

# Spatial differentiations of trade links between Ukraine and Czechia

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## ABSTRACT

The purpose of this article is to examine the current status of economic ties between Ukraine and Czechia, identify main trends in the contemporary commodity trade between Ukraine and Czechia, and to investigate the regional structure of Ukraine's external trade with Czechia. The article employs the coefficients of equilibrium and connectivity of regional trade links between Ukraine and Czechia in order to classify Ukrainian regions into distinct categories based on the degree of connectivity of commodity trade and the types of trade links between these two countries.

## KEYWORDS

exports; imports; commodity trade; trade equilibrium coefficient; trade connectivity coefficient; Ukraine; Czechia

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## 1. Introduction

Foreign trade is a traditional object of geographic research, which is realized within the context of the theory of international division of labor. The mechanism of foreign trade is conditioned by the existence of a country's or a region's benefits in the production of certain goods, as well as existing theoretical models based on united theories of location and international trade that can be applied to international trade relations. The main reason for foreign trade interactions between countries and regions is the presence of various factors of production, which lead to commodity and industrial specialization within the domestic and international divisions of labor. These factors also lead to regional differences in foreign trade.

In models of foreign trade, developed by Krugman (1991) within the framework of new economic geography, the emphasis is on the mechanisms of monopolistic competition, which, along with the classical principles of absolute and relative advantages, provide additional gain from international trade by increasing the scale of production. The ideas of Krugman make it possible to prove that the geographical structure of countries' foreign trade is characterized by dominance of large cities and industrially developed regions that benefit from high volumes of production. This leads to territorial disproportions and regional differences in the distribution of external and internal trade flows.

P. Krugman, M. Fujita and others consider the model of new economic geography as a model of the location combining elements of traditional regional science and a new trade theory (Krugman 1999; Fujita, Krugman and Venables 1999). It is designed for the analysis of the spatial structure peculiarities, for the degree of concentration and differentiation of countries' and regions' foreign trade relations.

Models of the new economic geography became the basis for developing gravitational models of trade interaction between countries and regions proposed by J. Tinbergen (Tinbergen 1962), D. Anderson and E. Wincoop (Anderson and Wincoop 2003), D. McCallum (McCallum 1995), etc. Gravitational models of foreign trade make it possible to assess bilateral trade flows between countries and regions, considering the gross regional product of two countries or regions and the distances between them.

Porter (1998) has attempted to combine neoclassical theories of competitiveness at the country level with the theory of foreign economic activity of individual regions and firms. According to Porter's theory of competitiveness, the spatial structure of foreign trade is highly differentiated due to competition on the domestic market, which determines the level of participation in international trade, depending on the availability of competitive advantages. The regional approach to the study of foreign trade is therefore important since it allows for assessing the regional

geographic structure of foreign trade and for the identifying spatial concentration and differentiation of trade flows between individual countries and regions.

The purpose of this article is to analyze the dynamics and main trends in the trade relations between Ukraine and Czechia between 2001 and 2017, to elucidate the features of the spatial differentiation of the bilateral commodity trade at the level of the Ukrainian regions and to determine the further interregional interaction prospects.

A key target of the Ukraine's sustainable and successful growth is to expand the external economic relations. The Ukrainian cooperation with Central and Eastern European countries holds a special place in this strategy. Ukraine has become active in the markets of those countries Czechia, as a partner country with lasting into external commercial relations with Ukraine has supported Ukraine in its attempts to integrate into the EU and it traditionally stays to be an important trading partner among other Central and Eastern European countries (Politychni ... 2017). Many Ukrainian regions have established stable trade relations with trading companies and partners from Czechia. Therefore, the goal of this article is to conduct the spatial analysis of bilateral trade relations among regions of Ukraine and Czechia.

Only recently, Ukrainian scholars have begun to study the challenging issues of the Ukrainian-Czech cooperation, primarily within the political realm, whilst other areas of the bilateral cooperation have not been comprehensively studied. Tsup (2009) focused on the analysis of the Ukrainian-Czech interstate relations in the 20th and early 21st centuries, including economic relations. Various aspects of Ukrainian relations have been examined by R. Korsak (2007, 2013, 2014, 2016). In particular, Korsak (2007) analyzed the bilateral relations, including trade links between Czechia and Ukraine between 1991 and 2005. Additional publications included Ukrainian periodicals (Molodczenko 2013; Mudriyevs'ka 2013; Reznikov and Borodenko 2014; Tkaczenko 2013; Ustych 2003; Tsup and Lazarovych 2007, et al.) and web sites (Ukraine-Czech ... 2005; Aktual'ni ... 2011; Ukraine ... 2017). All of them primarily deal with the analysis of exports and imports of goods between the regions of Ukraine and Czechia, as well as the dynamics, structure and prospects of their trade relations. Some publications discuss the main trends and prospects essential to the development of trade relations among Ukraine's regions and countries of Central Europe, as well as between Ukraine and the EU, which partially cover some of the aspects characterizing the Ukrainian-Czech trade relations (Matveieva 2007; Moroz and colleagues 2017; Petruk and Kovtun 2016, and others). The Ukrainian-Czech trade and economic relations and their status are also partially examined in Krayinoznavcha ... (2015). However, the comprehensive spatial analysis of Ukrainian-Czech trade relations is still absent.

