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Research Article

Spatial features of trade in goods between Ukrainian regions and France

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Abstract: Trade relations with EU countries have intensified since the signing of the EU-Ukraine Deep and Comprehensive Free Trade Agreement (DCFTA). The EU lifted trade restrictions on Ukrainian exports and allowed Ukraine to expand trade in goods with the most developed countries, including France. In this paper, we aim to examine the spatial features of trade between Ukrainian regions and France in the context of growing trade and economic relations. We applied various methods such as comparative geographical analysis, statistical analysis, mapping, time series approach, typology and correlation analysis to study the dynamics of trade in goods between Ukrainian regions and France from 2017 to 2021 and to reveal the main geographical features in the distribution of export-import flows. Trade turnover with France increased the most in regions with a high level of socio-economic development. It was found that trade between the regions of Ukraine and France is characterised by spatial asymmetry due to the element of geographical distance. Compared to the eastern regions, the western regions have a higher volume of exports and imports of commodities and a higher coefficient of trade linkage with France. In the spatial differentiation of trade in goods between Ukraine and France, there is a high variability and asymmetry in export and import measures.

Keywords: export of goods; import of goods; trade balance coefficient; trade connectivity coefficient; Ukraine; France

Highlights:

- Although Ukrainian-French trade relations are intensifying, the importance of trade is regionally differentiated.
- The western regions of Ukraine trade more with France than the eastern regions.
- The interaction is more intense in the regions with a high level of socio-economic development.
- Kyiv accounts for 58.5% of French goods.

1. Introduction

Increasing globalisation and regionalisation are leading to significant changes in the commodity and geographical structure of foreign trade between countries and regions. The current socio-economic development is characterised by a certain imbalance in foreign trade relations as well as significant differences in the geographical structure of foreign trade in goods and services. After the signing of the Association Agreement with the EU in 2014, the geographical structure of Ukraine's foreign trade has changed significantly and Ukraine's trade in goods with EU countries has become more diverse. The agreement on a deep and comprehensive free trade area between the EU and Ukraine, which entered into force on 1 January 2016, led to an increase in trade with the majority of EU countries. The lifting of EU trade restrictions on Ukrainian exports allowed Ukrainian products to compete on an equal footing with EU products, increasing the volume of mutual trade in goods. In Ukraine, it is recognised that integration is a factor that brings the country closer to the standards of a socially oriented market economy and contributes to the country's development, economic growth and stability.

The European vector of cooperation is clearly visible in Ukraine's foreign trade relations today, especially in commodity trade with EU countries. While in 2014 about 25% of Ukrainian exports were delivered to EU countries, this share will increase significantly between 2014 and 2021. Thus, in 2021, the 'share of the EU in total Ukrainian exports to the world market will be 38.7%, while imports will be 40.7% (State Statistics Service of Ukraine, 2022a). Currently, the EU is Ukraine's largest trading partner, accounting for almost 40% of total trade turnover (Tereshchuk, 2022). After the EU member states voted on 23 June 2022 to grant Ukraine the status of an EU candidate country, the issue of developing foreign trade relations, especially with the most developed EU countries, has become crucial (Bakonina, 2022). However, on the way to EU accession, Ukraine needs to implement a number of reforms and adapt its legislation to European standards.

In our view, it is possible to look at Ukrainian relations with the EU not only as a whole, but also with each individual country. Ukraine has serious intentions to develop its trade relations, especially with the most developed EU countries. We have chosen France for our analysis because it actively supports Ukraine's European integration efforts. At the same time, the French share in Ukraine's foreign trade turnover is rather small compared to other leading (main) EU countries, which opens numerous opportunities for cooperation.

The French Republic, one of Ukraine's leading investors, is an important and reliable trade and economic partner among EU Member States. Since the establishment of diplomatic relations between Ukraine and France in 1992, trade and economic cooperation have grown steadily. Total trade turnover between the two countries reached €2.1 billion in 2021 (up from € 1.6 billion in 2020). In 2021, France ranked thirteenth in the world (1.8% of total goods and services turnover with the rest of the world) and seventh in Europe (4.6% of total trade turnover with EU countries). In terms of investment in the Ukrainian economy, France ranked eighth in the world (sixth in the EU) as of 30 June 2021 (Embassy of Ukraine in the French Republic, 2022).

Inter-state relations between Ukraine and France have long been limited. The reason is that French foreign policy prefers the southern vector of interaction to the eastern one and focuses on Russian policy. Compared to neighbouring countries in Western Europe, the EU and beyond, the French economy has had little interest in Ukraine. Ukraine cooperated with France far less than with Poland, Germany or even Italy and the Netherlands. At the same time, both countries have recently expanded their bilateral cooperation, especially within the Normandy format. This has led to Ukraine becoming one of France's top ten foreign policy priorities. The country now serves as a defender of Ukrainian sovereignty and an important player in European security (Litra et al, 2016). At the same time, Ukraine considers France an important trading partner among EU members. The strengthening of bilateral trade relations with France is also due to Ukraine's accession to the Free Trade Agreement with the EU in 2017 and Ukraine's designation as a candidate for EU membership in 2022. This situation has positively influenced the expansion of interregional trade cooperation with French partners. Therefore, the identification of spatial aspects in commodity trade between Ukraine and France using a regional approach –is an urgent scientific issue in 2017-2021.

The aim of our study is to examine the spatial characteristics of trade between Ukrainian regions and France in the context of the expansion of trade and economic relations that took place after the signing of the agreement on a free trade area between Ukraine and the EU.

