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Employees at Risk of Poverty on the Czech Labor Market in the Period from the Global Economic Crisis to the Global Coronavirus Crisis

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Abstract: Czechia is one of the richest economies in the former Eastern bloc. However, wages are lagging significantly behind Western Europe and the situation does not seem to change in the future. This paper deals with the issue of the lowest wages in the Czech Republic in the period from the global economic crisis, the consequences of which were fully felt in the Czechia in 2009, to the global coronavirus crisis, which fully hit the world at the end of winter 2020. This is the period 2009–2020 and the paper focuses on comparing the issue of low wages between men and women. The development of wage distributions for men and women in the period 2009–2020 is captured, while three-parameter lognormal curves are used in the construction of wage distribution models. The minimum of lognormal curves is estimated by the minimum wage in a year, the remaining two parameters of lognormal curves are estimated by the maximum likelihood method. The fifth percentile, the first decile and the first quartile are used to determine the low wages. Overall, it is found that the phenomenon of low wages affects women to a greater extent than men in the Czechia.

Keywords: minimum wage; gross monthly wage; poverty, coronavirus crisis; three-parameter lognormal curve; maximum likelihood method

JEL Classification: E24; I32; C13

1. Introduction

Working for low wages has been a very topical and politically important topic in most European countries. The current coronavirus and thus economic crises are leading many companies to the need to lay off employees or at least reduce their wages, which further emphasizes the importance of this area. For employees who were already earning low wages before the crisis, any further reduction in earnings can mean not only a dramatic threat to living standards, but also existential problems. The unfavorable development on the income side for poorer households is further exacerbated on the expenditure side of the budget through rising prices. The COVID-19 pandemic raises food prices around the world, including the Czech Republic, where food in March 2020 made a major contribution to higher year-on-year price growth. At the same time, food expenditure forms a significantly larger part of the budget of poorer households compared to richer households.

Working for low wages has been a hot topic of the Czech economy, too. For these reasons, the issue of low wages is a frequently researched topic in the Czech Republic and abroad.

An overview of the most important publications on this topic is presented in the following paragraph of this text. The aim of this paper is to capture the differences in the development of the entire wage distribution between men and women in the period from the global economic crisis, the consequences of which fully manifested in the Czech Republic in 2009, to the global and coronavirus and hence economic crises that hit the world at the end of winter 2020. A comparison of the development of the lowest wages of men and women in the period 2009–2020 is another no less important goal of this paper.

Three-parameter lognormal curves are used in modeling wage distributions. The beginning of these curves is estimated through the minimum wage, the remaining two parameters of the lognormal curves were estimated by the maximum likelihood method. The fifth percentile, the first decile and the first quartile are used to define the limit for the lowest wages. Development of these characteristics of wage level in the period 2009–2020 is captured in the paper.

The basic scientific hypothesis is based on the assumption that the phenomenon of the lowest wages poses a greater threat for women than for men.

Table 1 shows the development of the monthly amounts of the minimum wage in the period 2009–2020.

Table 1. Development of the minimum wage amounts in the years 2009–2020 in the Czech Republic

	Year					
	2009	**2010**	**2011**	**2012**	**2013**	**2014**
Minimum wage	8,000	8,000	8,000	8,000	8,208	8,500
	2015	**2016**	**2017**	**2018**	**2019**	**2020**
Minimum wage	9,200	9,900	11,000	12,200	13,350	14,600

Note: In 2013, the minimum wage was CZK 8,000 until July 31 and CZK 8,500 from August 1. The amount shown in the table represents the weighted average of the minimum wage of CZK 8,000, which was valid for seven months, and the minimum wage of CZK 8,500, which was valid for the remaining five months.

1.1. Literature Overview

The issue of low-income households and the poverty of their families is a constant research topic of many domestic and foreign authors. We only give examples of some of them.

The research (Kreidl, 2000) analyses the perceived "*legitimacy of poverty and wealth in the United States, West Germany, the Netherlands, Hungary, the Czech Republic, and Russia*," discussing several theories about the perception of poverty and wealth, the most influential being the dominant ideology. Data from the International Social Justice Project demonstrate that when it comes to poverty, "*individuals distinguish between merited, unmerited, and fatalistic types of poverty*."

The pair of authors (Eriksson & Pytlíková, 2004) report that "*after the initial decline in the level of real minimum wage rates, there were series of unusually large increases in their levels*" in the Czech and Slovak Republics between 1999 and 2002, by 70% and 50%. Based on information from the same employee-employer data sets, the authors examine the impact of increasing the minimum wage on wages and employment. The authors found that "*there are some, but not significant, job losses*" in response to minimum wage increases and that the impact on

corporate wages is relatively large, suggesting "*that further increases of a similar magnitude may very well have negative consequences for employment*."

Paper (Večerník, 2004) provides "*a summary of evidence on the development of poverty in the Czech Republic since 1989*." The author states that "b*efore 1989, poverty was caused mainly by demographic factors. In contrast, unemployment became the strongest factor of poverty under the market economy*," which to a large extent "manifested itself after 1997, when unemployment in the Czech Republic rose rapidly and "*the numbers of long-term unemployed grew even faster*."