The Ukrainian-Czech interstate trade and economic cooperation has not yet been sufficiently analyzed. Moreover, there is a little attention paid to the analysis of trade relations between these two countries. The exception is Fomenko (2006) who analyzed the Ukrainian-Czech trade relations between 2001 and 2006. However, the bilateral trade relations from the geographical point of view are not studied at all.

Among Czech authors, Palata (2011, 2012) and Vesela (2011) focus their attention on political aspects of the Ukrainian-Czech interstate relations, pointing out that the rapprochement of Ukraine with the European Union will have a positive effect on the economic development of Ukraine and its bilateral trade relations with the EU. Vošta et. al (2016) consider Ukraine's foreign trade relations with the EU within the framework of the Eastern Partnership Program, some attention has been paid to Ukraine in various documents (e.g. Agenda 2017) (Hlavní ... 2017; Concept ... 2015), and in the analysis of the Czech foreign policy (Kořan 2016).

Overall, scientific publications dealing with the study of the Ukrainian and Czech trade relations testify to the insufficient and superficial coverage of this issue from the standpoint of social geography whilst geographical aspects of these links and their spatial differences have not yet been deeply studied either in the Ukrainian or in the Czech scientific literature. There are no publications studying the spatial differentiation and concentration of bilateral ties as to the trade in goods and services existing among regions of these two countries. For these reasons, we will conduct the analysis of trade cooperation between Ukraine and Czechia from the geographical perspective in the remainder of this article.

## 2. Data and Methods

Some statistical data for the period from 2001 up to 2017 given by the National Bureau of Statistics of Ukraine were used to analyze the Ukrainian-Czech trade links and to determine the main trends in their formation. To reveal the spatial features of the regional distribution of these links, the official data of the regional statistical offices of the Ukrainian 24 regions and the city of Kyiv have been used with taking into consideration the analysis of their commodity export and import volumes, foreign trade turnover and balance over 2016. The data on Crimea, including the city of Sevastopol, and some area in the East of Ukraine have not been taken into consideration because they are not available. The commodity trade accounts for more than 92% of the total volume of the interstate trade operations between Ukraine and Czechia and the total turnover of the trade in services was only USD 129,6 million (Derzhavna ... 2018). Therefore, in this article the trade in services has not been examined within the framework of the Ukrainian regions

(Derzhavna ... 2018) because of their small export volumes to Czechia and imports from Czechia to most Ukrainian regions. As a result, it requires a separate detailed study.

In order to conduct the analysis of regional trade relations between Czechia and Ukraine, we have first selected indicators and procedures of their interpretation and applied them to the dynamics of foreign commodity trade between Ukraine and Czechia for the period between 2001 and 2017. Both its commodity structure and intensity of growth in exports, imports, balances and foreign trade turnovers have been determined relying upon the regression and correlation analyses. We have used a probabilistic polynomial model to find the dependent variables by the following formula:

$$y_i = b_0 + b_{1x} + b_{2x^2} + b_{3x^3} + b_{4x^4} \quad (1)$$

Unknown parameters like  $b_0, b_1, b_2, b_3, b_4$ , characterizing some of groups involved factors affecting commodity trade have been calculated using the least square method. Any verification of the expository power of the polynomial model chosen herein allows explaining the specific dynamics of trade flows and the general trend in this dynamics on-study. Additionally, the correlation analysis technique has been employed to show the reliance of volumes of trade flows on various factors influencing on the regional foreign economic activity and to test the expository power of the regression model, entirety. To test the statistical significance of the correlation coefficients, Student's criterion (t-test) was used.

An important foreign trade factor is its coefficient of equilibrium reflecting the ratio of export and import flows among the regions of Ukraine and Czechia. It is calculated as the ratio of the foreign trade balance to the total trade turnover by the following formula:

$$Kzb_i = S_i / T_i \quad (2)$$

where  $Kzb_i$  – the coefficient of equilibrium of commodity trade between the  $i$ -region of Ukraine and Czechia;  $S_i$  – the balance of trade in goods of the same region of Ukraine with Czechia;  $T_i$  – the volume of foreign trade turnover of the  $i$ -region with Czechia. The value of the  $Kzb_i$  coefficient of equilibrium of commodity trade can range from 1 to  $-1$ . The positive value reflects the greater volume of exports than imports, the negative value shows the greater volume of imports than exports, and 0 (zero) reflects the equality of exports and imports.

The trade connectivity coefficient ( $K_{zv}$ ) has been used for the spatial analysis of foreign commodity trade among the regions of Ukraine and Czechia. It has been calculated by the technique proposed by A. Vaniushkin (Vaniushkin 2004) under the formula (3):

$$K_{zv} = (X_{mn} / X_m) : (M_{nm} / M_m), \quad (3)$$

where  $K_{zv}$  – means the trade connectivity coefficient of the  $m$ -region with the  $n$ -country;  $X_{mn}$  – exports from the  $m$ -region to the  $n$ -country;  $X_m$  – the aggregate exports of the  $m$ -region;  $M_{nm}$  – imports from the  $n$ -country to the  $m$ -region;  $M_m$  is the total imports of the  $m$ -region.