At the beginning of the study, we formulated three working hypotheses:

- The first hypothesis states that trade relations between Ukrainian regions and France have strengthened between 2017 and 2021.
- The second hypothesis states that the level of trade interaction between Ukrainian regions and France is determined by the level of socio-economic development in both countries.
- The third hypothesis states that due to geographical proximity, the intensity of trade relations with France is greater in Ukrainian border regions than in eastern regions.

2. Theoretical and Methodological Base

Until recently, theories of the international division of labour were widely used in geographical studies of foreign trade between states and regions of the world. Since the end of the twentieth century, however, scholars have begun to use new theoretical models that combine theories of international trade and geographical locations. These theories served to identify regional differentiation in foreign trade relations. Their combination led to the conclusion that the main reason for modern foreign trade relations between countries and regions is the presence of factors of production that determine the nature and extent of supply on the world market, as well as production specialisation in national and international systems of division of labour. Therefore, there are significant regional differences in the production and consumption of exports, as well as spatial heterogeneity in the distribution of export-import flows.

To study the spatial aspects of global foreign trade activities under modern conditions, the “new economic geography” models developed by Krugman (1991), Fujita et al. (1999), Anderson and Wincoop (2003), Porter (1998), Tinbergen (1962), Ikonomou (2011) and others are quite effective. They allow us to examine the geographical structure of foreign economic activities in countries and regions and to determine the degree of regional differentiation and geographical transformation of their foreign trade relations.

Based on a combination of traditional regional science and new trade theory, Krugman (1991), Fujita et al. (1999) and others consider the models of new economic geography as location models that, together with geographical location, allow us to adequately analyse the geographical structural characteristics and determine the degree of concentration and differentiation of countries' and regions' foreign trade. At the same time, the predominance of developed regions and large cities in the modern geographical structure of global foreign trade is emphasised. Therefore, there are spatial disparities and regional differences in the directions of external and internal flows of goods. Identifying the characteristics and directions of change in the geographical structure of external trade in goods is therefore an important subject of modern geographical research.

According to Porter (1998), the geographical structure of foreign trade is highly differentiated depending on competitive advantages due to competition in a country’s domestic market, which is determined by the degree to which regions participate in international trade. Consequently, the location model of export product manufacturers is useful for analysing the spatial characteristics and directions of foreign trade relations between countries and regions. External and internal export-import trade flows are spatially distributed and reveal regional differences and mismatches. To identify these differences and mismatches, the regional approach is recommended with an assessment of the rationality and equity of the geographical structure of regional and metropolitan foreign trade.

Studies of trade interactions between trading partners based on gravity models have recently been carried out intensively in the context of the ‘new economic geography’. Anderson (2003), McCallum (1995), Tinbergen (1962) and others have in particular studied bilateral trade flows between countries and regions, taking into account the gross regional product of two countries or regions and the transport distances between them.

The theory of trade intensification in the context of deepening economic integration (trade creation and trade diversion effect) is promising for regional analysis. It was founded by Viner (1950) and later developed by Clausing (2001), Kiziltan (2022), Krueger (1999), Magee (2008), Mattoo et al. (2022), Urata and Okabe (2014) and other scholars. The essence of this theory is that there are two effects in the creation of a free trade area: Trade creation (meaning that consumption shifts from a high-cost producer to a low cost producer and therefore trade expands) and trade diversion (meaning that trade shifts from a lower cost producer outside the union to a higher cost producer inside the union). The far-reaching preferential trade agreements lead to more trade creation and less trade diversion than flat agreements and have a public good aspect and increase trade also with non-members (Mattoo et al., 2022). Regarding specific regional trade agreements, agreements with the EU have a trade-creating effect in trade in agricultural commodities (Urata & Okabe, 2010).

The main theoretical provisions of the new economic geography and trade intensification theory for the study of trade relations between regions and subnational entities have also been used by scholars such as Aguirre (1999), Dickson (2014), Royels (2017) and others. They examined the impact of various factors on regional differentiation, commodity structure and the geographical structure of trade relations and flows. Thus, analysing the spatial characteristics of foreign trade relations at different spatial levels from the perspective of the new economic geography is an urgent issue, as the prospects for modern foreign trade relations are directly related to the economic restructuring of economies in the context of globalisation and supranational regionalisation (especially with the EU).

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3. Literature Review

The eastward enlargement of the European Union' has exponentially expanded the area of free trade in goods and services. In this context, the experience of the Central and Eastern European countries and the countries of the Western Balkans in establishing trade relations with the EU prior to their accession to it is crucial for Ukraine's integration into the EU.

It is important to note that the issue of the European integration of these countries and the deepening of their trade relations with the EU has been the focus of numerous studies dealing with the political, legal and trade affairs between the EU and its candidate countries. For example, Baldwin et al. (1997), Mann (2015), Schuller (2002) and others examine the economic advantages and disadvantages of EU enlargement to the East using a general equilibrium model. They argue for European integration and emphasise that enlargement is a win-win situation for both current and new EU members. Montanari (2005) used the gravity model to assess the growth potential of trade between the EU and the Western Balkan countries before their accession in 2004. The Western Balkan countries have shown that they have significant opportunities to increase both their imports and exports due to their geographical proximity to the EU. Nuroğlu and Kurtagic (2012) have examined the variables affecting trade flows between the EU and the countries of South-Eastern Europe. It was found that the volume of GDP, geographical distance and several changing variables are important factors in increasing trade flows. The potential impact of increased trade flows following the accession of these countries' to the EU was also examined.