The study (Sirovátka & Mareš, 2006) analyses "*the pattern of poverty and social exclusion in the Czech Republic and the impact of social policy on this pattern*." The authors find that "*the poverty rate in the Czech Republic is among of the lowest in Europe, on the other hand. The authors consider labor market policy measures to be insufficient in scope and inadequate in material deprivation, as well as concentration of poverty within specific population groups, is high, with the unemployed facing the highest risk of poverty … targeting groups which are facing the highest risk of labour market exclusion and poverty*."

Study (Jones, 2007) states that "*income inequality and relative poverty among the working-age population in Japan have risen to levels above the OECD average*" and that "*this trend is partially explained by labour market dualism, with an increasing proportion of non-regular workers who are paid significantly less than regular workers, as well as by other factors, including the aging of the workforce*." The author emphasizes that "*social spending as a share of GDP has been expanding in the context of population aging, although it remains below the OECD average and the proportion received by low-income households is small*."

The pair of authors (Kohl & Platzer, 2007) considers "*Governments in Central and Eastern Europe are dominant players in the field of industrial relations, acting in a 'liberalisation dilemma' between the needs of further state regulation to compensate the shortcomings of autonomous self-regulation by social actors and the demands of liberalised markets in the enlarged EU*." This article highlights the current "trends of differentiation and convergence of remuneration principles as well as "*urgent tasks of the state to regulate the unsolved problems of poverty, labour markets and labour standards*."

The issue of the relationship between the minimum wage and employment is also addressed in a case study of a pair of authors (Neumark & Wascher, 2000). Locally, the authors focus on the New Jersey and Pennsylvania circuit with relevant comments.

The paper (Aidukaite, 2011) summarizes "*recent sociological changes in the ten new member states of the European Union of Central and Eastern Europe and the earlier and recent debates on the emergence of a post-communist welfare state regime. The findings of this document suggest that, despite some slight differences within, the new countries of the European Union show lower indicators compared to the EU-15 in terms of minimum wages and social protection expenditure. The degree of material deprivation and the shadow economy is on average also higher if compared to the EU-15 or the EU-27*."

The paper (Dobija, 2011) considers "*the phenomenon of human natural dispersion is a starting point for the theory of minimum wage, which ought to be sufficient to counterbalance the natural thinning out of the initial human capital of an employee*." The author considers the statutory minimum wage to be often too low and considers labor productivity to be one of the basic

factors that allow the proper level of the minimum wage to be determined. The author highlights the 8% rule, which states that "*each human capital is vanquished by spontaneous and random diffusion, which averages 8% of the initial capital*."

The team (Marx et al., 2012) notes that at the European level and in the most Member States of the European Union, higher employment rates are considered the key to better poverty outcomes and that so far shift ratio analysis was used to "*estimate the impact of rising employment on relative income poverty*." The authors "*propose a more sophisticated simulation model that builds on regression-based estimates of employment probabilities and wages. … This article shows that employment growth does not necessarily result in lower relative poverty shares, a result that is largely consistent with observed outcomes over the past decade*."

The purpose of paper (Wang & Gunderson, 2012) is "*to estimate the impact of minimum wages on employment and wages in China. … The study finds that overall, minimum wages in China do have an adverse employment effect, but the effect is statistically insignificant and quantitatively inconsequential*." The authors found that "*the adverse employment effects are generally larger in the more market-driven sectors, in the low-wage sector of retail and wholesale trade and restaurants, and for women, however even these effects are extremely small*."

The study (Bartošová & Želinský, 2013) emphasizes that "*poverty is still a serious problem in developing and developed countries.*" The authors point out that "*before 1989, Czechoslovakia was a communist state with a centrally planned economy, in November 1989 the Velvet Revolution restored democracy in the country, and on January 1, 1993, Czechoslovakia split into two countries, the Czechia and Slovakia*." The authors point out that "*before 1989, the acceptance of the existence of poverty was contrary to the communist ideological principle of equality, and socio-economic research on it was even prohibited*." The term poverty has been replaced by limited ability to consume.

The paper (Crettaz, 2013) emphasizes that although awareness of the re-emergence of working poverty is growing, "*this topic remains relatively under-researched*." This article provides a comprehensive "*review of the literature dealing with the situation in Europe, North America and the Antipodes, with a focus on the theoretical models found in this literature, the definitions used and the risk groups identified*." The article concludes by focusing on what remains to be done, as there are "*good reasons to think that working poverty might become a more pressing problem in the near future*."

The three authors (Pavelka et al., 2014) analyze the motivational function of the minimum wage and compare "*the net minimum wage with the subsistence minimum*." The authors found that "*the motivational function of the minimum wage has been reducing in recent years*," especially for people with dependent children. The last part of the article contains "*an analysis of the relationship between the increase in the minimum wage and the unemployment rate in the Czech Republic*." The authors found that "*there is no clear relationship between the minimum wage and the unemployment rates in the Czech Republic*."

The author (Sturn, 2018) investigates "*effects of minimum wage rates on low-skilled, female low-skilled, and youth employment*," where "*the sample consists of 19 … OECD countries from 1997 to 2013 for low-skilled workers and from 1983 to 2013 for young workers*" and "*six different static or dynamic estimation approaches are applied on different versions of the specifications, controlling for up to quadratic time trends. … The findings provide little evidence of substantial disemployment*

effects for low-skilled, female low-skilled, or young workers" and "*the estimated employment elasticities are small and statistically indistinguishable from zero*."