The trade connectivity coefficient  $K_{zv}$  equal to 1 or more than 1 points out to the fact that the  $m$ -region has some trade connectivity with the  $n$ -country (in our case with Czechia), as well as, that there is a high degree of focus on the trade relations with trading partners in the  $n$ -country. The coefficient less than 1 reflect three possibilities (Matveieva 2007). In the first case, the share of exports from the  $m$ -region to the  $n$ -country is much greater than the average volume of its exports to all of the countries with which it trades. Then, such a region depends upon the  $n$ -importer, but there is no feedback due to the significant size of the  $n$ -country's market. In a formalized form, it looks as follows:

$$X_{mn} \gg X_m / N_{xm}, \quad (4)$$

where  $N_{xm}$  means the number of those countries to which the  $m$ -region exports goods.

In the second case, the  $n$ -country's share in the exports of the  $m$ -region is much smaller than the share of the  $m$ -region in the  $n$ -country's imports. Then, the  $n$ -country depends on the exports of the  $m$ -region, but the  $m$ -region does not depend on trade with the  $n$ -country. In a formalized form, it looks like:

$$(X_{mn} / X_m) \ll (M_{nm} / M_n), \quad (5)$$

where  $M_n$  means the  $n$ -country's aggregate import.

In the third case, the exports from the  $m$ -region to the  $n$ -country are less than the average volume of its exports to all the partner countries, and imports from the  $m$ -region to the  $n$ -country are less than the average volume of the  $n$ -country's imports from all of the trading partner countries. This shows the independence of the  $m$ -region and the  $n$ -partner-country from each other in the commodity trade. In a formalized form, it looks like:

$$X_{mn} < (X_m / N_{xm}) \text{ and } M_{nm} < (M_n / N_{mn}), \quad (6)$$

where  $N_{mn}$  means the number of countries from which the  $n$ -country imports goods.

Computational results concerning the connectivity coefficient ( $K_{zv}$ ) of trade links among the Ukrainian and Czech regions according to the technique mentioned above allow us to assess the dominant trade flows and the asymmetry of the trade relations, as well as to classify regions by the type of their trade links with Czechia. Various values of the trade connectivity coefficient are possible in the conditions of the

commodity trade asymmetry, which point to a certain degree of dependence of each region on the  $n$ -country (in our case, Czechia) either relative to the exports or imports of goods.

According to this methodology, the connectivity coefficient of trade in goods among the 25 Ukrainian regions and Czech regions in the unilateral direction is calculated due to the lack of the statistical information as to the foreign trade of the Czech regions with the Ukrainian ones. The statistical data on exports and imports of goods from the Ukrainian regions have been used to perform calculations based on the data from the regional statistical offices and the foreign trade data of Czechia for 2016 from the website of the Czech Statistical Office (External ... 2017; Zovnishn'oekonomichna ... 2018).

### 3. The Current State of the External Commodity Trade between Ukraine and Czechia

Having a long history of development, the Ukrainian-Czech interstate relations have been dynamic. The legal framework of agreements concluded between Ukraine and Czechia includes more than 50 interstate documents that regulate foreign trade relations between these two countries. The most important treaties include The Treaty on Friendly Relations and Cooperation between Ukraine and Czechia dated April 26, 1995 (Dohovir ... 1995), and the Agreement between the Cabinet of Ministers of Ukraine and the Government of Czechia 'On Economic, Industrial and Scientific-Technical Cooperation' dated April 15, 2004.

The EU-Ukraine Association Agreement signed in 2014 and effective on September 1, 2017 is very essential for the development of the Ukrainian-Czech bilateral relations. It envisages the establishment of a free trade zone between Ukraine and the EU. The Ukrainian-Czech Intergovernmental Mixed Commission on Economic, Industrial, Scientific and Technical Cooperation (established in December 1995) has become crucial for the coordination of bilateral trade and economic cooperation. The last (seventh) meeting of the Commission was held in June 2017 in Kyiv (Posol'stvo 2018).

Since the independence of Ukraine and the establishment of diplomatic relations with Czechia (January 3, 1993), the foreign trade relations between these two countries have been constantly expanding. The intensity of the Ukrainian-Czech economic ties over the past decades has been affected by geopolitical, social, economic, political and geographical circumstances Czechia has always been one of the important trade partners of Ukraine since the moment of its (Ukraine) independence (Torhovel'no-ekonomichne ... 2018).

The revival of bilateral trade cooperation between Ukraine and Czechia in the early 21st century is



related to the establishment of trade relations among the commercial and business structures of these two countries, deeper investment and production cooperation, the expansion of the interregional cooperation, and the accession of Czechia to the EU. Despite the positive dynamics of trade relations between Ukraine and Czechia, these countries have not become the main trading partners. Czechia accounted for only 1.6% of total Ukrainian exports of goods in 2016 (the National Bureau of Statistics of Ukraine), and the share of imports of Czech goods to Ukraine was only 1.7% of the total volume of the Ukrainian imports (Derzhavna ... 2017). Thus, Czechia occupied the 16th place among countries in the regional structure of the Ukrainian commodity exports in 2016 and the 13th place in imports (Eksport ... 2017). A similar situation was in trade in services. The share of Czechia in the Ukrainian exports and imports of services was even less at 0.6% (the 30th place among the trading partner countries) and 1.0% (the 19th place), respectively (Derzhavna ... 2018; Zovnishn'oekonomichna ... 2018).