Czarny and Lang (2002), Erjavec et al. (1998), Kaminski (2001), Kimakova and Rajabiun (1999), Schuller (2002), Stoenescu (2015), Zawalinska (1999) and others examined structural changes in the economy and foreign trade that might occur after Poland and other countries join the EU. Mackowiak (2011) studied the changes in the commodity structure of Polish regions' trade with the EU after Poland's accession to the EU. He also calculated the index of transformation of trade in goods of Polish regions with the EU from 1999 to 2007.

Due to the low level of interest in this topic, the problems of Ukrainian-French trade relations are insufficiently addressed in modern scientific literature. According to the analysis of Ukrainian literary sources, the existing scientific works on the studied topic are mostly fragmentary. First, the article by Frèrejean at al. (2017) provides a comprehensive economic and geographical analysis of the structure of contemporary French direct investment in the Ukrainian economy, as well as an examination of the geographical aspects of its distribution. The uniqueness of the economic geography approach to the study of the spatial distribution of French direct investment within the country becomes clear. The distributional structure of French direct investment in the Ukrainian economy as well as the spatial distribution of the corresponding enterprises with French investments are also described.

The study by Rakhman and Morieva (2021), which examines the current state, trends and main objectives of Ukraine's foreign economic policy, should be mentioned separately. They identified France's position and the instruments of bilateral economic cooperation, as well as a structural analysis of the export and import balance and total trade turnover between the two countries. Kramar (2021) has examined the specifics of Ukraine's foreign trade with France before Russia's aggression against Ukraine, highlighting the importance of bilateral trade for Ukraine. He also suggests ways to strengthen Ukrainian-French trade relations and increase Ukrainian exports to the French market.

Andriychuk and Veryzhenko (2006), Donchenko (2006), Onishchuk (2000), Savin (2010), Sokolov (2009a, 2009b) and others looked at interstate trade and economic cooperation between Ukraine and France in recent decades against the background of bilateral political cooperation between the two states. They also examined the problems and prospects for the growth of bilateral trade relations. In the context of intensifying trade cooperation with EU countries, France is seen as an attractive trade partner for Ukraine. Interestingly, none of the above publications addressed the issue of analysing the characteristics of the spatial distribution of export-import trade flows at the regional level.

The issue of interstate trade and economic cooperation between France and Ukraine is not a priority for French researchers, nor is Ukraine a focus of attention. The conceptual foundations of inter-state relations between France and Ukraine are mainly studied by French researchers in the political sphere, while the trade and economic spheres receive little attention. The trade and economic relations of the two countries are mainly considered in the context of intergovernmental cooperation and strategic partnership. At the same time, the spatial dimensions of Franco-Ukrainian trade relations are not examined. As Mitrofanova (2022) notes, the problem is that there are very few Ukrainian specialists in France who speak not only Russian but also Ukrainian and are familiar with Ukrainian publications in the field of politics and economics.

The articles by French scholars are characterised by a simplified and fragmented approach to analysing the trade and economic relations of the two countries. For example, French scholars Dubien and Duchene (2004) examined the state of interstate relations between France and Ukraine at the beginning of the twenty-first century. They focused on the trade turnover of the two countries between 2000 and 2002 and on changes in the commodity structure of interstate trade. The authors mentioned above published a similar article in 2006, in which they examined changes in Ukrainian-French interstate relations and foreign trade between 2002 and 2005 (Dubien & Duchene, 2006). In both papers, however, these scholars ignored the issues of the regional distribution of commodity trade between the two countries. In 2006, Ukraine received its own issue of the journal Études Économiques de l'OCDE. This presented the main macroeconomic indicators, Ukraine's macroeconomic policies at the turn of the century and the role of institutional and regulatory reforms in economic development. The third chapter examined the commodity and geographic structure indicators of Ukraine's trade relations with the rest of the world in order to strengthen the competitiveness of the Ukrainian economy (OCDE, 2006).

French scholars examined the development of trade relations between France and Ukraine, particularly in the context of the EU's growing regional integration (Richard, 2007). Examining EU trade flows according to the spatial interaction model applied by Richard and Tobelem Zanin (2009), the place of Ukraine in these flows in particular was partially examined and a trend towards strengthening trade relations between Ukraine and EU countries, including France, was noted.

Recently, Ukraine has been discussed in French academic literature mainly in the context of Russian military aggression and the impact of these events on Franco-Ukrainian relations, including trade and economic relations. Jean and Jégourel (2022) examine the impact of the Russian-Ukrainian war on global commodity markets and the future role of Ukraine in global trade. In his article, Sampognaro (2022) examines the economic losses of EU member states, including France, as a result of the Russian invasion of Ukraine. Assuming that Ukraine's economy and EU membership recover, the volume of bilateral commodity trade could increase significantly after the end of Russian aggression.

Thus, the peculiarities of spatial differentiation of Ukrainian-French trade relations remain unnoticed and practically unexplored in both Ukrainian and French academic literature. This calls for a regional approach to the study of commodity trade between the two countries, based on the results of assessing the degree of trade linkages between Ukrainian regions and French trading partners.

