000-2017.

There are 41 categories of funds donated by climate aid providers to the industry. From figure 4, it can be found that the top five of the funds donated by climate aid providers from 2000 to 2017 are transport and storage, energy generation (renewable energy), general environment protection, water supply and sanitation and agriculture, which accept 16 percent, 13 percent, 12 percent, 10 percent and 8 percent, respectively, of which about 60 percent of the total amount of money is received. The remaining 36 categories of industries account for only about 40 per cent, indicating that donor countries' preference for climate aid funds is mainly concentrated in these five industries. It can be found that these five industries are not only directly related to climate control, but also related to climate problems, which is enough to show that climate aid providers prefer to invest money in the source of climate-related problems and to achieve a governance effect from the source. In addition, the proportion of funds in these five industries is relatively uniform, basically in about 10%.

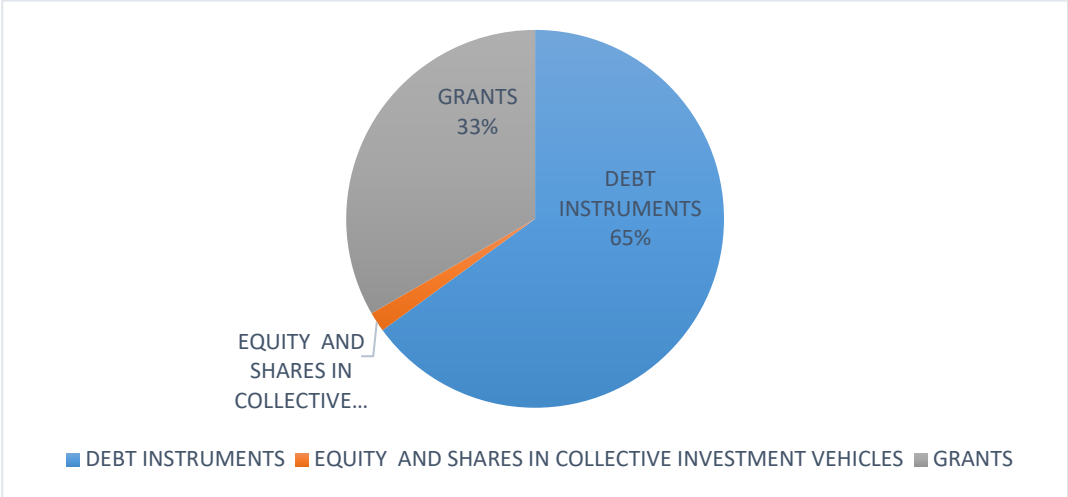


Figure 5. Financial instruments used by donors of climate aid funds, 2000-2017.

As can be seen from figure 5, the most important types of financial instruments for climate aid funds are grants, loans and equity and share in co-investment instruments. Donors to climate aid funds for 2000-2017 are mainly exported in the form of loans, accounting for about 65 percent of the total, while grants account for 33 percent, and only 2 percent of the funds are exported in the form of equity and share in co-investment instruments. Obviously, most of the climate aid funds donated by climate aid donors are not donated directly to other countries for climate governance, but are exported in the form of loans, which illustrates that donors are not unconditionally allocated to donors for climate aid.

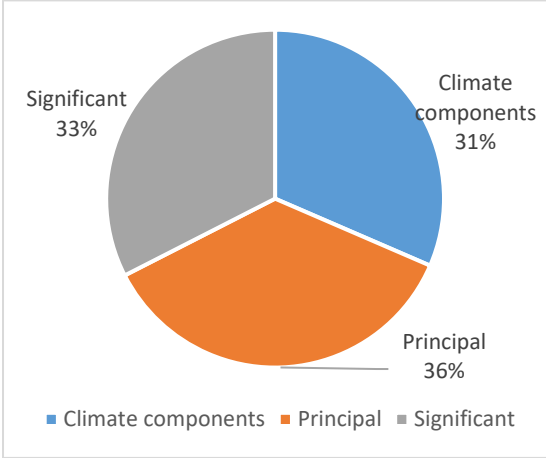
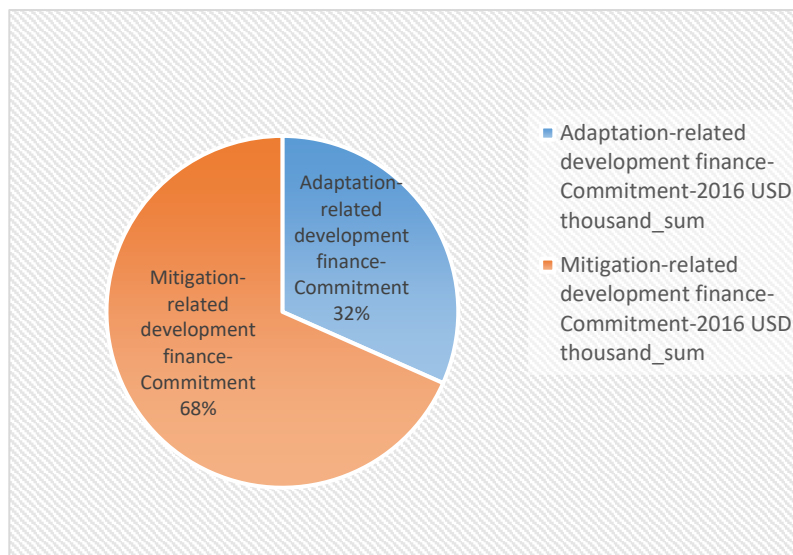


Figure 6. Extent to which climate aid funds target climate change targets, 2000-2017.



