

Export of Czech Animal Production to Selected Countries of European Union

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Abstract: The aim of this article is to explore volume (in US dollars) of foreign trade of animals and animal products classified under SITC codes 00 live animals, 01 meat and meat products and 02 milk products and eggs in context of distance between states. Eight states of the European Union were analysed according to the number of inhabitants relatively equal to the Czech Republic. Ordinary Least Squares model was performed for variables distance, gross domestic product per capita, dummy variable border, and dummy variable history. Gravity model showed that significant variable distance is negatively affecting agrarian export. Significant variable gross domestic product per capita of exported country impacted agrarian export positively also significant variable history impacted agrarian trade positively. Variables borders and gross domestic product per capita of the Czech Republic were both nonsignificant and with negative effect. This article used panel data for analysis of agrarian trade with animal products. For future research will be used more types of model for evaluation and more states from Europe. New variables will be possibly added appropriately to selected countries.

Keywords: gravity model; foreign trade; animal production; export

JEL Classification: C33; Q17; Q18

1. Introduction

The agricultural sector, together with industry and services, is naturally part of the national economies of all countries in the world (Tanentzap et al., 2015). The position of agriculture and the entire agricultural sector within the national economy is the result of long-term tendencies of economic development, political situations of the state of society (Marunelu, 2020). The trade with agricultural products expands choice, stable demand, and supply (Stieglitz & Charleton, 2007). Agriculture is one of the traditional human activities and trade in agricultural commodities through countertrade is one of the oldest trade activities in history.

At present, the agricultural sector, agrarian trade and agriculture itself face many challenges such as increasing crop productivity, expanding organic farming, strengthening ties with other sectors, but also maintaining the competitiveness of the sector itself and many others (Smutka et al. 2019). From a long-term point of view, the current global agri-food sector is exposed to climate change (Huang et al., 2011). In recent years, there have been growing concerns around the world about the undesirable combined consequences that accompany

rapid economic growth, which is based on the free market and the development of science and technology. The issue of sustainability thus becomes a topic (Mangee & Elmslie, 2010) that is discussed in relation to individual economic sectors (Rehber & Grega, 2008).

The study of the economics of international trade in agricultural and food products is a relatively new specialization in the field of agricultural economics (Josling et al., 2010). One of the methods how is possible examine international trade are gravitational models (Ugurlu & Jindřichovská, 2019). Anderson (1979) considers gravitational models to be one of the most successful empirical tools of research and notes that gravitational equations can be applied to a wide range of goods and factors that move across regional and national borders.

The coronavirus pandemic (COVID-19) will certainly affect the future of the world, including trade and agriculture. Within the agri-food complex, self-sufficiency at the level of individual countries and regions (Fontan Sers & Mughal, 2020) will be probably priority. The growing interest of consumers in local production could be seen in previous years. One possible explanation for this situation is that it is a possible reaction of the inhabitants of individual countries to a certain unification of the market in the international context of (Schjøll, 2017).

The aim of this article is to explore (in US dollars) of foreign trade in animals and animal products classified under SITC codes 00 live animals, 01 meat and meat products and 02 milk products and eggs in context of distance between states.

The article consists of several parts, which follow each other logically. In the Introduction is the elaboration of the theoretical framework of the solved problem. The chapter Methodology describes the methodological procedure of own calculations and sources of information. Subsequently, the resulting findings are presented in the Results. These are further discussed. Finally, the conclusion summarized all findings in article.

2. Methodology

The theoretical framework of the presented paper was elaborated on the basis of scientific articles and literature. Secondary data for the research were obtained from official databases.

The analysis of trade will be evaluated using a gravitational model of foreign trade. The software used for the analysis is SPSS Statistic 24 for data matrix modification. All calculations are performed in the econometric program Gretl.

Data from year 2004 to 2019 were taken. Eight states of the European Union were analysed according to the number of inhabitants relatively equal to the Czech Republic. Among the selected were originally countries with an average population of 7 million to 13 million. To improve the explanatory power of the model, the list of countries was extended by Netherlands. Selected countries are Bulgaria, Austria, Hungary, Sweden, Portugal, Greece, Belgium, and the Netherlands. The population of country was chosen as factor to narrow selection sample of EU countries.

Portugal's data lacked a calculation for 2016 for livestock, which was interpolated according to the average of the surrounding values. Furthermore, the flow was not known in financial terms for meat and meat products for the years 2004 and 2005. With respect to the

low surrounding values, the data were supplemented by a minimum value of 1,000 US dollars.