A team of authors (Caliendo et al., 2019) offers a discussion on "*the short-term effects of the introduction of a new minimum wage in Germany in 2015*." The authors emphasize that this minimum wage was not only generally binding, but was also set at a relatively high level, and concluded that while hourly wages increased for low-wage earners, some small negative effects on employment could be identified. The authors point out that the effects on aspired goals, such as reducing poverty and inequality, have not materialized in the short term. Instead, there was a tendency to shorten working hours, which mitigates the desired positive impact on monthly income.

1.2. Database

The data come from the official website of the Czech Statistical Office (Czech Statistical Office, 2021). The wage data presented on the website of the Czech Statistical Office are in the form of interval frequency distributions with extreme open intervals. The employee's gross monthly wage in the individual years considered (annual data) is the main variable examined.

The data for this research includes employees in both business and non-business spheres. The wage is paid to the employee for the work done in the private (business) sphere, salary in the budget (state, public, non-business) sector. From the point of view of the data from the Czech Statistical Office, both wages in the business sphere and salaries in the non-business sector are included under the wage term.

The data was processed using the SPSS and Statgraphics statistical packets and the Microsoft Excel spreadsheet.

2. Methodology

2.1. Three-Parameter Lognormal Curves

The characteristic features of the process described by the lognormal model are the gradual action of interdependent factors, the tendency to develop in geometric sequence and the growth of random variability into systematic variability, i.e. differentiation. In the field of economics, wages and incomes of the population are among the many phenomena that the lognormal model can interpret.

The random variable X has a three-parameter lognormal distribution with parameters μ, σ^2 a θ, where $-\infty < \mu < \infty$, $\sigma^2 > 0$, $-\infty < \theta < \infty$, if its probability density has a shape

$$f(x;\mu,\sigma^2,\theta) = \frac{1}{\sigma\cdot(x-\theta)\cdot\sqrt{2\pi}}\cdot\exp\left[-\frac{[\ln(x-\theta)-\mu]^2}{2\sigma^2}\right], \quad (1)$$

$$= 0, \qquad \text{else.}$$

The probability density of the three-parameter lognormal distribution is asymmetric, positively skewed. A graph of the probability density of the three-parameter lognormal distribution as a function of the values of the parameters μ, σ^2 and θ is shown in Figures 1–2.

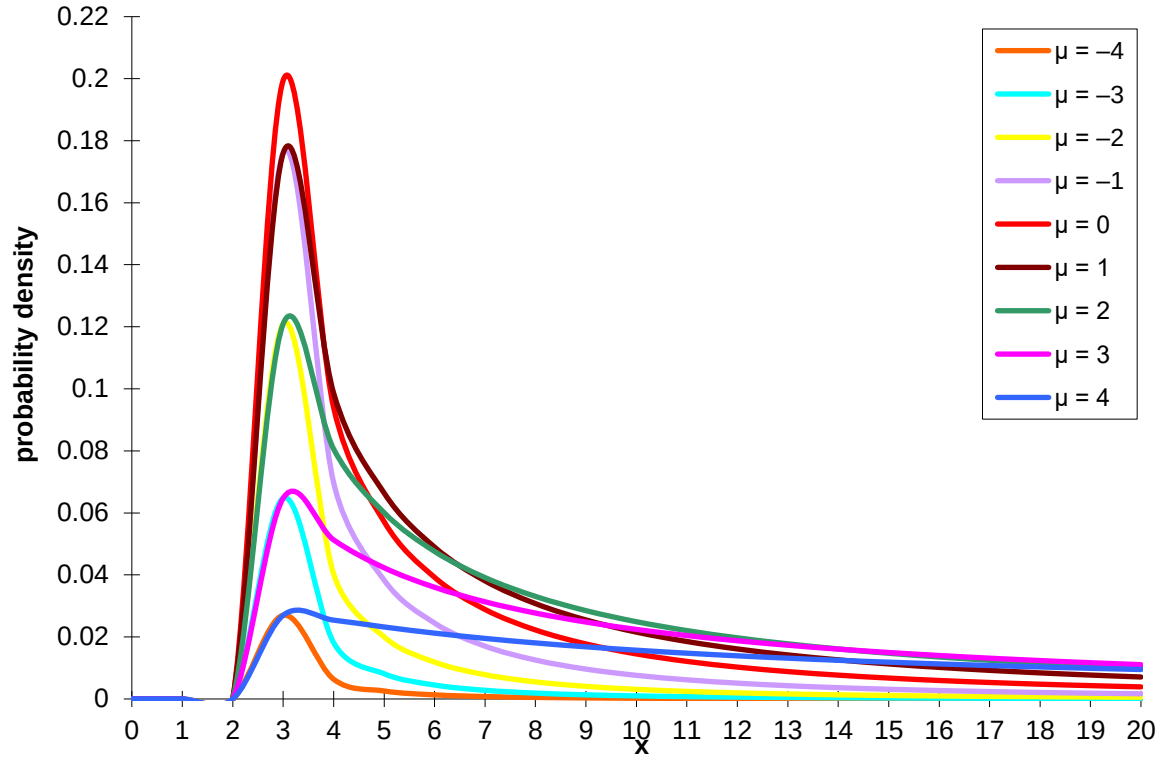

Figure 1. Probability densities of three-parameter lognormal distribution for parameter values $\sigma = 2$ ($\sigma^2 = 4$); $\theta = 2$