**Figure 7.** Use of climate aid funds, 2000-2017

As can be seen from figure 6, the preference of climate aid donors for climate change targets for 2000-2017 is not obvious, with the three categories of "principal", "significant" and "climate components" accounting for 36%, 33% and 31%, respectively. The "principal" means that climate aid funds are first aimed at climate change governance, and "significant" means that climate aid funds are important in addressing climate change issues, but are not the first to be used to address climate change issues. It is clear from figure 6 that although the "principal" may be slightly higher than the other two some, but the difference between the three is not significant. But according to OECD, we can categorize the "climate components" as the "principal" category, with the overall proportion of climate aid funds targeting climate change targets at 67%, so the preference of climate aid donors for the extent to which climate aid funds target climate change targets in 2000-2017 is mainly the "principal" category.

As can be seen from figure 7, climate aid funds for climate change mitigation and adaptation accounted for 68% and 32% respectively in 2000-2017, so donors to climate aid funds prefer to be used to mitigate climate change.

### 3. 2. The reasonableness analysis of climate aid financial preference

ND-GAIN (The Notre Dame-Global Adaptation Index) is a project of the University of Notre Dame Environmental change Initiative (ND-ECI), which brings together 74 variables, 45 indicators and more than 20 years of data to summarize the vulnerability of 181 countries to climate change. The higher the climate vulnerability index, the greater the risk of climate change, and vice versa. According to the availability of data, this paper selects the vulnerability index of 136 countries, uses the method of ranking the average value of the index, analyzes the 136 countries and their regions and income groups, and then compares with the specific situation of the donation preference from the above analysis, so as to judge the reasonableness of the donor's preference for the recipient.

**Table 1.** Vulnerability to climate change and donated funds in the top 20 countries in 2000-2017.

The top 20 countries of the climate change vulnerability index	Ranking of donated funds of the country	Ranking of climate change vulnerability index - ranking of donated funds	Top 20 recipient countries	Ranking of climate change vulnerability index of the country	ranking of donated funds-Ranking of climate change vulnerability index
----------------------------------------------------------------	-----------------------------------------	--------------------------------------------------------------------------	----------------------------	--------------------------------------------------------------	------------------------------------------------------------------------

Niger	55	-54	India	47	46
Somalia	88	-86	Turkey	130	128
Solomon Islands	104	-101	China (People's Republic of)	103	100
Micronesia, Federated States of	150	-146	Indonesia	72	68
Chad	95	-90	Viet Nam	56	51
Guinea-Bissau	127	-121	Bangladesh	29	23
Sudan	101	-94	Egypt	87	80
Mali	54	-46	Brazil	120	112
Liberia	84	-75	Morocco	112	103
Afghanistan	35	-25	Philippines	66	56
Eritrea	130	-119	Pakistan	46	35
Burkina Faso	49	-37	Ukraine	127	115
Congo, the Democratic Republic	133	-120	Kenya	30	17
Ethiopia	18	-4	South of Sahara, regional	-	-
Uganda	42	-27	Anonymised	-	-
Benin	74	-58	Mexico	118	102
Madagascar	70	-53	Colombia	108	91
Maldives	123	-105	Ethiopia	14	-4
Burundi	76	-57	Africa, regional	-	-
Central African Republic	148	-128	Peru	81	61

Table 1 selects the top 20 countries of the climate change vulnerability index and the top 20 recipient countries for analysis. In terms of individual countries, the above conclusions show that donors prefer India when providing climate aid funding, followed by Turkey, China, Indonesia and Vietnam. And the five countries that receive the most funding are all out of 30 in terms of climate vulnerability, indicating that these countries are not the most crisis facing the risk of climate change. Overall, of the 17 countries that receive the most donations (three of which do not have relevant data), only three countries rank within 30 in terms of climate vulnerability, while the other 14 countries rank outside 30. Moreover, Niger ranks first in the global climate change vulnerability index and has the worst anti climate change ability in the world. However, it ranks 55th in the list of donated funds, far less than India, which ranks 47th in the list of climate change vulnerability, and Somalia, Solomon Island and the Federated States of Micronesia, which ranked second, third and fourth in climate vulnerability index, rank 60th. Overall, of the 20 most vulnerable countries to climate change, only six

countries rank within 60 in the list of donated funds, while the other 14 countries rank outside 60. Compared with the ranking of climate vulnerability and donated funds, only Ethiopia's climate vulnerability and donated funds are roughly matched in the top 20 countries.

Generally speaking, the current preference of donors for countries is not very reasonable. The most vulnerable countries that need climate assistance do not receive the necessary climate assistance funds. Therefore, donor countries should invest more climate assistance funds to the countries with the worst ability to combat climate change.

**Table 2.** Ranking of regional climate change vulnerability and donated funds in 2000-2017

<b>Region</b>	<b>Vulnerability ranking</b>	<b>Ranking of donated funds</b>
Oceania	1	5
Africa	2	2
Asia	3	1
America	4	3
Europe	5	4

The regions of 136 countries are listed in Table 2. It can be seen from table 2 that Oceania is the most vulnerable region in the world to resist climate change, but Oceania receives the least climate aid funds, only about 1%, which shows that the flow of climate aid funds among regions is not reasonable.