The input data for analyses were determined as follows for the individual variables:

Table 1. Sources of data for analyses. Own elaboration, 2020

Variable	Source of data
GDP per capita of countries	World Bank: World Development Indicators
Distance between countries	CEPI II gravity database
Export of CZ to j countries	Czech statistical office- Foreign trade database
Borders	own research
History	own research

The basic idea of the gravity model is to use the distance between the capitals of the observed countries. In our case, the CEPI II database was used, which provides data on distances between capitals. In Figure 1 are distances taken from CEPI II database. The disadvantage of this method is that agrarian foreign trade is not directed from the capital of the Czech Republic to the capital. Márquez – Ramos et al. (2006) states that distance variable is commonly used to define transport costs.

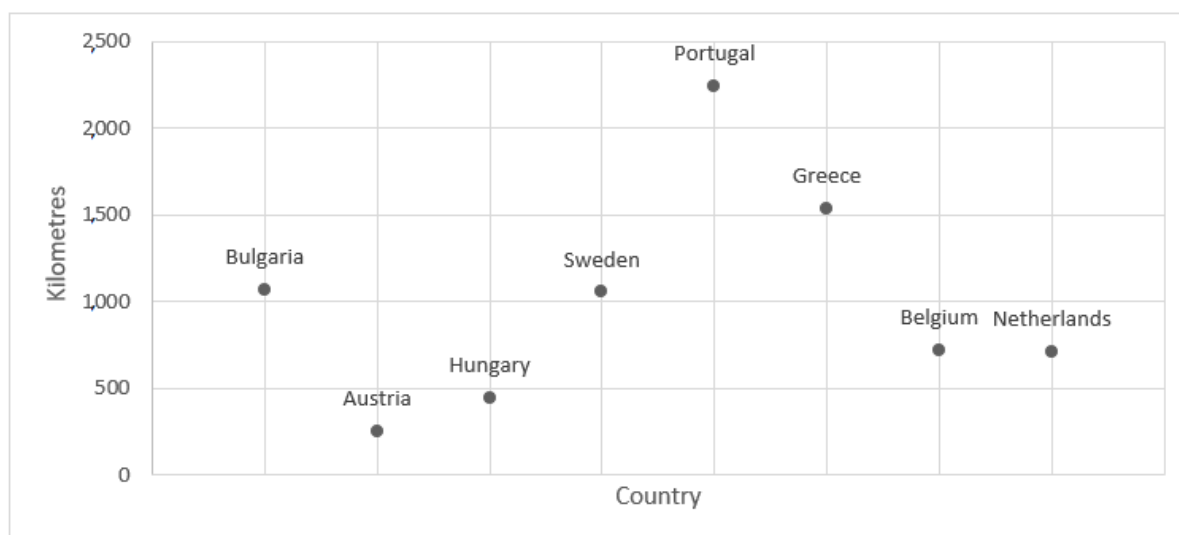


Figure 1. Distance between Prague and capital of selected countries in kilometers, own elaboration according to CEPI II (2020)

Tinbergen (1962) and Poyhonen (1963) can be included among the most important pioneers of gravitational models in the field of international trade. According to these authors, the volume of trade is affected by the gravitational attraction between objects. Thus, it is directly dependent on their size and indirectly on the distances between them, depending on the proportionality factor G .

Tinbergen (1962) defined his model using the following relationship.

$$F_{ij} = G \frac{Y_i^{a_1} Y_j^{a_2}}{D_{ij}^{a_3}} \quad (1)$$

Where:

F_{ij} flow trade flow between economies i and j

Y_i and Y_j Represent economic distance between countries i and j

D_{ij} Geographic distance between countries

G Gravity constant

Many years have passed since the definition of the basic model, and Deardorff's (1998) research was groundbreaking, showing that the relational equations of the gravitational model can be explained using standard business theory. Subsequently, Evenett and Keller (1998) defined a model from the Heckscher-Ohlin model and a theory of increasing returns to scale. Cuenca García et al. (2013) used for model variable comcol which was variable for countries colonized by same colonizer, due to history of Czech Republic Austria – Hungary Monarchy was selected as relationship between colonized countries. Bubáková (2013) mentioned using of gross domestic product per capita for model.