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4. Materials and Methods

Based on the statistical data of the State Statistics Service of Ukraine and its regional departments for 2017—2021 (State Statistics Service of Ukraine, 2022a, 2022b), a regional analysis of the geographical structure of Ukrainian-French trade relations was conducted with the identification of the main trends in their development. With the help of trend analysis, we examined the dynamics of goods trade relations between Ukraine and France at the interstate level over a period of 20 years. In order to identify the characteristics of spatial differentiation of the volume of modern bilateral commodity export and import flows in 2017–2021, we used the official data of the regional statistical offices of the regions of Ukraine and the city of Kyiv, published on the websites of these offices in the section "Geographical structure of foreign trade in goods". It should be noted that statistical data on the Autonomous Republic of Crimea, the city of Sevastopol and parts of the Luhansk and Donetsk regions, which are no longer under Ukrainian control due to the Russian annexation of these territories, were not taken into account. In addition, statistical data on the volume of trade in services, which accounted for 13.9% of total interstate trade turnover in 2021 (12.8% in 2020), were not examined, which could be the subject of a separate publication.

The regional differentiation of trade in goods between Ukrainian regions and France was examined using the coefficients of balance and connectivity of trade flows, which reflect the ratio of exports and imports of goods and their turnover.

The coefficient of commodity trading balance between the region of Ukraine and France was calculated using the following formula:

$$Kzb_i = S_i / T_i \quad (1)$$

where Kzb_i is the coefficient of commodity trading balance between the i-th region of Ukraine and France, and S_i is the commodity trading balance between that region of Ukraine and France, and T_i is the volume of trade turnover between that region of Ukraine and France.

The balance coefficient Kzb_i can range from +1 to -1. Trade is considered balanced when the balance coefficients range from +0.2 to -0.2. If Kzb_i is greater than +0.2, the region expands its exports to markets in another region or country; if Kzb_i is less than -0.2, a foreign trade partner expands its imports.

Any regional differentiation and disproportionality in trade relations between Ukraine and France should be examined using the connectivity and symmetry of trade flow criterion. The coefficient of commodity trading connectivity was calculated for this purpose using the following formula:

$$Kzv = (X_{mn}/X_m): (M_{nm}/M_m) \quad (2)$$

where Kzv is the correlation coefficient of commodity trading of region m with country n, X_{mn} is export from region m to country n, X_m is the total export of region m, M_{nm} is import from country n to region m, and M_m is the total import of region m.

The resulting coefficient takes into account the export-import ratio of region m, which exports to a given country n, in relation to the total commodity export-import volumes of region m under study in trade with all countries of the world.

Due to the asymmetry in bilateral trade in goods, the value of the connectivity coefficient Kzv varies, which allows us to determine the degree of dependence of each region on the markets of the country n under study (France in our case) for both goods exports and imports. If a region has a high degree of goods dependence with the country n under study, the coefficient Kzv can be equal to or greater than 1.0. If the region's trade relations with the country n under consideration are unstable, the coefficient Kzv will be less than 1.0. The connectivity coefficient allows us to assess the prevailing trade commodity flows, determine the degree of asymmetry in trade relations between Ukrainian regions and categorise them based on the nature of trade relations with France. In addition, paired correlation analysis was used to identify interdependencies between the main parameters of export-import flows, the calculated coefficients of balance and connectivity of trade in goods between Ukraine and France, and the gross regional product produced, which reflects the level of their socio-economic development. Student's t-distribution was used to determine the statistical significance of the correlation coefficients (t-distribution).

5. Results

For various reasons and circumstances, the dynamics of trade relations between Ukraine and France have been volatile over the past 20 years. The development of bilateral trade relations between the trade and business structures of the two countries, as well as the expansion of interregional cooperation, have recently been associated with a revival of bilateral trade cooperation between the two countries. The joint Ukrainian-French Intergovernmental Commission on Economic Cooperation, which held its eighth meeting on 26-27 November 2020, is an important instrument of bilateral economic cooperation (Embassy of Ukraine in the French Republic, 2022).

Geopolitical, socio-economic, historical and political-geographical conditions and factors have determined the dynamics and intensity of modern Ukrainian-French trade and economic relations over the last 20 years. Despite the positive dynamics in bilateral trade relations, a certain asymmetry can be observed, as Ukraine is not among the leading countries in French foreign trade due to France's geo-economic orientation in international trade towards EU member states and economically developed countries.

From the turn of the century XXI until the global economic crisis of 2008-2009, the foreign trade turnover of goods traded between the two countries had been steadily increasing (Fig. 1). In 2009, the volume of trade declined dramatically, to US$1413.8 million compared to US$2196.0 million in 2008 (State Statistics Service of Ukraine, 2022b). The decline in bilateral trade in goods between the two countries during this period is related to both the global economic crisis and a decrease in the volume of production of Ukraine's main export goods. Subsequently, the trade turnover of the two countries' recorded a sustained positive growth, reaching 2420.2 million US dollars in 2013. Since the beginning of Russian aggression in eastern Ukraine and Crimea in 2014, the volume of interstate trade decreased significantly, reaching a total of 1023.1 million US dollars in 2016, which was 2.4 times less than in 2013. After that, the dynamics of bilateral foreign trade was volatile, with some increase in trade in goods between the two countries in 2017-2019 and a slight decrease in 2020 as a result of the coronavirus pandemic, in contrast to a consistent trend of increasing trade volume between the two countries up to and including 2019. Undoubtedly, the pandemic COVID -19 had a significant impact on the socio-economic development of Ukrainian regions and caused a decrease in GDP production. As a result, the volume of

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trade between the two nations decreased. For example, the volume of trade between Ukraine and France in 2020 amounted to 2060.1 million US dollars, which is 1.2 times less than in 2013 (Fig. 1).