**Table 3.** Ranking of climate change vulnerability and donated funds of income groups in 2000-2017

<b>Income groups</b>	<b>Vulnerability ranking</b>	<b>Ranking of donated funds</b>
LDCs	1	3
LMICs	2	4
Other LICs	3	1
UMICs	4	2

Similarly, table 3 summarizes the income groups of 136 countries and ranks them. From the perspective of income groups, the most vulnerable income group of global climate change is the least developed countries, followed by other low-income countries. However, from the perspective of donated funds, donor countries prefer low-income countries, accounting for 44% of the total climate aid funds, followed by low-income countries Middle and high-income countries and regions accounted for 33%, while the least vulnerable least developed countries accounted for only 20%, and other low-income countries accounted for the least, only 3%. This conclusion fully shows that the preference of climate aid funds of donor countries in 2000-2017 is unreasonable among income groups. Donor countries should invest more climate aid funds in the least developed countries, followed by other low-income countries.

*3. 3. Reasonableness analysis of the use of climate aid funds.*

In the above, we have analyzed the Recipient industries of climate aid funds from 2000 to 2017, the purpose and the preference for use, but we do not know whether these industries will make full use of the funds to climate mitigation and adaptation. Therefore, this paper will introduce Rio Marker to analyze the use of funds in recipient industries, in order to explore the reasonableness of the use of climate aid funds.

The purpose of the Rio Marker is to track the extent to which environmental issues are taken into account in development cooperation projects, rather than quantitative statistics of funds. Therefore, the Rio Marker is based on a set of criteria for the definition and evaluation of projects and activities, that is to say, the core of the statistical data is each grant activity, the main purpose of which is to track various grant flows while avoiding duplicative measurement. The result of marking is to mark items or activities as "principal" (marked as 2), "significant"(marked as 1) and "untargeted" (marked as 0). There are three types of markers: "2", "1" and "0". Only activities or projects that clearly indicate that the underlying purpose or motivation is to mitigate or adapt to climate change can be marked as "2". Those activities or projects that are clearly expressed as belonging to the area of addressing climate change, but whose fundamental purpose or motivation is not to mitigate or adapt to climate change, can only be marked as "1". A project marked "0" means that the activity or project has been verified and is determined not to be aimed at addressing climate change. In short, the Rio marker defines the extent to which each project responds to climate change. Table 4 lists the sectors involved in climate aid funds for 2000-2017 and their possible Rio Marker.

**Table 4.** The industries involved in climate aid funds and their possible Rio Marker, 2000-2017

Recipient industry <sup>1</sup>	"Mitigating climate change"Rio Marker <sup>2</sup>	"Adaptating climate change"Rio Marker <sup>2</sup>	Proportion of funds donated to the industry
II. 1. Transport & Storage	2, 1or 0 1, 2or 0	0, 1or 2 0or 1	16%
II. 3. b. Energy generation, renewable sources	2or 1	0or 1	13%
IV. 1. General Environment Protection	2, 1or 0 1, 2or 0 0or 1	2, 1or 0 1, 2or 0 2or 1	12%
III. 1. a. Water Supply & Sanitation	2, 1or 0	2, 1or 0	10%
I. 4. Agriculture	0, 1or 2	1, 2or 0	8%
II. 3. f. Energy distribution	2, 1or 0 1, 2or 0	0, 1or 2 1, 2or 0	6%
IV. 2. Other Multisector	1or 0	1, 0or 2	6%
II. 3. a. Energy Policy	0, 1or 2	0, 1or 2	4%
XII. Unallocated / Unspecified	2, 1or 0	0, 1or 2	4%
II. 4. Banking & Financial Services	n. a	n. a	4%
	0, 1or 2	0, 1or 2	3%

II. 3. c. Energy generation, non-renewable sources	0or 1	0	3%
III. 1. b. Forestry	2, 1or 0	0, 1or 2	2%
IX. Unallocated / Unspecified	n. a	n. a	2%
VIII. 3. Disaster Prevention & Preparedness	0or 1	1, 2or 0	2%
III. 2. a. Industry	0, 1or 2	0, 1or 2	2%
I. 6. Other Social Infrastructure & Services	0, 1or 2	0, 1or 2	1%
I. 5. a. Government & Civil Society-general	0, 1or 2	0, 1or 2	1%
VI. 2. Developmental Food Aid/Food Security aid	0	0, 1or 2	1%
VIII. 1. Emergency Response	0or 1	0or 1	0%
other	n. a	n. a	3%

Data sources : Annex 18. Rio Markers, The EU guidance by the OECD-DAC committee on Official Development Aid, statistics, [https://www.oecd.org/dac/stats/DCD-DAC\(2016\)3-ADD2-FINAL%20-ENG.pdf](https://www.oecd.org/dac/stats/DCD-DAC(2016)3-ADD2-FINAL%20-ENG.pdf)

<sup>1</sup> The industry II. 1、 IV. 1 and IV. 2. all have different industries under them. There will be different Rio Marker for each sub-industry, but these sub-industries are not specifically covered here, so they are not clearly written.

<sup>2</sup> The Rio Marker of " Climate change mitigation " and "Climate change adaptation" are presented in descending order of probability.