In terms of turnover, Ukraine is the second largest trade partner of Czechia (after Russia) among all former state socialist countries of Eastern Europe. According to the 2016 data from the Czech Statistical Office, Ukraine ranked 23rd among the Czech trading partner countries (0.6% of the total turnover), 22nd (0.5% of the total exports) in commodity exports from Czechia and 25th (0.6% of the total imports) in Czech commodity imports (External ... 2017).

The analysis of foreign trade relations between Ukraine and Czechia since the beginning of the 21st century showed that the turnover of commodity trade grew before the 2008–2009 global economic crisis from 395.7 million US dollars in 2001 to 2046.8 million US dollars in 2008, when it peaked (Derzhavna ... 2018). During the economic crisis, the foreign trade turnover sharply decreased to 962.8 million US dollars in 2009 and then recovered to 2023.7 million US dollars in 2011. Another decrease to 1215.6 million US dollars took place due to the economic crisis in Ukraine in 2016 followed by the recovery to 1584.3 million US dollars in 2017 (Derzhavna ... 2018).

The common trend of external commodity trade between Ukraine and Czechia for the period under study can be described by a fourth-degree polynomial model with a sufficiently high determination coefficient ( $R^2 = 0.73$ ) (Figure 1c). Similar models of the trend based on the polynomial function are also traced in the dynamics of the volume of commodity exports from Ukraine to Czechia ( $R^2 = 0.79$ ) and imports from Czechia to Ukraine ( $R^2 = 0.67$ ) (Figures 1a and 1b). This shows the influence of various factors that led to instability and fluctuations in the volumes of mutual deliveries of goods, especially in last ten years.

The common trend of the Ukrainian-Czech bilateral commodity trade relations since the beginning of

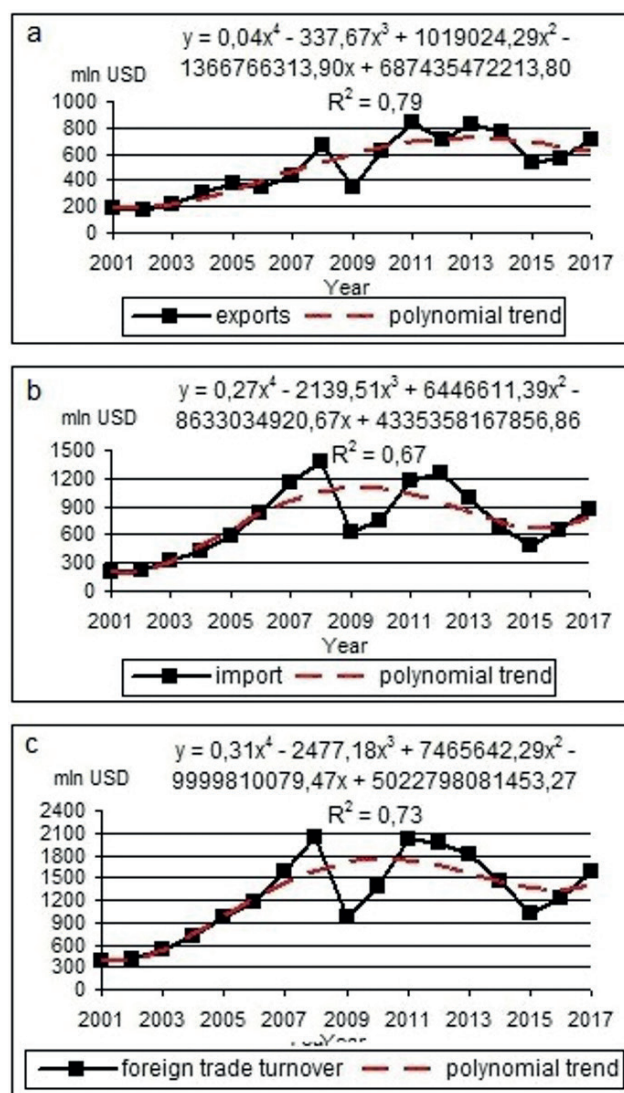


Fig. 1 Dynamics of Indicators of Commodity Trade between Ukraine and Czechia in the Period from 2001 up to 2017: a) exports of goods; c) imports of goods; c) foreign trade turnover.

the 21st century has coincided with the overall trends of the Ukrainian foreign commodity trade with other countries (Figure 1). Thus for the 2001–2017 period, the coefficient of the pair correlation between the volume of commodity exports from Ukraine to other countries and the volume of Ukrainian exports to Czechia is 0.89 ( $t_{st} = 7.37$ ;  $t_{15; 0.05} = 2.13$ ) and it is 0.84 ( $t_{st} = 7.33$ ;  $t_{15; 0.05} = 2.07$ ) for commodity imports.