For the purposes of this article, the gravitational model will be used in following logarithmic form:

$$\ln X_i = \beta_0 + \beta_1 \ln \text{GDPPC}_i + \beta_2 \ln \text{GDPPC}_j + \beta_3 \ln \text{DIST}_{ij} + \beta_4 \text{BORDER}_{ij} + \beta_5 \text{HISTORY}_{ij} + \varepsilon_{ij} \quad (2)$$

Where:

GDPPC_i – gross domestic product per capita of i country

GDPPC_j – gross domestic product per capita of j country

DIST_{ij} – geographical distance between countries

BORDER_{ij} – dummy variable indicating if country i and j share common land border

HISTORY_{ij} - Dummy variable indicating historical relationships between country i and j (Austria-Hungary)

ε_{ij} – random error

For selecting most suitable model were used F – test, Breusch – Pagan test and Hausman test. The selection was from the following model types - Ordinary Least Squares model, Fixed Effects Model and Random Effects Model. White test was performed on the model to determine the heteroscedasticity. Autocorrelation was investigated by Wooldridge test in panel data.

The following abbreviations were used in the article: EFTA = European Free Trade Association, EU = European Union, GDP = Gross domestic product, SITC = Standard International Trade Classification. OLS = Ordinary Least Squares, PQRM = Poisson quasi maximum likelihood

3. Results

The basic idea of the gravitational model is to use the distance between the capitals of the observed countries. In our case, the CEPI II database was used, which provides data on distances between capitals. The disadvantage of this method is that agrarian foreign trade is

not directed from the capital of the Czech Republic to the capital. Márquez-Ramos et al. (2006) states that distance variable is commonly used to define transport costs.

Problems with heteroscedasticity were identified for SITC 00 and SITC 01 and after major modifications it would be possible to use a gravitational model (lagging of variables, dynamization of models). On the contrary, a good result was investigated for SITC 02. Multicollinearity was not found between the variables. Descriptive statistics are presented in Table 2.

Table 2. Summary statistics for agregation SITC 02, source own calculation and elaboration

Variable	Mean	Median	Minimum	Maximum
Milk products and eggs (thousands of US\$)	9,833	6,815.5	3	4,9856
Distance (km)	1,003.6	886	252	2245
GDPPCi (US\$)	19,203	19,881	11,750	23,495
GDPPCj (US\$)	32,327	33,681	3,389.7	61,127

The model was tested by F-test. Breusch-Pagan test and Hausman test. After testing of heteroscedasticity and autocorrelation. Ordinary Least Squares model was chosen as suitable for describing relationship between variables. McCallum (1995) used Ordinary least squares model as estimation method for his model with dummy variables borders. Null hypotheses for white test for heteroscedasticity and Wooldridge test for autocorrelation were not rejected.

Table 3. Results for SITC 02 – milk and milk products, source own calculation and elaboration

Variable	Coefficient	P-value	Significance
Constant	6.09383	0.3965	
GDPPCi	-0.144352	0.7973	
GDPPCj	1.38122	0.0041	***
Distance	-1.60406	0.0005	***
Borders	-0.979803	0.1452	
History	2.24083	0.0136	**

Note: ***statistically significant at 1% level, **significant at 5%

Table 3 Shows that SITC 02 milk products and eggs are influenced by significant variable distance, GDPPCj and History. Variable distance is possible to interpret that with every 1% grow is amount of exported agrarian products lower for 1.60%. Variable Gross domestic product per capita is significant and the interpretation is that with every 1% grow of GDPPCj will also raise export for 1.38%. Third Significance variable is history. Variable history in relationship to Czech Republic was represent by Austria-Hungary monarchy. For this variable is possible to do extension of model by other countries which were in monarchy. Variable border is not significant this could be caused by representation by only one state Austria. In Figure 2 are volumes of agrarian trade for selected states for years 2004, 2008, 2012, 2016 and 2019. There is possible to recognize in compare with other states that export to Austria is not in long term period significant. For future research will be added other states which are neighboring the Czech Republic. Variable GDPPCi is not significant.