The previous analysis found that, in terms of the amount of funds, the top five sectors favoured by climate aid finance—transport and storage, energy generation (renewable energy), general environment protection, water supply and sanitation, and agriculture—were 60% of the total. Therefore, we focus on these five industries. As can be found from Table 5-4, in terms of climate change mitigation, the first place of the Rio Marker in transport and storage, energy generation (renewable energy) and general environment protection is almost 2, followed by 1, and finally 0, while the first place of the Rio Marker for water supply and sanitation, agriculture is 0, followed by 1, and finally 2. Therefore, on the whole, the preference industry of climate aid funds will be directly or indirectly used to mitigate climate change. In terms of climate change adaptation, transport and storage, energy generation (renewable energy) are the first to be 0, followed by 1, and finally 2, while the Rio Marker for general environment protection, water supply and sanitation, and agriculture are all 1 or 2, and finally 0. As a result, the preferred industry for climate aid funds is only about half the chance that it will be used to adapt to climate change. With the exception of these five preference industries, it can be found from Table 2 that the rest of the industries are using capital, almost all of which will not be used for climate mitigation or adaptation.

Overall, preference industries for climate aid funds in 2000-2017 spend almost all of their money directly or indirectly on climate mitigation, but less on climate adaptation. The use of climate finance can be divided into two categories: one is to mitigate climate change, the other is to adapt to climate change. Climate finance is used to mitigate climate change to reduce, limit, or store greenhouse gases, while climate change adaptation is used to promote human and ecosystem adaptation to climate change and to reduce current and future risks or vulnerabilities posed by climate change. In addressing climate change, although climate change mitigation and climate change adaptation should complement each other and be indispensable, in the above analysis, we found that the preference



groups for climate aid funds are mainly least developed and low-and middle-income areas. Most of these regions belong to developing countries, and for developing countries, priority should be given to adaptation to climate change on climate issues. Zheng Dawei mentioned in 2014: Because the current greenhouse gas emission levels in developing countries are very low and are in the historical development stage of industrialization and urbanization, the demand for energy is growing rapidly and reducing emissions is a long-term and arduous task. The adverse impact of climate change on developing countries is more prominent, and adaptation is more realistic and urgent. (Zheng Dawei, 2014). Moreover, since 1990, we have realized that in order to avoid catastrophic disturbances in the global climate, the global average temperature increase cannot exceed the threshold of 2°C. However, the global average temperature is now 0.8 °C higher than in the pre-industrial era, and the concentration of carbon dioxide in the atmosphere soared above 400ppm last year (ppm is ppm). Many scientists point out that the more realistic prediction is that global temperatures are likely to rise by 3 to 4 degrees Celsius by the end of the century. Even if we reach the toughest global emission reduction agreement-which is still far away-scientists think it may be too late to stop global warming. And we should be soberly aware of how insignificant our achievements in reducing greenhouse gas emissions have been over the past 29 years, so climate adaptation is the more urgent task right now.

Therefore, on the whole, the use of climate aid funds still lacks a certain reasonableness. So the international community should give full consideration to how to adapt to climate change that has occurred and is about to occur, in particular to improve the ability of developing countries to adapt to climate change and withstand catastrophic climate events. In addition, further attention should be paid to how to adapt to climate change, learn to survive and develop in global climate change, and take effective measures to avoid damage. Mitigating global climate change is a long-term and arduous challenge, and adapting to climate change is a more realistic and urgent task (Liu Yi, Cai Jingjing, 2008).

To sum up, there is a lack of reasonableness in climate aid funds preferences for countries and uses. In the current economic environment, donors should invest more climate aid funds in countries with the worst ability to combat climate change, balance the proportion of climate funds in mitigation and adaptation, and increase donations to climate adaptation.

Authors should discuss the results and hypothesis testing and how they can be interpreted in perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted. Provide an overview of your study limitations i. e. sample size, time-series, methods employed etc.

#### **4. Conclusions**

This paper abandons the previous research directions of climate finance, such as funds source, responsibility distribution, system design and so on, but studies the preference of climate aid funds, and proves the preference of donor countries when providing climate aid funds by using the relevant climate aid fund data of OECD, and discusses the reasonableness of this preference. Through the analysis, the following conclusions are drawn:

First, overall, donors do have a preference for climate aid. In terms of recipients, donor countries prefer India, Turkey, China, Indonesia and Vietnam in providing climate aid funds. In terms of recipient regions, they prefer Asia, Africa and the Americas. In terms of income groups of the recipients, they prefer low-and middle-income, middle-and high-income and least developed countries and regions. In terms of industries, climate aid providers have preferences for transport and storage, energy generation (renewable energy), general environment protection, water supply and sanitation, and agriculture. In terms of the form of financial instruments, donors mainly prefer loans. In terms of the extent to which climate change goals are targeted, the main preference is "principal", that is, climate aid funds are first aimed at climate change governance. In terms of the use of climate aid funds, donors prefer to donate climate funds to mitigate climate change.

Second, there are some unreasonable problems in the preference of climate aid funds for countries and uses. As far as individual countries are concerned, the most vulnerable countries most

in need of climate aid do not receive the climate aid funds they deserved. And the preferred industries of climate aid funds invest almost all of them directly or indirectly in climate mitigation when they use the funds, but the direct or indirect investment in climate adaptation is relatively small. Therefore, in the current economic environment, donors should invest more climate aid funds in the countries with the least ability to combat climate change, balance the proportion of climate funds in mitigation and adaptation, and increase donations to climate adaptation. This section is not mandatory but can be added to sum up the topic if results and discussion sections are long or complex.