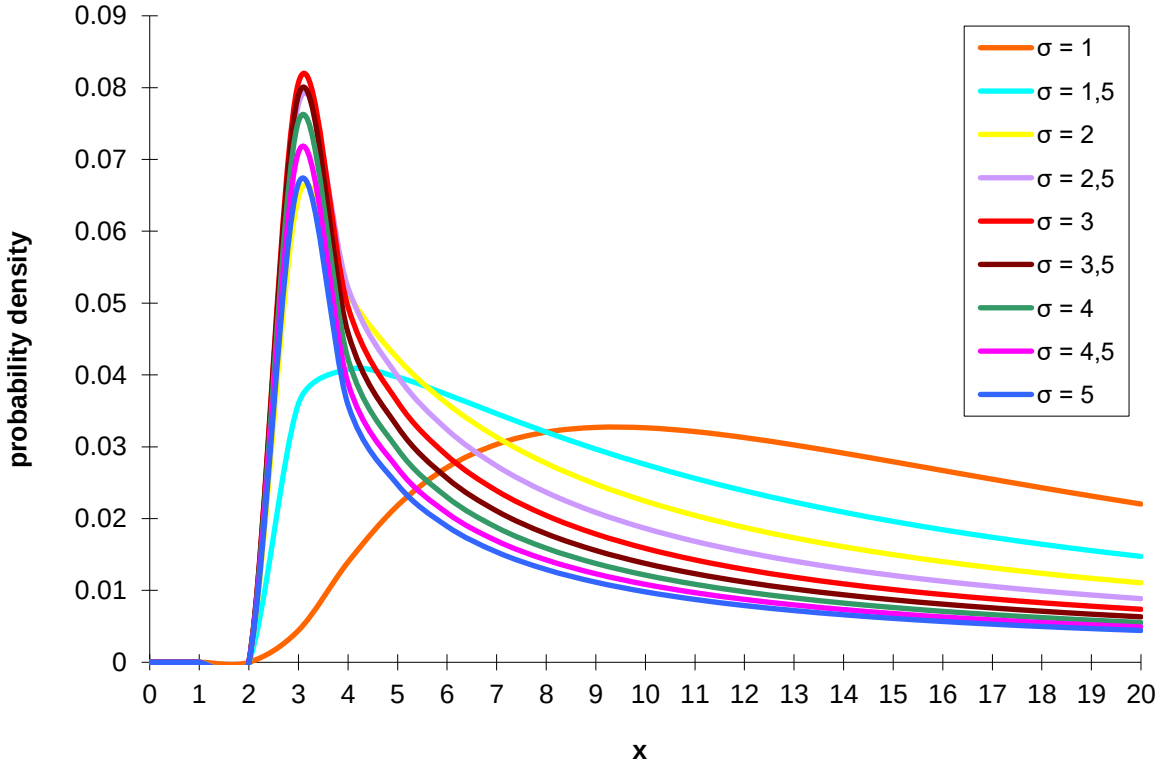

Figure 2. Probability densities of three-parameter lognormal distribution for parameter values $\mu = 3$; $\theta = 2$

The parameter θ represents the minimum (theoretical minimum) of the three-parameter lognormal curve, the expression exp (μ) is the distance of the median wage from this theoretical minimum. The parameters μ and σ^2 represent the expected value and variance of the logarithms of the distances between wage and the theoretical minimum.

The values of the parameters of the three-parameter lognormal curves were estimated using the maximum likelihood method, while the minimum wage in the given year was considered as an estimate of the parameter θ

$$\hat{\theta} = \text{min. mzda}. \tag{2}$$

The maximum likelihood estimates of the remaining two parameters μ and σ^2 calculated from the interval frequency distribution have the form

$$\mu(\hat{\theta}) = \sum_{i=1}^{k} [\ln(x_i - \hat{\theta})] \times p_i, \tag{3}$$

$$\hat{\sigma}^2(\hat{\theta}) = \sum_{i=1}^{k} [\ln(x_i - \mu) - \mu]^2 \times p_i, \tag{4}$$

where p_i are the relative frequencies of the individual intervals and x_i are the midpoints of the intervals, $i = 1, 2, \ldots, k$, k is the number of wage intervals.

2.2. Descriptive Characteristics

The *P*% quantile from the interval frequency distribution is estimated as follows. First, it is necessary to determine in which interval, the searched *P*% quantile is located, which is the interval where the *P*% value first exceeds the cumulative relative frequency of the interval (multiplied by one hundred in percent). We then estimate the *P*% quantile value by linear interpolation using the relation

$$\frac{x_P - x_l}{x_u - x_l} = \frac{P - i_l}{i_u - i_l} \quad \Rightarrow \quad x_P = x_l + \frac{x_u - x_l}{i_u - i_l} \times (P - i_l), \tag{5}$$

where: x_P is the *P*% quantile,

x_u is the upper limit of the interval in which the *P*% quantile is located,

x_l is the lower limit of the interval in which the *P*% quantile is located,

i_u is the cumulative relative frequency after multiplying hundreds in percent of the interval in which the *P*% quantile is,

i_l is the cumulative relative frequency multiplied by one hundred in percent of the previous interval.

The fifth percentile represents the 5% quantile, which is the wage value that separates 5% of the lowest wages from the remaining 95% of wages. The first decile represents the 10% quantile, which is the wage value that separates the 10% of the lowest wages from the remaining 90% of the wages. The first quartile, also called the lower quartile, is the 25% quantile, which represents the wage value that separates 25% of the lowest wages from the remaining 75% of wages.