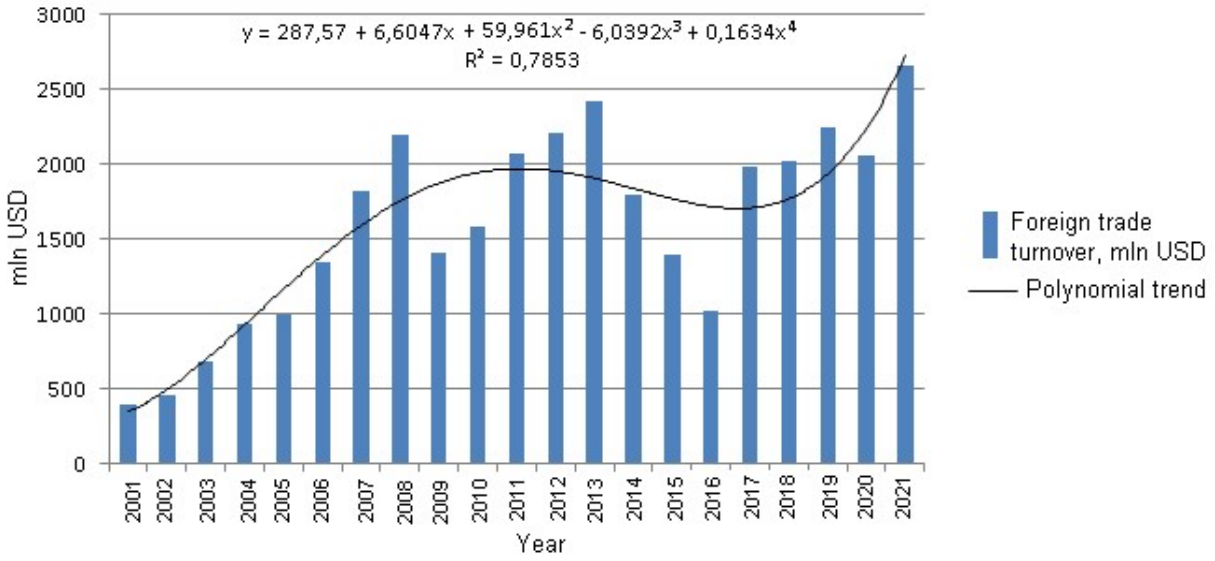

Figure 1. The dynamic trend of Ukrainian-French trade from 2001 to 2021.

The volume of interstate trade in goods increased by 29.2% in 2021 compared to 2020, reaching the amount of US$2,661.4 million. This was the most important indicator in bilateral trade in goods between the two countries during Ukraine's independence. France ranked 14th among all trading partners in 2021 (1.89% of Ukraine's total trade turnover). The increase in goods turnover was caused by an increase in bilateral goods exports (+51.3%) and imports (+27.5%), resulting in a positive trend for Ukraine in bilateral trade with France in 2021 (State Statistics Service of Ukraine, 2022b). Ukrainian export volumes to France grew mainly due to a significant increase in world market prices for key Ukrainian export food and metallurgical products. Export shipments to France remained essentially at the same level as Ukraine's shipments to neighbouring Moldova, but increased slightly above shipments to Bulgaria. This was due to the imperfect commodity structure of Ukrainian exports and unstable global commodity prices, which prevented growing sales of Ukrainian goods (Kramar, 2021).

According to the Ukrainian State Statistics Service, France ranked 19th in the world in terms of Ukrainian goods exports to global markets in 2021 (1.32% of total Ukrainian exports). However, the volume of Ukrainian goods on the French market is quite low, and France's position in Ukrainian goods imports has shifted in recent years. If in 2017 France had a share of 3.15% (9th among all countries), in 2021 it will have a share of 2.42% (10th among countries in the world). It should be noted that Ukraine's foreign trade relations with the rest of the world, and with France in particular, have changed dramatically since the start of Russia's military aggression against Ukraine on 24 February 2022. Further statistical analysis of the dynamics of Ukrainian trade relations with the rest of the world could not be carried out in depth, as the trade statistics of 2022 are currently not allowed to be disseminated in accordance with the Ukrainian Law on Protection of Interests of Reporting Entities and Other Documents during Martial Law or State of War (Verkhovna Rada of Ukraine, 2022).

Recently, there have been some positive changes in the commodity structure of Ukrainian exports to France. Mainly foodstuffs and raw materials with low added value dominate the structure of Ukrainian exports. These include animal or vegetable fats and oils (22.1% of all commodity exports to France in 2021), oilseeds and fruits (18.7%), food industry residues and wastes (9.8%), ferrous metals (7.2%), wood and wood products (5.4%), fertilisers (3.5%), edible fruits and nuts (3.3%) and electrical machinery (3.2%). In 2021, these eight major product groups accounted for 73.2% of the market (State Statistics Service of Ukraine, 2022a). According to the 2021 results, the value of Ukraine's main commodity exports such as clothing and clothing accessories (-29.1%) and food industry residues and wastes (-19.3%) decreased compared to 2020. At the same time, positive dynamics were observed in other trade items compared to 2020: Ferrous metals (increase by 3.6 times), ores, slags and ashes (+70%), fats and oils of animal or vegetable origin (+69.6%), products of ferrous metals (+67.1%), electrical machinery (+63.3%), seeds and fruits of oil plants (+62.3%), etc. Export shipments of Ukrainian goods to France increased by 11.3 times compared to 2020, cereals by 10.2 times, watches by 12.2 times, etc. (State Statistics Service of Ukraine, 2022a).