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# Security of Wi-Fi as a Key Factor for IoT

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**Abstract:** The Internet of Things is an ever-growing system of smart and connected devices. IoT devices are becoming an increasingly important component of everyday life and hence part of a critical area of critical data processing. New threats are constantly emerging, making security and credibility increasingly important. This paper contributes to the effort to ensure the security of IoT devices. It aims to introduce the most widely used communication technologies and their different security solutions and subsequently to identify security threats based on EBIOS methodology. These technologies are Bluetooth, Wi-Fi, LTE and this paper analyses only Wi-Fi technology. The aim of this paper is to identify threats when using Wi-Fi technology. Based on the analysis are made recommendations that are focused on common users of IoT devices. Even the users themselves can significantly contribute to the security of IoT devices and thus increase the security and credibility of the entire IoT system.

**Keywords:** internet of things; security; Bluetooth; Wi-Fi; LTE; IoT

**JEL Classification:** 014; L86; 032

## 1. Introduction

Internet of Things (IoT) is nowadays becoming a dynamically growing industry of electronic devices. The term IoT is used primarily for devices that are capable of collecting and storing data. At the same time, they are not expected to be connected to the Internet and to send data independently of people's activities.

Dozens of new IoT devices are available each month that can connect to networks through one or more connection methods (IOT Now 2019). Two basic types of connections are wired via cable, and the other group is devices that are connected wirelessly. A wireless connection offers some advantages over a conventional cable connection, such as the free movement of a device. However, such benefits are associated with higher cost risks and, in particular, new security risks.

In the current conditions of the Czech Republic, the most frequently used technologies are Bluetooth, 2G / GSM / EDGE, 3G-GPS / GPRS, Cellular 4G / LTE, Wi-Fi, Zig-Bee, Z-Wave, 9LowPAN. Among the best known and most used communication technologies in IoT are Wi-Fi, Bluetooth, ZigBee and cellular (RS Component 2015).

At present, there is hardly any literature that comprehensively examines the technical aspects and issues of the analyzed networks that provide the interconnection of IoT technologies, and therefore this article focuses on diagnosing the risks associated with Wi-Fi technology as one of the ways of communication between IoT devices. The aim of the article is to provide a security risk analysis of Wi-Fi (Wireless Fidelity) technology as a representative of the Local Area Network (LAN).

## 2. State of the Art

The idea of connecting devices to applications is not new. Machine to Machine (M2M) communication has been expanded over the past decade. This platform was promoted mainly by telecommunications companies looking for new ways of using existing mobile networks. Compared to M2M, IoT has more complex event processing, data analysis and service offerings (Slama et al. 2015). IoT is therefore not part of M2M, because being on the internet means that people can (and want) access these IoT things directly, not just through other machines.

Things that cannot be connected directly (by air or water), or indirectly (by vacuum or happiness) cannot be accessed even on the Internet of everything, just because by name it could be deduced. A thing or person is required to connect to the Internet (Waher 2015).

The definition of IoT is already a plethora. Their main problem, however, is that they are not so much a definition as a vision. One of these visions says that the basic prerequisite and goal of IoT is to connect unconnected. This means that objects that are not currently connected to a computer network will be connected so that they can communicate and interact with people and other objects. IoT is a technology transition in which IoT devices allow us to perceive and control the physical world by making objects smarter and connected through a smart network (Hanes 2017). It can also be said that IoT consists of devices with communication capabilities, computing power, and local decision-making in a limited context. Communication can take place via any wireless or wired mechanism. However, wireless methods are typically preferred as they eliminate wiring costs (Sinha & Park 2017).

From a safety point of view, IoT is not a completely new concept. When billions of smart devices connect to the Internet under the auspices of IoT, there should be robust security mechanisms to get the right information to the right place at the right time through the right channel and most importantly without errors. When communication takes place between all people, objects and machines, the credibility, availability, and integrity of data - that is, security - are absolutely essential (Mahmood 2016).

The main factor why IoT is such a major security challenge is its own explosive growth. This is due to the fact that IoT equipment manufacturers and developers are under great pressure to produce equipment in the shortest possible time with the lowest possible purchase price. Safety precautions often go aside (Keenan 2017).

A secure IoT solution includes several levels that combine important IoT security features in four different layers: the device itself (A), communications (B), cloud (C), and lifecycle management (D). These levels are graphically illustrated in Figure 1.

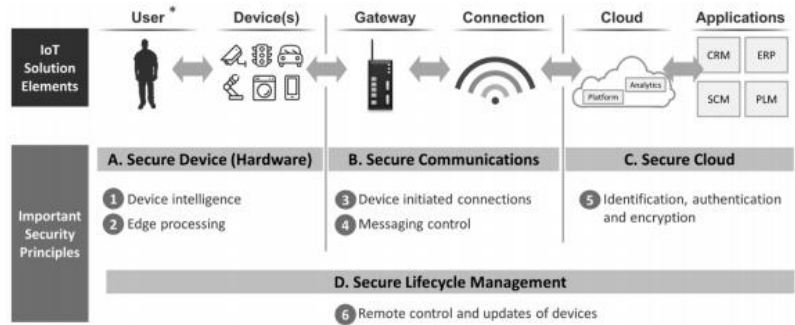


Figure 1. IoT security layers, source: (Padraig 2016).