The growth rate of the time series has a shape

$$100 \times k_t - 100 = 100 \times \frac{x_t}{x_{t-1}} - 100, \quad t = 2, 3, ..., n, \tag{6}$$

where x_t is the value of the variable x in year t and k_t is the growth coefficient in year t.

3. Results

Figures 3–4 represent the development of model wage distributions for men and women in the period 2009–2020. These figures show that all wage distributions are positively skewed, which means that below-average wages outweigh above-average wages. This situation is typical for wage distributions. In the initial period of 2009–2020, the wage distributions of men and women have more kurtosis and they are more positively skewed; over time, we observe a tendency for the kurtosis and skewness of these distributions to decrease, which means that wages increase over time. If we compare the model wage distributions of men and women, it is clear that the wage distributions of women have more kurtosis and they are more positively skewed than the wage distributions of men, which indicates a higher level of wages in favor of men compared to women.

Figures 5 shows the development of the 5th percentile, 1st decile and 1st quartile, which separate 5%, 10% and 25% of the lowest wages of men and women in the period 2009–2020. This figure shows higher values of these quantiles in the case of men compared to women in the whole period. Figures 6–8 show the growth rates of the 5th percentile, 1st decile and 1st quartile of the wage distribution of men and women in the period 2009–2020. These figures show a decrease in the above-mentioned characteristics of wage level in 2011, when the effects of the global economic crisis hit mainly wages in the Czech Republic. This decrease is more pronounced in men than in women. Significant wage growth is recorded in the period 2017–2019 just before the coronavirus crisis, especially in women.

4. Discussion and Conclusions

Based on the analysis, it was proved that the issue of low wages affects women to a greater extent than men in the Czech Republic. The basic scientific hypothesis can therefore be considered proven. As in (Blau & Kahn, 2017), analogous reasons can be seen. For example, "*women's work force interruptions and shorter hours remain significant in high-skilled occupations." Psychological attributes or noncognitive skills comprise one of the newer explanations for gender differences in outcomes*."

For the comparison, the study (Magnusson, 2013) reveals "*a non-linear relationship between sex composition and wages, where the highest wages for both men and women are earned in sex-integrated occupations*."

Gender differences in occupations and industries, as well as differences in gender roles and the gender division of labor remain important, and research suggests that discrimination cannot be discounted. Interesting paper (Schwenkenberg, 2014) analyzes "*intergenerational mobility experiences of daughters and sons with respect to their fathers' occupational status and documents changes in gender differences over time. While women have been in occupations with lower*