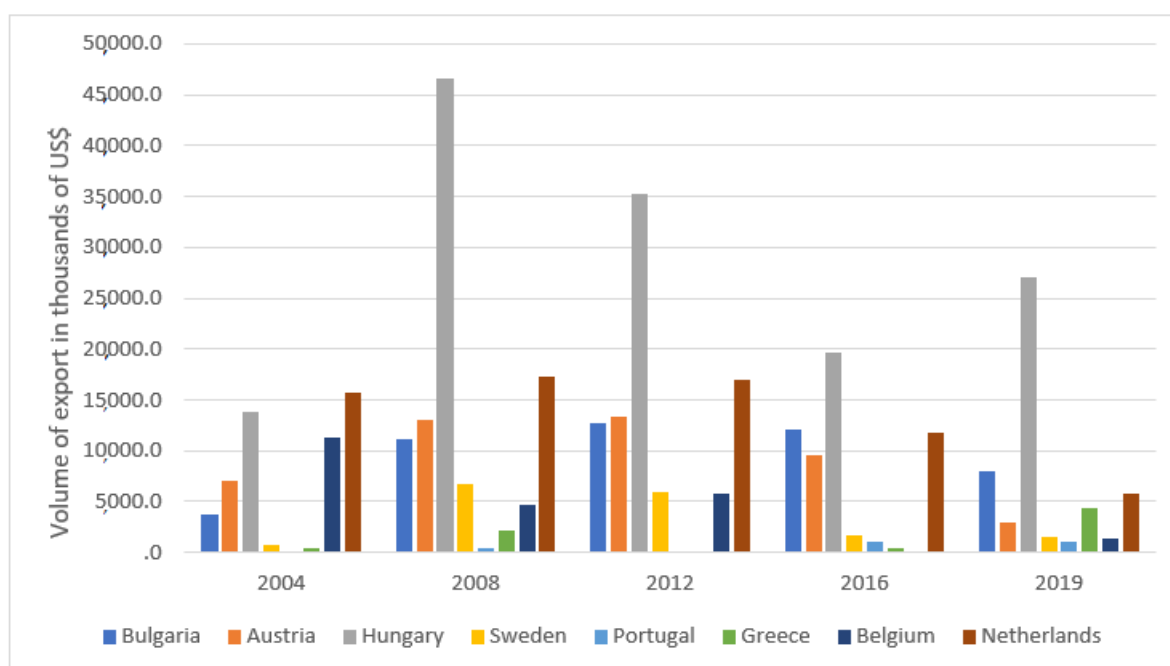


Figure 2. Export of milk products and eggs to selected countries. own elaboration according to Czech Statistical Office (2020)

Variable border is not significant this could be caused by representation by only one state Austria. For future research will be added other states which are neighboring the Czech Republic. In Figure 2 are volumes of export of milk products and eggs from Czech Republic to selected states for years 2004, 2008, 2012, 2016 and 2019. There is possible to recognize fluctuation and degressivity for all states. The most important partners for year 2019 of foreign trade of SITC 02 – milk products and eggs are Germany with 283,792 thousand of dollars, Slovakia with 208,060 thousand of dollars, Italy with 125,809 thousand of dollars and Poland with 69,398 thousand of dollars.

4. Discussion

Ševela (2002) developed a static model based on cross-sectional data. The significant variables with positive effect were gross national income and GDP. The negative factor was investigated for the distance between business partners. On the contrary, the influence of customs duties (the paper was prepared before the accession of the Czech Republic to the EU) and the real effective exchange rate and dummy variables expressing membership in the EU or EFTA has not been proven.

Balogh and Leitão (2019) created a comprehensive model of agrarian trade, which included a major trading partner of the country. In this paper authors included dummy variables such as landlocked countries, similar religions, and possible trade agreements. All variables in model were significant.

Morland et al. (2020) extended his model by a common language and variables GDP per capita were used. The model also includes the forest rents variable, which is not relevant for this research.

Braha et al. (2017) add to variable list of econometric models also effect of exchange rate. The assumption of adding this variable is that increasing in exchange rate would devalue home currency (in case of our article Czech crown), hence export would be cheaper. Assumption are with positive sign because of export should grow.

Ugurlu and Jindřichovská (2019) in his research add dummy variable Visegrad Fourth which could be also interesting to analyze. Compared to our study, there is a similarity between the variable of Visegrad Fourth and history. The author of article worked with importance of International Financial Reporting Standards which by his finding should positively affect the export.

Findings of Cuenca García et al. (2013) correspond with our results. Distance as factor play role. This fact author verifies on 160950 observation in panel data. Author for his work used variables border and history too.

Bergstrand et al. (2015) assembled model with Poisson quasi maximum likelihood (PQML) which he prefers as estimator over he admits that results are qualitatively the same using OLS.

Key topic for future research will be extension of data matrix. In research will be chosen all countries from EU and Europe.

5. Conclusions

The aim of this article was to analyse volume (in US dollars) of foreign trade in animals and animal products classified under standard international trade classification (SITC) codes 00 live animals, 01 meat and meat products and 02 milk products and eggs in context of distance between states including variables Gross domestic product per capita, dummy variable borders which indicates if country is bordering with Czech Republic and history. Negative impact of significant variable distance was identified. Positive impact of variable history and gross domestic product per capita of country where is product exported was significant and verified. The topic of gravity model is still very important in context of foreign trade. Future research will take into account more states from Europe and other models as Poisson quasi maximum likelihood will be examined.

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