In this paper, we focus on layer B - Secure Communication (part of the connection), namely in the area of Wi-Fi.

### 2.1. Wi-Fi standards

Wi-Fi is a digital communication protocol for wireless communication in computer networks. It was established in 1997 in the form of the IEEE 802.11 standard for wireless modes (Mathur 2019) using radio technology. This radio technology can transmit data over short distances using high frequencies. 802.11 usually operates in the band of Gigahertz units. (For IEEE 802.11 a, b, v, n, these are 2.4GHz - 5GHz). The central point of the network is the access point, which is a router with broadcast antennas that direct data traffic (Oswald, n.d.).

Wi-Fi standards are a set of services and protocols that determine how a Wi-Fi network works. The current Wi-Fi standard is IEEE 802.11ac, while the next generation of the IEEE 802.11ax Wi-Fi standard is in the process of being deployed (Phillips 2019; TBWI n.d.). Wi-Fi Certification Program 6

The Wi-Fi Alliance will launch in autumn 2019 (Kastrenakes 2019). A more detailed description of Wi-Fi protocols can be found in (LLC n.d.; Phillips 2019; TBWI n.d.).

## 2.2. Wi-Fi security

IEEE 802.11 security is dependent on the Wired Equivalent Privacy (WEP) security method, which seeks to maintain a level of privacy equivalent to wired networks. However, this method had several shortcomings intended to replace the amendments to the appendix to this standard. In particular, it introduced the Robust Security Network concept, hereafter referred to as RSN, which only allows robust network security associations (RSNAs) to ensure the security of the WLAN against threats (Boland & Mousavi 2004; Jyh-Cheng Chen et al. 2005).

RSN contains three components. The first component is a station (STA), a wireless terminal. Another element is Access or Access Point (AP), which allows the STA to communicate wirelessly and connect to another network. The last element is an authentication server (AS) that provides authentication services to the STA. IEEE 802.11 has two basic architectural components, STA and AP (O'Hara and Petrick 2005).

## 3. Methodology

Basic methods of data and information collection using secondary sources analysis and document analysis are used for this paper.

The main source of data are reports focused on security and threat analysis published every year by ENISA (European Union Agency for Cybersecurity). The reports contain a summary of the most prevalent cyber-threats. The reports are based on an analysis of cyber-threads, which: everybody is exposed, with the main motive being monetization. This paper is based on reports published between 2015 and 2019. Every report (1 report for 1 year) is collection, analysis and assessment activity of cyberthreat in a defined domain. Data are provided by MISP (MISP - Open Source Threat Intelligence Platform & Open Standards for Threat Information Sharing) and by CYjAX company.

The EBIOS methodology (Expression of Besoins and Identification of Objectives of Sécurité - Expression of Needs and Identification of Security Objectives) (EBIOS n.d.) has been selected for the processing of risks related to communication technologies. The first step of this methodology is to define the context and parameters to be taken into account in the risk analysis. This is primarily to ensure the confidentiality, integrity, and availability of equipment. The next two steps are an analysis of security needs and an analysis of potential sources of threats and thus of dreaded events. These two activities take place simultaneously. This step identifies three categories of threat sources and lists the most common threats.

The fourth step is a risk assessment in terms of severity and probability. The next step is to specify the safety measures to be implemented and evaluated.

For each attack considered in the EBIOS methodology, the level of impact severity, threat risk, and interest categories are added. These are the parameters for assessing the impact of each attack-related event on success.

1. The severity of the impact shall reflect the extent of the consequences that will have to be addressed if security breaches occur. Four levels are defined:
  - **Negligible** means that it's so small or unimportant as to be safely disregarded.
  - **Restrictive** means that the functionality of some components is impaired.
  - **Significant** means disrupt non-essential services and breaches of network security policy.
  - **Critical** means that incidents will usually cause the degradation of vital service(s), involve a serious breach of network security, affect mission-critical equipment or services.
2. The risk of threat represents the frequency of occurrence of the threat (ARO - Annual Rate of Occurrence). Four levels are defined (Blank and Gallagher 2012; EBIOS 2010):
  - **The minimal risk** of danger means that it is very unlikely. The attack occurs less than once a year, but more than once every 10 years.

- **A significant risk** of threat means that the incidence of attacks is between 1-10 times a year.
- **Strong risk** means that the attack occurs 10-100 times a year.
- **The maximum risk** of threats is that it is almost certain that an attack will occur and occur more than 100 times a year

### 3. Categories of attack

- **Process control** aims to take control of the process being monitored
- **Process disruption** is intended to disrupt the proper functioning of the process
- **Spy and steal data** to reveal process processed data

## 4. Results and Discussion

In general, the threat to IoT is associated with a purpose and almost always is caused by man, except for natural disasters and the consequences of natural change. The purpose may vary depending on the destination. Because IoT devices are used and operated by humans, an attacker may want to gain unwanted access to a selected person, or by intercepting wireless devices, an attacker may want to obtain confidential information. In this paper, we focus on the threat to IoT through one of the communication technologies, namely Wi-Fi.

### 4.1. Basic analysis of Wi-Fi security risks

Wi-Fi WLANs usually supports several security targets. These are achieved through a combination of security features built into the wireless network standard. In addition to traditional confidentiality, integrity, and availability, access control is the most common security target for WLANs. Access control restricts the rights of devices or individuals to access the network or resources within the network.