Ukraine had the negative trade balance with Czechia during this period, which peaked in 2007 (–725.6 million US dollars) but it then decreased before 2010 only to increase in 2012 (to –539.6 million US dollars) followed by another decrease, which resulted in the positive trade balance of Ukraine in 2014–2015 (84.7 million US dollars in 2014 and 61.2 million in 2015) (Derzhavna ... 2018). This change reflected the overall collapse in imports to Ukraine due to the political instability in Ukraine after 2013–2014. The Ukrainian balance of the commodity trade with Czechia was negative for Ukraine in the

period from 2016 up to 2017 (-154.0 million US dollars in 2017) (Derzhavna ... 2018).

The commodity structure of Ukrainian exports to Czechia has not changed significantly in recent years. For example, there was an increase in exports of 13 and a decrease in seven major commodity headings out of 20 in 2016 compared to 2015 (Eksport ... 2017). Although the share of raw materials has decreased, iron ore and concentrates (39%) still prevailed in the Ukrainian exports, followed by the electric machinery and equipment (24%), ferrous metals (13.1%), sets of wires for spark plugs (9.7%), cables (5.4%), iron and steel products (4.9%) and other goods (Eksport ... 2017).

At the same time, technological goods accounted for the largest share of Ukrainian imports from Czechia in 2016, including nuclear reactors, boilers and equipment (22.9% of the total), electrical machinery and equipment (14.9%), land transport (14.0%). Ukraine also imported devices for cellular networks (9.0%), polymer materials, plastics (7.2%), mineral fuel, oil and its distillation products (4.7%) and sets of wires for spark plugs (4, 5%) from Czechia in 2017. Overall, the share of technological goods in Czech exports to Ukraine increased by 43.1% between 2015 and 2016 (Eksport ... 2017; Posol'stvo ... 2017).

### 4. Results and Discussion

A significant spatial differentiation and greater variability in the values of the trade turnover are seen in the regional structure of the external commodity trade among the Ukrainian and Czech regions during the analysed period. The most economically developed and western border regions of Ukraine have become leaders in trade relations with Czechia. The largest volume of the trade turnover is accounted for by the city of Kyiv (282.1 million US dollars in 2016). Dnipropetrovsk, Transcarpathian, Lviv, Donetsk, Zaporizhzhia, Ivano-Frankivsk and Poltava regions had slightly smaller volumes of trade with Czechia (Figure 2). It should be noted that Dnipropetrovsk region mainly exports goods of mining and metallurgy industries to Czechia, and it is almost 4.3 times more than it imports from Czechia. Close trade relations have developed between the Transcarpathian region and partners from Czechia, because only the Transcarpathian region has a partnership and cooperation agreement with the Czech Vysočina region. In 2016, the Transcarpathian region had the third largest trade turnover with Czechia among the Ukrainian regions (152.8 million US dollars). Trade relations of Transcarpathia with Czech regions, especially with the