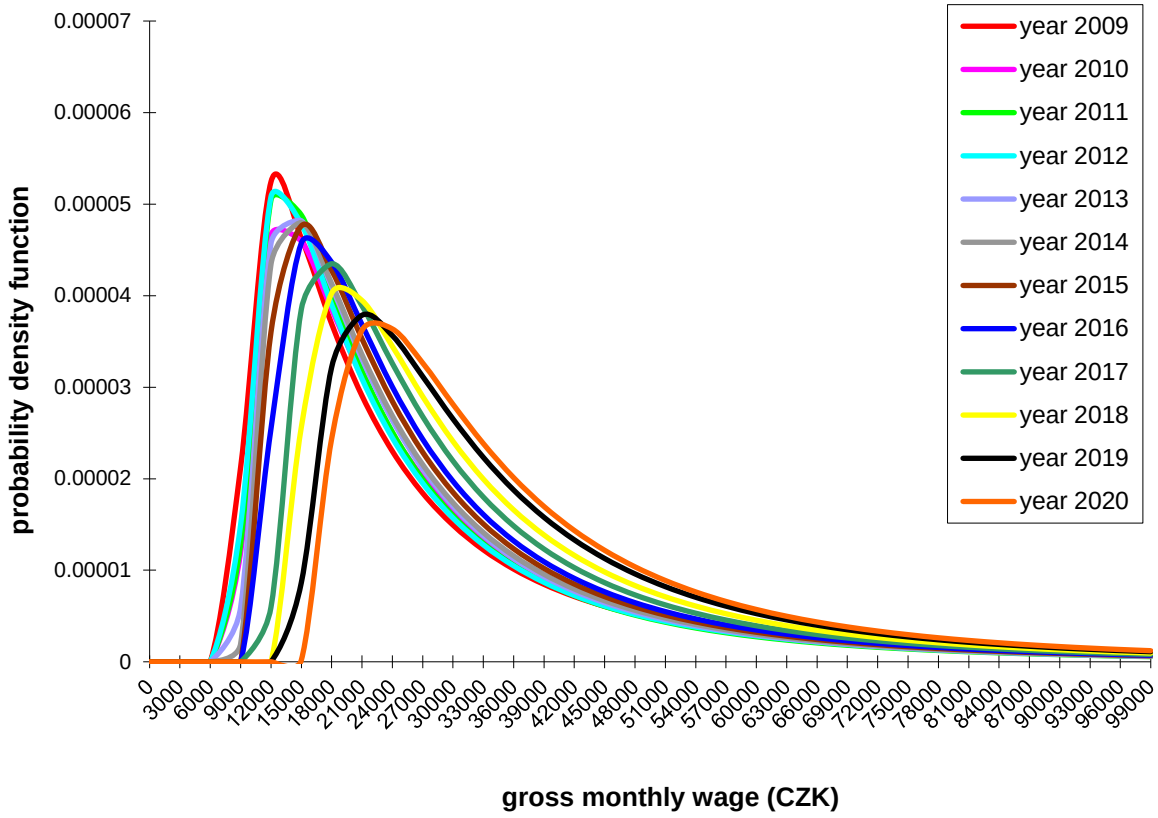

Figure 3. Development of model wage distribution for men in the period 2009–2020

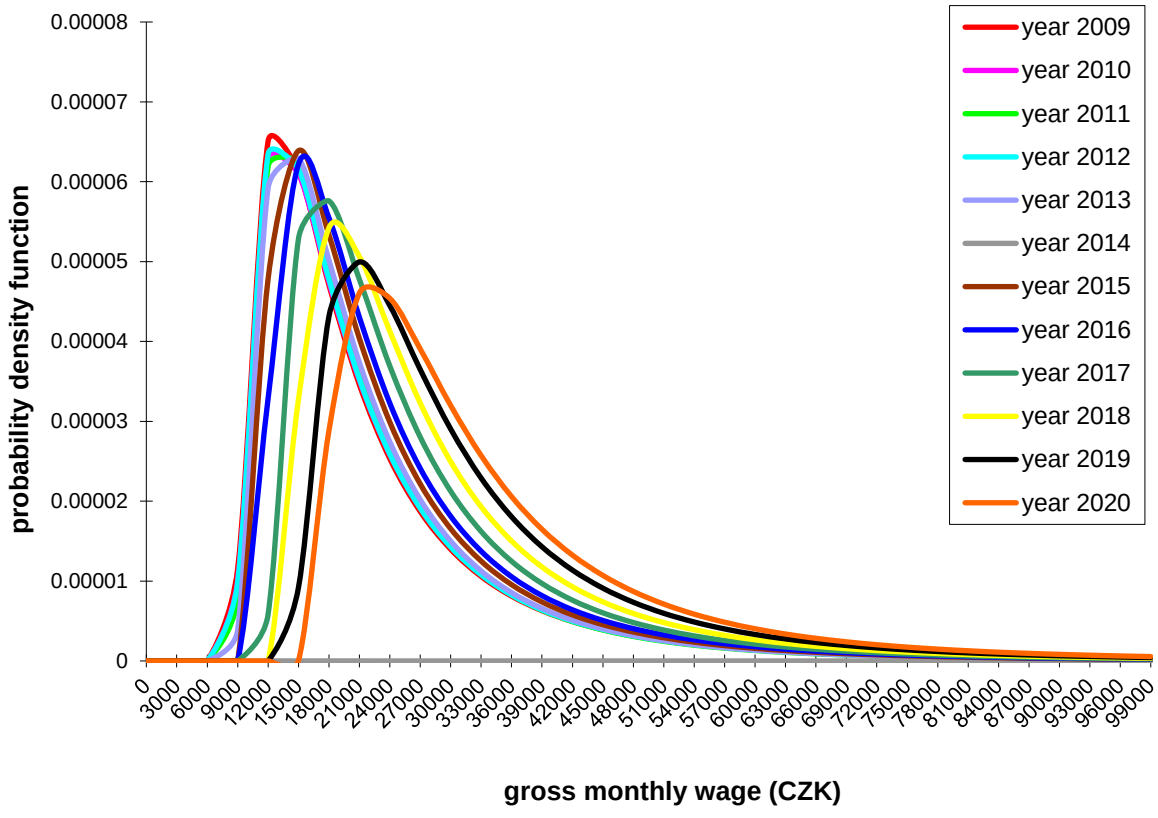

Figure 4. Development of model wage distribution for women in the period 2009–2020