**Table 1.** Definition of wi-fi network threats. Source: (Frankel et al. 2007; Mohamad Noor and Hassan 2018).

ID	Threat	Description
W1	Man-in-the-Middle	The attacker actively intercepts the path of communication between the two to obtain authentication credentials and data. That can be achieved through false access to a point that looks like authorized access.
W2	Rogue Access Points (RAP)	The purpose of RAP is to take over connections of legitimate users to it was possible to detect activities or steal confidential credentials users and later launch further attacks or simply penetrate the network.
W3	Eavesdropping	The attacker monitors network data communication passively, including authentication credentials.
W4	Masquerading	An attacker impersonates and acquires an authorized user with certain unauthorized permissions.
W5	Traffic analysis	The attacker passively monitors the transmissions to identify the communication patterns and participants.
W6	Security scanning and password cracking	Vulnerability checking is the process where hackers use it for network scanning certain tools such as Kismet and InSSIDer.
W7	Packet Sniffing	During this attack, the attacker usually "sniffs" the content packets and gain access to unencrypted user packets names and passwords.
W8	Denial of Service	The attacker prevents or prohibits the normal use of or network or network device management.
W9	Message modification	An attacker changes a legitimate message by deleting, adding, change or rearrange.

W10	Message playback	The attacker passively monitors transmissions and broadcasts messages like the attacker would be a legitimate user.
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Most WLAN threats typically involve an attacker with access to a radio link between an STA and an AP or between two STAs. Key threats affecting Wi-Fi security are listed in Table 1.

The mapping of Wi-Fi threats and their impacts at the threat severity level is performed in Table 2 below.

**Table 2.** Severity of impact for individual Wi-Fi threats. Source: authors. Data: (Kidston et al. n.d.; Qiu et al. 2006).

ID	Threat	Severity of impact
W1	Man-in-the-Middle	Critical
W2	Rogue Access Points (RAP)	Critical
W3	Eavesdropping	Negligible
W4	Masquerading	Restrictive
W5	Traffic analysis	Restrictive
W6	Security scanning and password cracking	Significant
W7	Packet Sniffing	Significant
W8	Denial of Service	Significant
W9	Message modification	Negligible
W10	Message playback	Critical

Every device and network are vulnerable to attacks. Security policies and the implementation of security mechanisms can reduce the risk of an attacker entering a protected system and gain access to valuable data. The risk for each type of threat is shown in the following Table 3.

**Table 3.** Risk of threat for different types of attack. Source: authors. Data: (ENISA 2016, 2017, 2018, 2019).

ID	Type of attack	2015	2016	2017	2018	Risk
1	Web Based Attack	+	+	+	+	Maximal
2	Data Breaches	0	+	+	+	Strong
3	Cyber Espionage	+	-	+	-	Significant
4	Information Leakage	+	+	+	+	Maximal

The risk of an attack is calculated based on the occurrence of an increase in threat frequency within the last four years. The maximum frequency occurs only for attacks that have an ascending threat frequency throughout the selected time span. Strong frequencies then occur in attacks that at least three years within the selected time period had an increased frequency of threats. A significant threat frequency requires at least two ascending threat frequencies within selected years. All other occurrences are indicated by a minimum degree of risk.

The binding of each Wi-Fi threat listed in Table 2 and Table 3 is shown in Table 4 below.

**Table 4.** Wi-Fi threats vs attack type. Source: authors. Data: (ENISA 2016, 2017, 2018, 2019).

ID	Threat	Type of attack
W1	Man-in-the-Middle	Web Based Attack
W2	Rogue Access Points (RAP)	Data Breaches
W3	Eavesdropping	Cyber Espionage
W4	Masquerading	Web Based Attack
W5	Traffic analysis	Web Based Attack
W6	Security scanning and password cracking	Data Breaches

W7	Packet Sniffing	Information Leakage
W8	Denial of Service	Web Based Attack
W9	Message modification	Cyber Espionage
W10	Message playback	Web Based Attack

The attack categories defined in the previous section are mapped to individual Wi-Fi threats as shown in Table 5 below.

From the table, it is clear that the greatest effort of the attackers is to spy on and steal data, which can be a source of potential gain.

**Table 5.** Wi-Fi threat by attack category. Source: authors. Data:(ENISA 2016, 2017, 2018, 2019).

ID	Threat	Attack category
W1	Man-in-the-Middle	Process control
W2	Rogue Access Points (RAP)	Process control
W3	Eavesdropping	Spying and stealing data
W4	Masquerading	Spying and stealing data
W5	Traffic analysis	Spying and stealing data
W6	Security scanning and password cracking	Spying and stealing data
W7	Packet Sniffing	Spying and stealing data
W8	Denial of Service	Process disruption
W9	Message modification	Process disruption
W10	Message playback	Process disruption

A comprehensive analysis of Wi-Fi threats, including attack severity, attack type, and its category, is shown in Table 6 below.