At the same time, high-tech and high-value products dominated the structure of French commodity imports to Ukraine. Chemical products were predominant in 2021 (14.5% of the total import value), as were vehicles for land transport other than railways (12.1%), pharmaceutical products (10.8%), reactors, nuclear boilers and machinery (8.4%), essential oils (8.4%) and electrical machinery (4.2%) (State Statistics Service of Ukraine, 2022a).

Thus, following the entry into force of the EU-Ukraine Free Trade Agreement in 2016, there was a noticeable intensification of trade relations between Ukraine and France, as well as structural changes in the export and import of goods. This is in line with the results of analyses of the development of trade relations between the countries of Central Europe, Eastern Europe, the Western Balkans and the EU during the period before EU accession, as presented in the works of Baldwin та ін. (1997), Mann (2015), Montanari (2005), Nuroğlu and Kurtagic (2012), Schuller (2002) and others.

The geographical structure of international trade between Ukraine and France is characterised by significant spatial differentiation, large differences in trade turnover, exports and imports, and disparities in the development of Ukrainian-French interregional cooperation. This is mainly

due to the participation of predominantly economically developed regions and border regions of Ukraine in the exchange of goods, as well as the negative foreign trade balance in goods, low investment activity and inefficient commodity export structure of Ukrainian regions.

The turnover of Ukrainian regions with France is characterised by a direct dependence of the value of Ukrainian regional export-import flows on their gross regional product volume (the correlation coefficient of the pair is 0.93, t_{st} = 12.13; $t_{23;\,0.05}$ = 2.07). In 2017–2021, Kyiv recorded the highest average volume of trade turnover with France (US$1,136.5 million or 51.8% of total trade turnover between Ukraine and France). The regions of Kyiv, Dnipropetrovsk, Lviv, Donetsk and Volhynia had a significantly lower average volume of trade with France (US$50–170 million) (Table 1). The regions with the lowest average trade turnover with France were Chernivtsi, Kherson, Kirovohrad, Zhytomyr, Transcarpathia, Sumy, Ternopil and Chernihiv (between 5.0 and 20 million US dollars) (Fig. 2).

Table 1. Commodity trading indicators between Ukrainian regions and France, annual averages for 2017–2021.

Region	Export of goods, USD million	Import of goods, USD million	Balance, USD million	Turnover, USD million	Trade balance coefficient	Trade connectivity coefficient
Cherkasy	9,585	13,700	-4,115	23,286	-0,367	0,506
Chernihiv	7,519	4,300	3,218	11,819	0,228	0,861
Chernivtsi	2,847	2,305	0,542	5,152	0,134	1,175
Dnipropetrovsk	51,717	90,586	-38,869	142,303	-0,329	0,319
Donetsk	29,235	15,261	13,974	44,496	0,234	0,675
Ivano-Frankivsk	10,441	10,525	-0,084	20,965	-0,016	0,905
Kharkiv	11,436	19,664	-8,228	31,100	-0,298	0,761
Kherson	3,853	1,507	2,346	5,360	0,244	2,244
Khmelnytskyi	11,458	11,223	0,235	22,681	-0,064	0,731
Kirovohrad	9,026	7,391	1,635	16,417	-0,013	0,399
Kyiv	30,129	142,750	-112,622	172,879	-0,662	0,437
Luhansk	13,867	10,045	3,822	23,912	0,162	2,067
Lviv	27,538	34,766	-7,228	62,304	-0,169	1,131
Mykolaiv	38,290	12,118	26,173	50,408	0,421	1,456
Odesa	20,736	22,702	-1,966	43,438	-0,046	1,086
Poltava	4,481	35,106	-30,625	39,586	-0,784	0,075
Rivne	26,901	10,244	16,656	37,145	0,423	2,163
Sumy	7,542	6,800	0,742	14,342	-0,021	0,862
Ternopil	6,367	9,731	-3,364	16,099	-0,333	0,525
Transcarpathian	10,468	9,073	1,395	19,542	0,062	1,142
Vinnytsia	17,152	6,363	10,789	23,515	0,436	1,219
Volyn	10,913	39,847	-28,934	50,760	-0,568	0,562
Zaporizhzhia	17,933	24,542	-6,609	42,475	-0,154	0,367
Zhytomyr	6,152	6,705	-0,553	12,858	-0,042	0,813
Kyiv city	223,817	912,643	-688,825	1136,460	-0,608	0,507
Ukraine	608,419	1585,917	-977,499	2194,336	-0,454	0,435