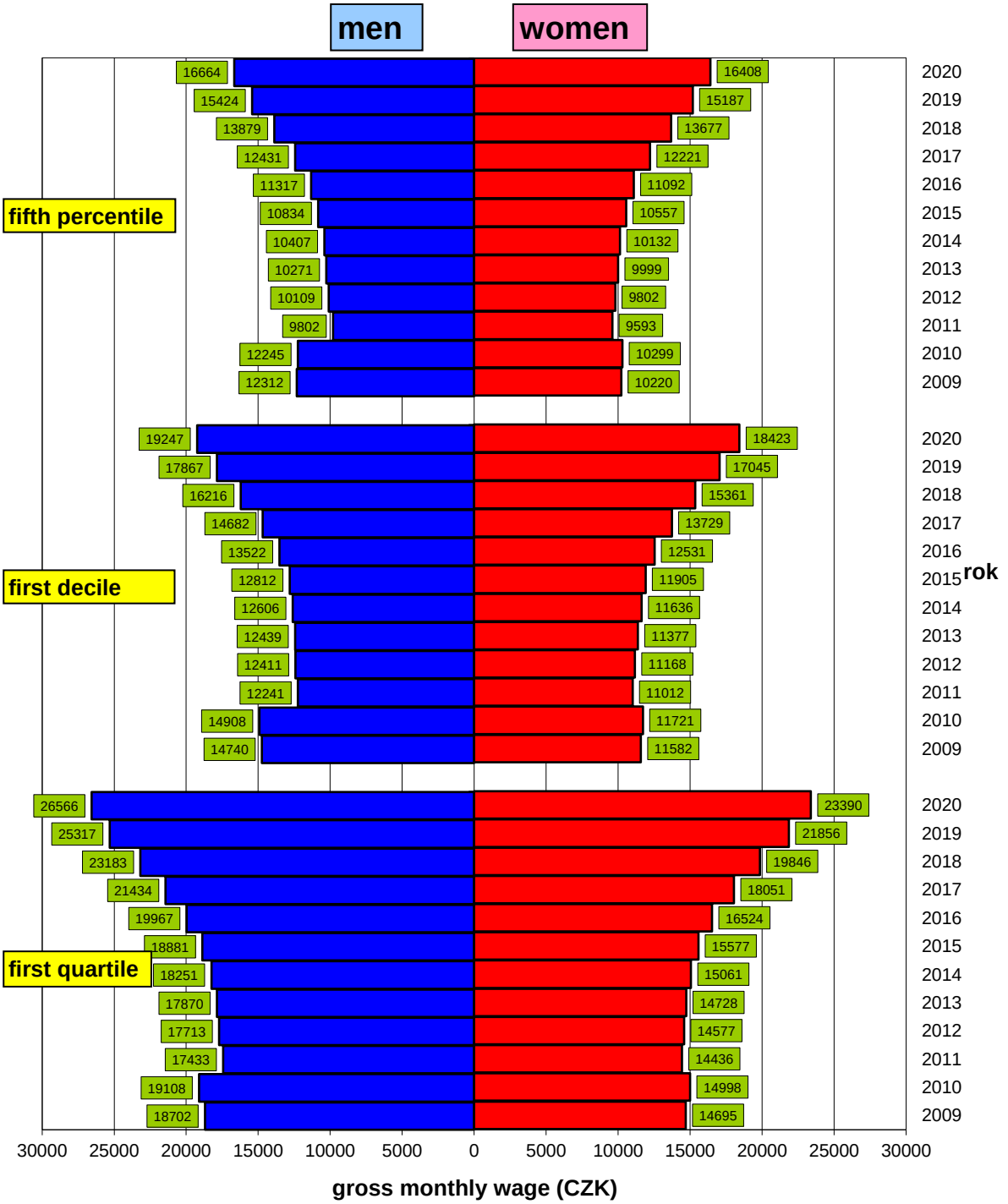

Figure 5. Development of the fifth percentile, the first decile and the first quartile of the gross monthly wage of men and women in the Czech Republic in the period 2009–2020

overall earnings potential, men are more likely to be in occupations characterized by long hours and low returns. The mobility gap in earnings has been closing and a mobility advantage with respect to education has been emerging."

The consequences of the coronavirus crisis on the functioning of countries and the lives of their populations are the subject of research by many scientists around the world. Study (Laborde et al., 2020) emphasizes that as the coronavirus "*pandemic progresses, trade-offs have emerged between the need to contain the virus and to avoid disastrous economic and food security crises that hurt the world's poor and hungry most*." The authors of this study point out that

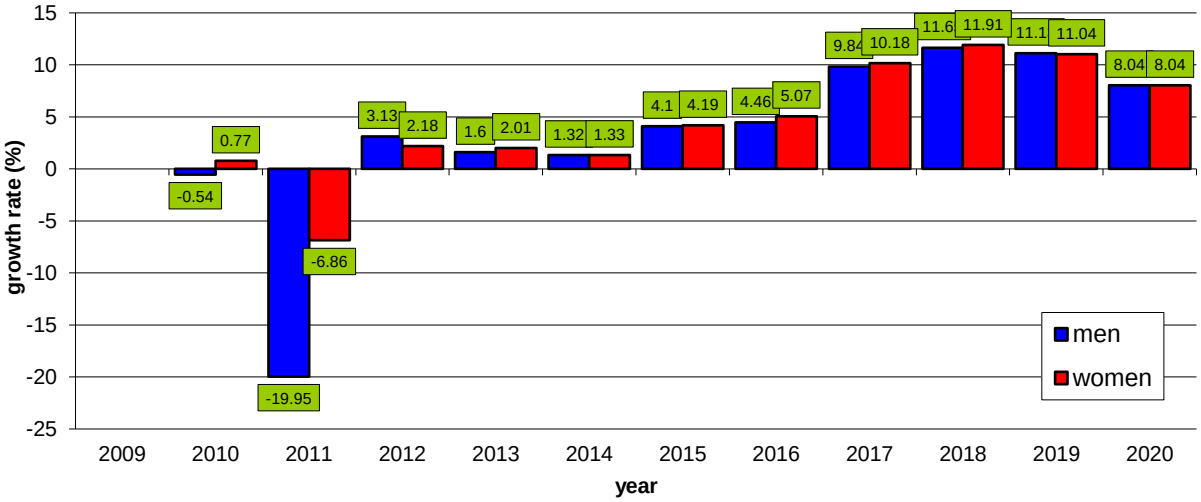

Figure 6. Development of the growth rate of the fifth percentile of gross monthly wage in the Czech Republic in the period 2009–2020