**Table 6.** Comprehensive threat analysis vs severity vs attack type and vs attack category.

EBIOS categories by objectives	LTE attacks – a dreaded event	Degree of severity (negligible, restrictive, significant, critical)	Degree of probability (minimal, significant, strong, maximal)
PROCESS CONTROL	Man-in-the-Middle	critical	Maximal (Web based Attack)
	Rogue Access Points (RAP)	critical	Strong (Data Breaches)
SPYING AND STEALING DATA	Eavesdropping	negligible	Significant (cyber Espionage)
	Masquerading	restrictive	Maximal (Web Based attack)
	Traffic analysis	restrictive	Maximal (Web Based attack)
	Security scanning and password cracking	significant	Strong (Data Breaches)
PROCESS DISRUPTION	Packet Sniffing	significant	Maximal (Information Leakage)
	Denial of Service	significant	Maximal
	Message modification	negligible	Significant (Cyber Espionage)
			Maximal (Web Based Attack)
	Message playback	critical	



#### 4.2. Risk diagnostics

Risk diagnosis is based on risk assessment according to the risk management under assessment. For the assessment of risks, in this case, the critical risks are those whose severity is significant or critical and whose probability is at least significant. Such critical risks should be avoided using security measures that reduce both their severity and their likelihood. Significant risks are risks with the least restrictive severity and a minimum probability. Controlling risks are those that are of restrictive or negligible severity and the probability is at least significant. Other risks are considered negligible. Wi-Fi risk diagnosis is shown in the following Figure 2.

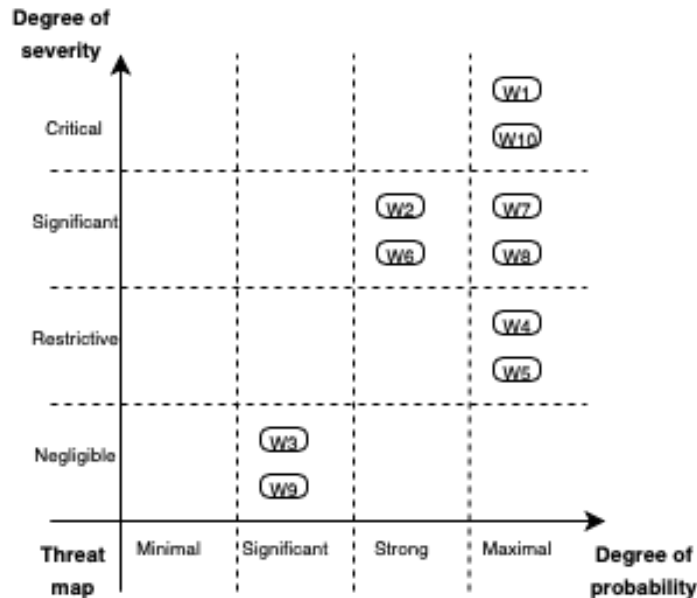


Figure 2. Wi-Fi risk diagnostics.

Wi-Fi risk diagnostics indicate that critical threats are Man-in-the Middle (W1) and Message Playback (W10). Security scanning and password breakage (W6), Packet Sniffing (W7), Denial of Service (W8), and RAP (W2) are significant. In this technology, threats from all three target-oriented categories are critical. Process control (W1, W2), spyware and data theft (W6, W7), and process violation (W8, W10) are included.

#### 5. Conclusions

The Internet of Things is a topic that has been addressed by many researchers seeking to increase the privacy of the Internet of Things. The design principles and methods for securing the Internet of Things need to be constantly explored. The security of communication technologies when using the Internet of Things is a key aspect. Security challenges arising from the very nature of intelligent objects and their rapid evolution.

In general, the threat to IoT is associated with a purpose and almost always is caused by man. The purpose may vary depending on the destination. Because IoT devices are used and operated by humans, an attacker may want to gain unwanted access to a selected person, or by tapping wireless devices, an attacker may want to obtain confidential information. In this paper, we focus on the threat to IoT through one of the communication technologies, namely Wi-Fi.

Based on Wi-Fi risk diagnostics, critical threats are Man-in-the-Child (W1), RAP (W2), Security Scanning and Password Break (W6), Packet Sniffing (W7), Denial of Service (W8) and message playback (W10).

In Wi-Fi technology, threats from all three target-targeted categories are critical. Both process control (W1, W2), spyware and data theft (W6, W7), and process violation (W8, W10) are included.

Taking into account the results of the security risk analysis and the responses of IoT users, several actions can be recommended that can help secure personal data when sharing through IoT communication technologies to protect users from potential spying or data theft:

- **Disable data sharing with unused services** - most systems allow users to enable or disable sharing of specific services, such as location sharing.
- **Use longer and more complicated passwords. Use a separate password for each device** - setting more complicated passwords prevents you from getting passwords with brute force, and almost makes it impossible to extract a password during the service operation. Reusing passwords is not a good idea. With Password Manager, you can track all your passwords.
- Never receive files or messages from untrusted devices - untrusted messages can contain an attack against the device.
- **Consider changing your Wi-Fi settings to not automatically connect** - this gives you more control over when and how your device uses Wi-Fi networks publicly
- **Do not stay logged into accounts permanently** - sign out when you're finished using your account
- Avoid public Wi-Fi networks. Or use a virtual private network (VPN) to access your online accounts regularly via Wi-Fi hotspots - you may want to manage your IoT device through a mobile device in a city café. If you use public Wi-Fi - which is generally not a good idea based on the analysis - use VPN.
- **Use two-factor authentication** - for example, a one-time code sent to your mobile phone - can keep attackers away from your device. If IoT device applications offer two-factor authentication, use it.

This topic is important for all advanced IT users/researches, because almost everyone is faced to various IoT technologies and Wi-Fi as mentioned above. The security of the IoT communicated by way of various technologies is key factor, which must be analysed. All losses related to the security breaches can affect not only private companies but public economic also.

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