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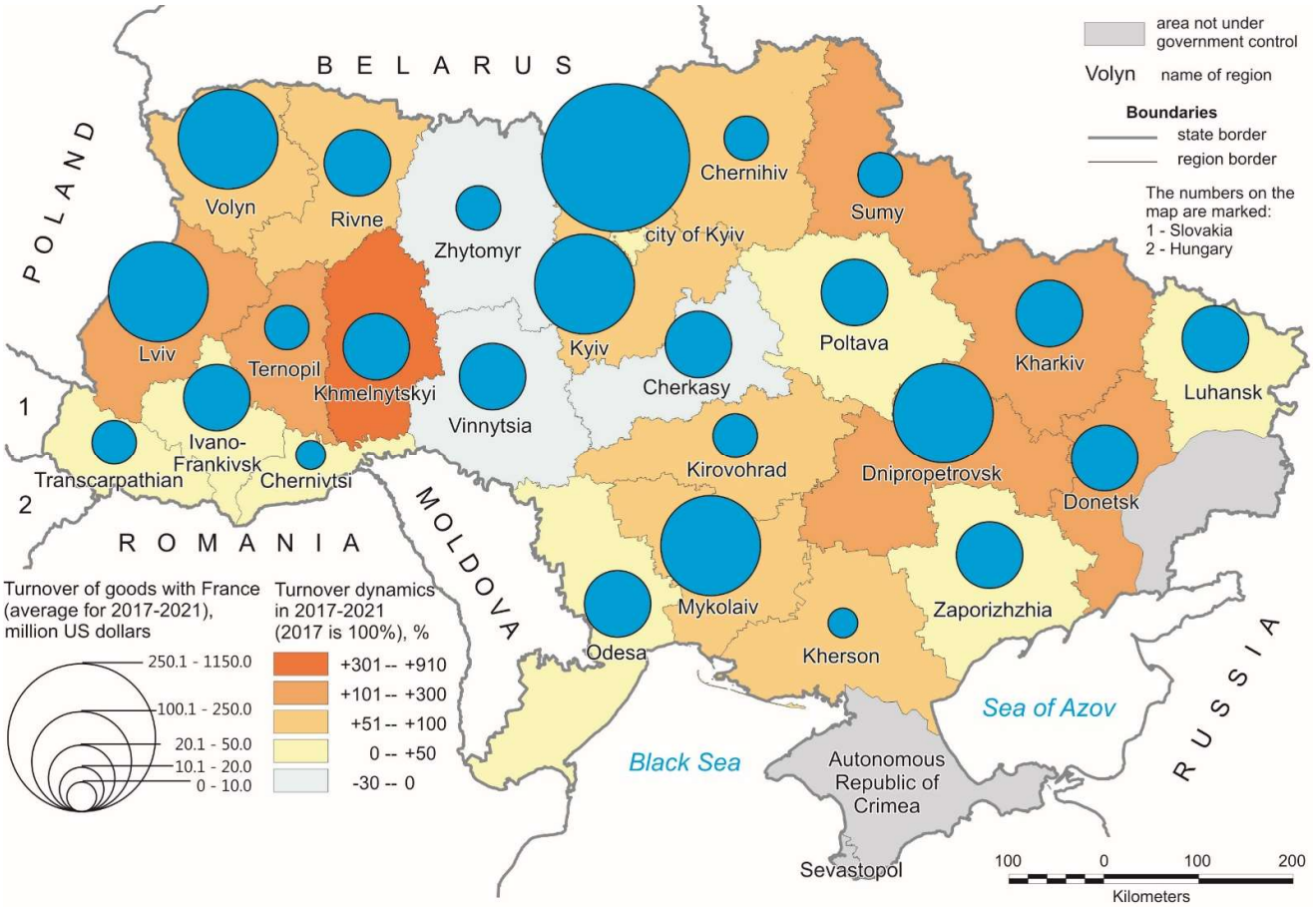

Figure 2. Spatial differentiation of the turnover between Ukrainian regions and France.

After 2016, there was an increase in trade with France in 22 Ukrainian regions. The largest increase is typical for the regions with advanced socio-economic growth. (Lviv, Kyiv, Donetsk, Dnipropetrovsk and Kyiv regions). During the study period, only three regions (Vinnytsia, Zhytomyr and Cherkasy) reduced total trade with France. (Fig. 2).

The French share of total trade in Ukrainian regions changed between 2017 and 2021. While France's share increased in 14 regions, it decreased in 11 regions, leading to a decrease in France's share of total trade turnover. France increased its share of trade turnover in Khmelnytskyi (by 1.22%), Ternopil (by 1.04%) and Luhansk (by 0.95%). In the regions of Cherkasy (-0.80%), Zhytomyr (-0.42%) and Kyiv (-0.47%), the decline in this indicator was the strongest.

The geographical structure of Ukrainian goods exports to France is characterised by disparity and regional differentiation, with the western and border regions spatially predominating (Fig. 3). Kyiv city (US$223.8 million), Dnipropetrovsk (57.9), Mykolaiv (38.7), Kyiv (30.1), Donetsk (29.2), Lviv (27.5) and Rivne (26.9) regions lead in terms of average total merchandise exports to France in 2017–2021. Luhansk (8.18%), Rivne (5.45%), Mykolaiv (1.68%), Khmelnytskyi (1.61%), Volyn (1.52%) and Kyiv (1.87%) regions had the highest total volume of export shipments to countries around the world (Figure 3).