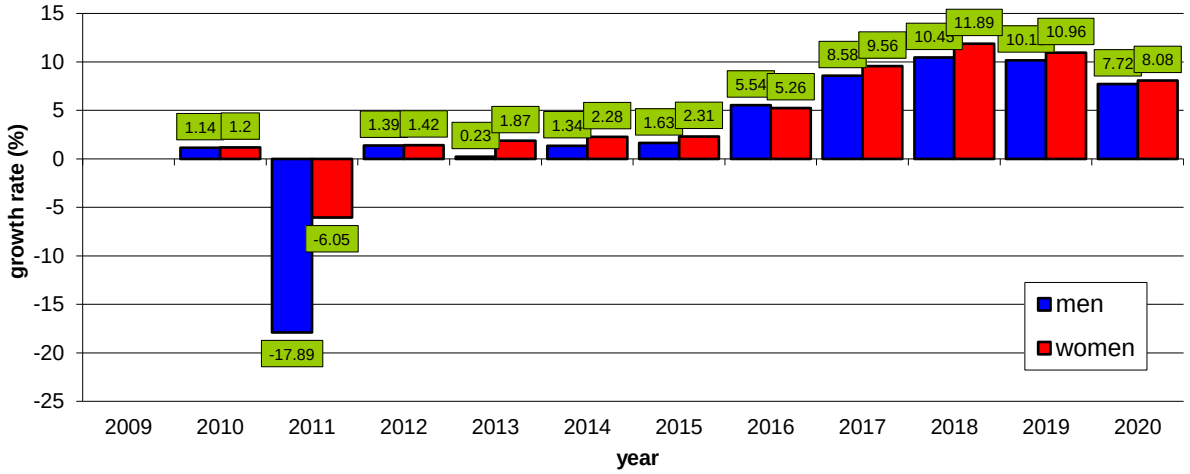

Figure 7. Development of the growth rate of the first decile of gross monthly wage in the Czech Republic in the period 2009–2020

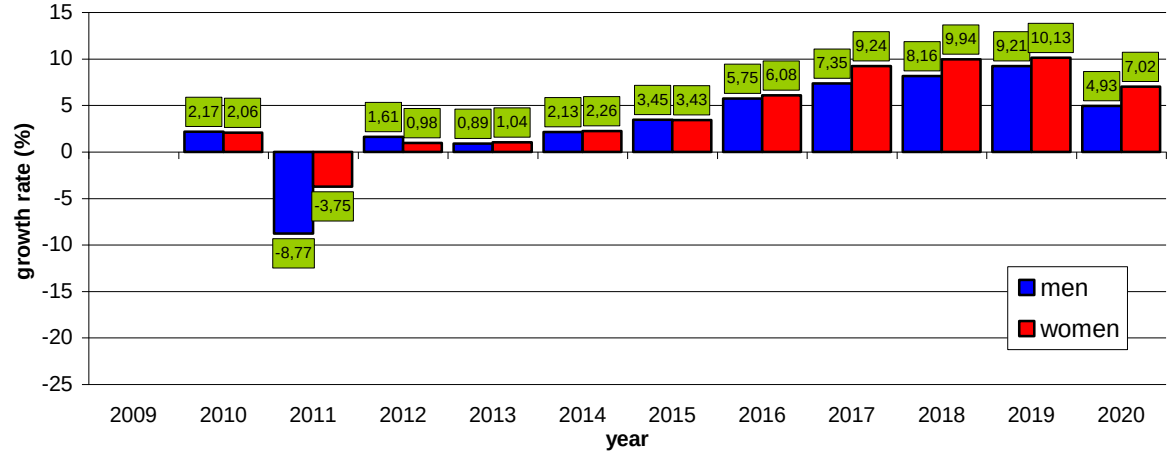

Figure 8. Development of the growth rate of the first quartile of gross monthly wage in the Czech Republic in the period 2009–2020

"*COVID-19 threatens access to food mainly through losses of income and assets that prejudice ability to buy food*" and that "*the poorest households spend around 70% of their incomes on food and have limited access to financial markets, making their food security particularly vulnerable to income shocks*." The research (Manderson & Levine, 2020) deals with the beginnings of the coronavirus crisis in the world. The authors point out that people around the world "*spent much of the last week tracking the exponential spread*" and numbers infected with coronavirus, and „*the consequent retraction of social engagement*." The authors „*are beginning to take stock of the social, economic, and political fallout that will follow as the virus surely spreads, with colder weather, to the global and geographic south*." The authors emphasize that „*we are witness to mediatization of the pandemic; closing of schools and universities, libraries and museums; cancellation of conferences and smaller meetings; and loss of income for people who run stalls and street-side services and work in the informal economy*." The paper (Júnior et al., 2020) presents "*several risk factors common to coronavirus and psychiatric illnesses as overcrowding, disruption of sewage disposal, poor standards of hygiene, poor nutrition, negligible sanitation, lack of access to shelter, health care, public services, and safety*." The authors state that "*these associated with fear and uncertainty create a closed ground for psychological sickness*" and coronavirus infection. The onset of the coronavirus crisis is also addressed in the article (Cook & Grimshaw, 2021). The authors underline that the coronavirus „*outbreak and resultant economic crisis has led to governments in Europe taking extraordinary action to support citizens*", where „*the International Labor Organization recommended such measures should include targeted support for the most affected population groups and women form one of these groups, with disproportionate impacts on their employment and economic resources already documented*." The study (Zavras, 2021) accentuates that "*the coronavirus disease … pandemic induced economic shock in Greece, which translated into a decrease in household income. The objective of this study is to measure social inequality with regard to income loss due to the COVID-19 pandemic in Greece, … the Erreygers' Concentration Index is calculated, using social class as the ranking variable. … According to the results of the logistic regression model*," the author finds that "*the odds of experiencing income loss are higher for residents of the Aegean Islands and Crete but also for self-employed, part-time employed, and unemployed individuals*."

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Conflict of interest: none

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