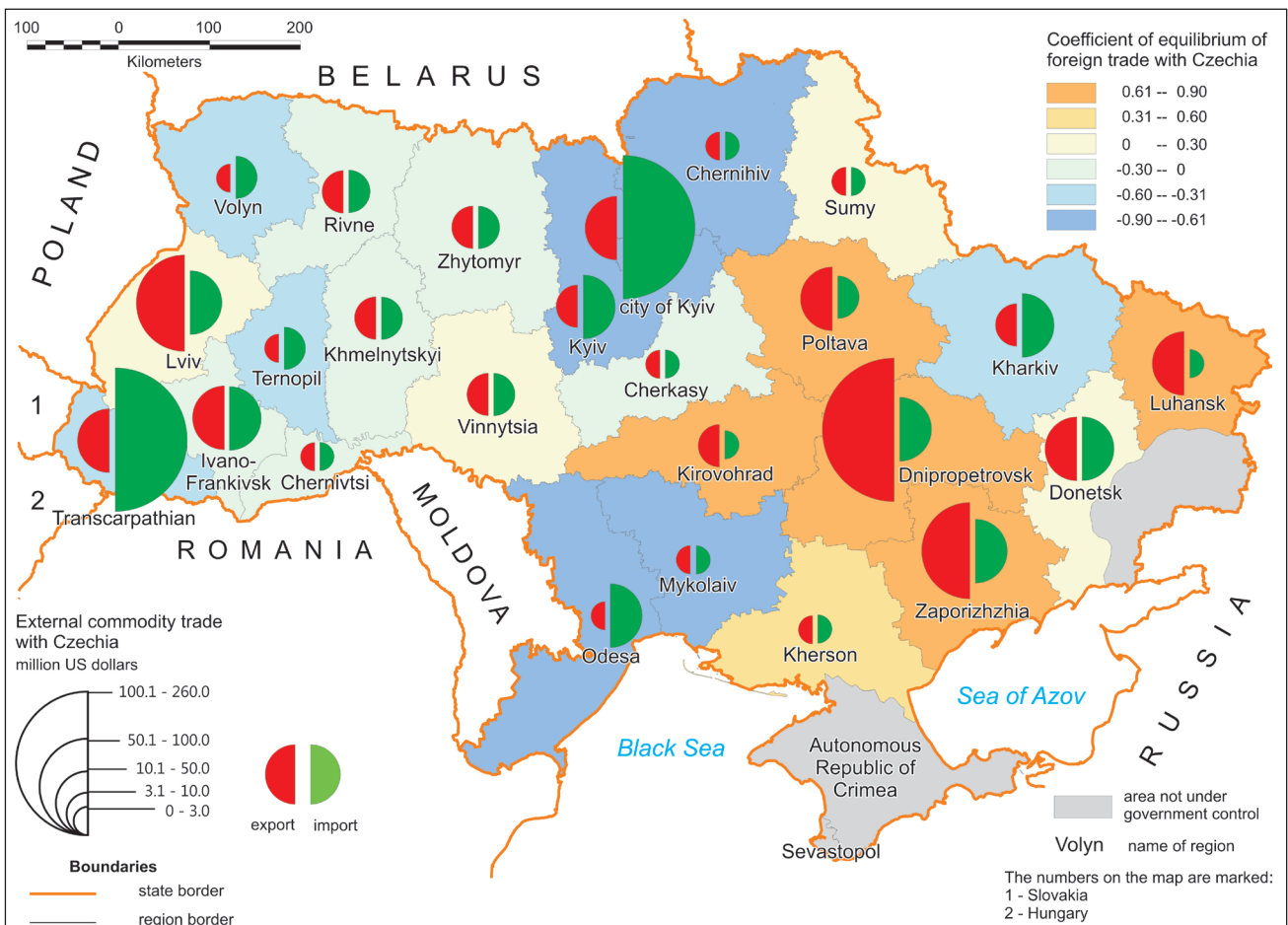


Fig. 2 Spatial Differentiations of Export-Import Relations among regions of Ukraine with Czechia in 2016.

province Vysočina, can be partially explained by historic ties (Transcarpathia was part of former Czechoslovakia between 1918 and 1939) and the transportation proximity. Czech-based enterprises also supply parts and accessories for the assembly of Škoda and Volkswagen models under licenses by 'Eurocar', which is located in the village of Solomonovo, Uzhgorod district of the Transcarpathian region, 2 kilometers from the border with Slovakia and Hungary.

Kyiv, a sister city of Prague, accounts for more than 38% of all Czech imports to Ukraine. The dominant role of Kyiv is explained by its large consumer market and the concentration of high-tech machine-building industries that require import supplies of equipment and components from Czechia. Chernivtsi, Kherson, Chernihiv, Mykolaiv, Sumy and Cherkasy regions have low levels of socio-economic development and also had the smallest volumes of the commodity trade with Czechia in 2016 (Figure 2). There is a positive correlation between the trade turnover of Ukrainian and Czech regions and the gross regional product (the coefficient of the pair correlation 0.82,  $t_{st} = 6.87$ ;  $t_{23; 0,05} = 2.07$ ).

The city of Kyiv and the most developed Ukrainian regions (Dnipropetrovsk, Lviv, Donetsk, Zaporizhzhia and Poltava regions), as well as the Transcarpathian

region, are the most important exporters to Czechia by volume. The lowest volumes of Ukrainian exports to Czechia originate in the Mykolaiv, Chernihiv, Chernivtsi, Ternopil and Cherkasy regions (Figure 2). In 2016, Czechia was the third most important export destination for the Lviv region, the 4th – for the Ivano-Frankivsk region, the 5th – for the Luhansk region, the 6th – for the Transcarpathian region, and the 7th – for the Poltava region.

The most important regional destinations of Czech commodity exports in Ukraine include Kiev (251.8 million US dollars in 2016), the Transcarpathian region (103.1 million US dollars), Lviv region (49.0 million US dollars), Dnipropetrovsk region (34.3 million US dollars) and Ivano-Frankivsk region (30.0 million US dollars). The least important Czech export destinations to Ukraine include the Chernivtsi, Kherson and Kirovograd regions (Figure 2).

Ten regions of Ukraine had a positive balance of the commodity trade turnover with Czechia in 2016. Dnipropetrovsk region had the largest positive balance (112.8 million US dollars) due to the supply of iron and manganese ore to Czechia, as well as products of the metallurgical, chemical and machine-building industries. The largest negative trade balance (-221.6 million US dollars) was in the city of Kyiv

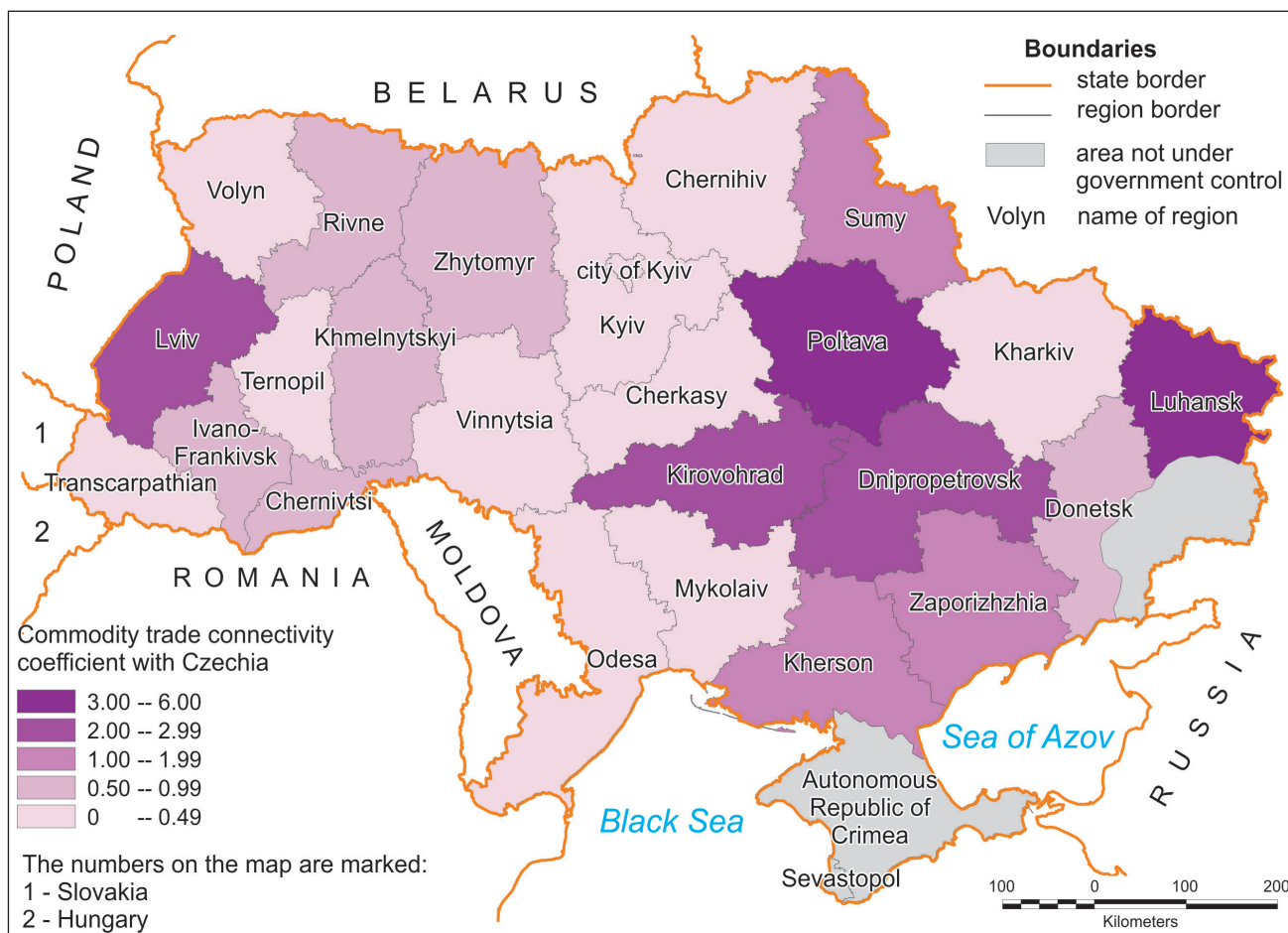


Fig. 3 The Commodity Trade Connectivity Coefficient of regions of Ukraine with Czechia.



(the main importer of the Czech goods), as well as in the Transcarpathian and Kyiv regions in the commodity trade with Czechia in 2016.

The estimation of the coefficient of equilibrium of the bilateral commodity trade ( $Kzb_i$ ) in the context of the regions of Ukraine showed that the external commodity trade of the Vinnytsia, Khmelnytskyi, Zhytomyr, Rivne, Chernivtsi and Ivano-Frankivsk regions with Czechia is more balanced with an insignificant import predominance over exports (the indicator is close to 0). The Donetsk, Luhansk, Dnipropetrovsk, Kirovograd and Poltava regions have the highest positive trade balance with Czechia ( $Kzb_i$  more than 0.6), while the Odesa and Kyiv regions as well as the city of Kyiv have the highest negative trade balance ( $Kzb_i$  more than -0.6) (Figure 2).

The connectivity coefficient ( $Kzv$ ) (formula 3) of trade relations between Czech and Ukrainian regions shows that eight Ukrainian regions have the close commodity trade connectivity with Czechia, since the value of the coefficient is greater than 1. The Luhansk, Poltava, Dnipropetrovsk, Kirovograd and Lviv regions have the most developed commercial relations with Czechia with the  $Kzv$  coefficients between 5.9 (the Luhansk region) and 2.5 (the Lviv and Dnipropetrovsk regions) (Figure 3). This is mainly due to the high levels of exports from mining, metallurgical and machine-building industries compared to fewer imported goods from Czechia. The coefficient varies between 2.0 and 1.3 in the Zaporizhzhia, Kherson and Sumy regions. The smallest coefficients of the trade-related co-operation with Czechia have been recorded in the Mykolaiv region ( $Kzv = 0.01$ ), Odesa, Chernihiv, Vinnytsia and Cherkasy regions and in the city of Kyiv. It shows their significant import dependence upon the trade with Czechia.

The connectivity coefficients of trade relations calculated on the basis of the formulas (4–6) made it possible to divide the regions of Ukraine according to the following characteristics:

1) the dependence of a Ukrainian region on trade (exports/imports) with Czechia; 2) the dependence of Czechia on trade with a Ukrainian region; 3) the absence of dependence on the part of a Ukrainian

region; and 4) the absence of dependence on the part of Czechia.

According to these criteria, regions of Ukraine can be classified under the following types of the trade links with Czechia as shown in Table 1.

A separate group consists of eight regions of Ukraine, which have a significant export dependence with Czechia, since the connectivity coefficient is greater than 1. Simultaneously, the regions of Ukraine with the connectivity coefficient of less than 1 belong to different types, depending on the ratio of the export-import flows to Czechia and the average volumes of exports and imports to all the partner countries determined on the basis of formulas (4–6). So, the Donetsk and Rivne regions greatly depend upon the exports of raw materials and chemical products to Czechia, whereas the Vinnytsia, Volyn and Chernivtsi regions have a lack of dependence on both the commodity exports to Czechia and imports of goods from Czechia (Table 1). The pair correlation coefficient ( $R = 0.40$ ;  $t_{st} = 2.08$ ;  $t_{23; 0.05} = 2.07$ ) between the volumes of commodity exports to Czechia and the gross regional product of the Ukrainian regions confirms the low degree of their export dependence on the Czech market. On the contrary, the high degree of economic dependence of the Ukrainian regions upon the commodity imports from Czechia is more typical. The pair correlation coefficient between the volume of imports from Czechia and the gross regional product confirms this dependence ( $R = 0.84$ ;  $t_{st} = 7.33$ ;  $t_{23; 0.05} = 2.07$ ).

Thus, the findings of the analysis revealed that the majority of Ukrainian regions primarily remain the suppliers of raw materials to Czechia and they are dependable upon the imports of predominantly high-tech industrial products from Czechia. There is a significant asymmetry in trade relations between the regions of Ukraine and Czechia. The comparison of the coefficients of equilibrium with the connectivity coefficients confirms the existence of a significant dependence of the commodity markets in highly developed regions of Ukraine on their commodity exports to Czechia. At the same time, there is a significant import dependence on the commodity flows of the Czech high-tech industrial products to the regions

**Tab. 1** The Classification of the Ukrainian Regions by the Type of the Commodity Trade with Czechia.

Character of Dependence	Export-Dependent Region	Import-Dependent Region	Lack of Dependence on the Part of the Region
Export Dependence of Czechia		Mykolaiv, Odesa, the city of Kyiv, Chernihiv, Cherkasy, Ternopil, Kyiv and Kharkiv regions	
Import Dependence of Czechia	Luhansk, Poltava, Kirovohrad, Dnipropetrovsk, Lviv, Zaporizhzhia, Kherson, Sumy regions		
Absence of Dependence on the Part of Czechia	Donetsk, Rivne regions	Zhytomyr, Transcarpathian, Ivano-Frankivsk and Khmelnytskyi regions	Vinnytsia, Volyn and Chernivtsi regions

\* The source: The authors' calculations.



that have a low level of the industrial development and specialize in the production of the agricultural commodity products. In general, Ukraine's trade with Czechia is more important for Ukraine and for most of its regions than it is for Czechia, since Czechia has a more diversified regional structure of its external commodity trade.

Therefore, the commodity trade of the Ukrainian regions with Czechia is significantly spatially differentiated. As to the regional structure of the external commodity trade between Ukraine and Czechia, the most economically developed regions and the western border regions of Ukraine occupy the leading positions because of their relative geographic proximity to Czechia. The balance assessment of the trade in services in the context of the Ukrainian regions has confirmed that the external commodity trade of Czechia is balanced in regions with an average level of their economic development. Highly developed regions of Ukraine have an unbalanced commodity trade due to the dominance of raw materials in their exports to Czechia. The connectivity coefficient for the bilateral commodity flows shows that a high level of trade with Czechia is typical for only 8 (eight) regions of Ukraine, while Ukraine, in general, has a relatively high level of its dependence on trade with Czechia ( $K_{zv} = 1.39$ ) (Matveieva 2007). There is also a significant spatial asymmetry in the bilateral Ukrainian-Czech trade in goods, since Czechia does not have a significant dependence on the trade with Ukraine, because of its focus on the EU and on highly developed world countries. At the same time, Ukraine is strongly dependent on exports of commodities to the Czech market. This situation can be addressed through the increased cooperation in research, the development of technologies, in the advancement of individual industries, in agriculture and in the modernization of transport infrastructure. Neither Ukraine nor Czechia fully uses the opportunities of their interregional cooperation based on the economic and natural potential of their regions because of limited financial resources and the difficult economic situation in Ukraine.

Thus, Ukraine is characterized by significant inter-regional differences in the level of attractiveness of regions in trade relations with Czechia. The spatial differentiation of trade relations of Ukrainian regions with Czechia is characterized by variability and the presence of significant spatial asymmetry. Regional disproportions are caused by the heterogeneity of the economic space of Ukraine, the degree of localization and concentration of export production and the specialization of import-oriented regions. The spatial structure of Ukraine's trade relations with Czechia is typified by the dominance of the capital city and developed regions in the volume of export-import flows. The calculated coefficients of interconnection of bilateral commodity flows show that most regions of Ukraine have a significant import dependence on trade with Czechia. The classification of Ukrainian

regions by the type of commodity trade with Czechia shows that eight economically developed regions have a close connection between commodity trading with Czechia and a significant export dependence on deliveries of mineral raw materials, metallurgical and machine-building goods to Czech markets. The selected types of regions reflect the optimality of the spatial structure of foreign trade of regions of Ukraine with Czechia. Results of this research can be considered during the development and adoption of managerial decisions aimed at optimizing the foreign trade activity of the regions of Ukraine.

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