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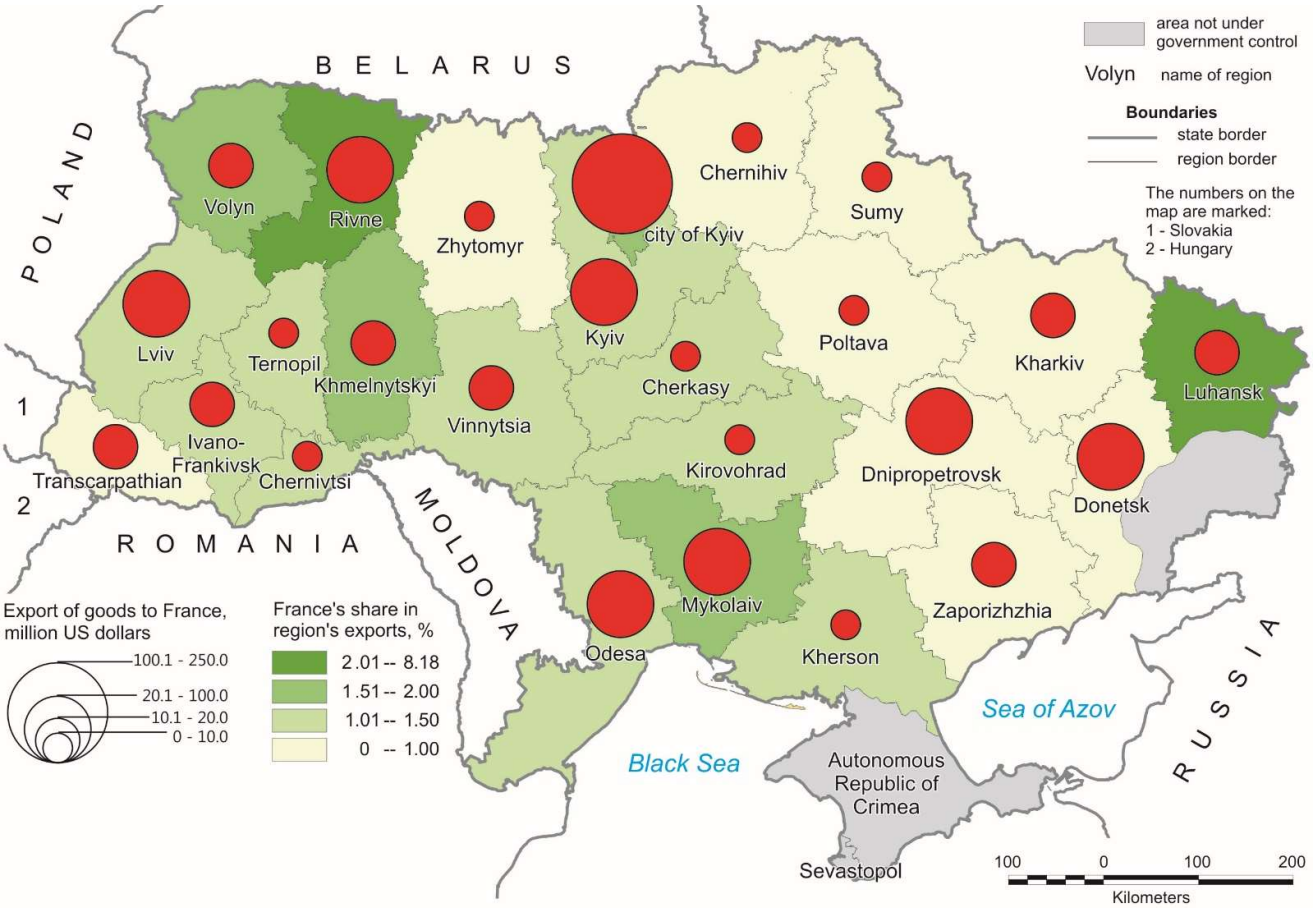

Figure 3. Exports of Ukrainian goods to France: regional differentiation (annual average for 2017–2021).

Nine Ukrainian regions exported goods to France in volume which wasworth less than US$10 million US dollarsto France in 2017–2021 (Chernivtsi, Poltava, CherkasyCherkassy, Sumy, Ternopil, Chernihiv, Kirovohrad, Zhytomyr, and Kherson regions) (Fig.Figure 3). These are the Ukrainian regions that are primarilymainly specialised in the export of agricultural and food industry exportsproducts. In Poltava (0.20%) France has a low and Zaporizhzhia (0.52%) regions, the share of France in the total volume of regional commodity exports of goods to all countries aroundof the world in Poltavais small (0.20%) and Zaporizhzhia (0.52%) regions (Fig. 3). The coefficient of pair the pairwise correlation between the production volume of the gross regional product production volumes andand commodity export commodity deliveries to France is 0.94 (t_{st} = 13.21; $t_{23;\,0.05}$ = 2.07). This shows the direct dependence of commodity export deliveries on the volume and structure of the production of marketable products in the Ukrainian regions.

Twenty Ukrainian regions stand out for an increase in goods exports to France between 2017 and 2021, as France's share increased significantly. This is in line with the general trend in interstate merchandise exports. In particular, France's share of goods export to Luhansk, Ternopil, Rivne, Khmelnytskyi and Kyiv regions increased. At the same time, only in Vinnytsia, Cherkassy and Kirovohrad regions, as well as in Kyiv, the share of France' in total merchandise exports decreased in 2021 compared to 2017 (Fig. 3).

The geographical structure of French merchandise imports to Ukraine is also characterised by considerable variability and disproportion (Fig. 4). The dominance of the most developed regions is visible in the spatial distribution. For example, in 2017–2021, the city of Kyiv (US$912.6 million or 57.5% of the average total value of French goods imports to Ukraine) and the Kyiv, Dnipropetrovsk, Volyn, Lviv and Poltava regions were in the lead (Table 1, Fig. 4). Luhansk (3.93%), Kyiv (3.40%), Kirovohrad (2.91%) and Kyiv city (3.71%) regions had the highest share of French goods in global import flows from all countries. On average, insignificant volumes of French import shipments (less than US$5 million) went to Kherson, Chernivtsi and Chernihiv regions in 2017-2021. During this period, the share of French imports in total imports was lowest in Kherson (0.52%), Transcarpathian (0.62%) and Donetsk (0.78%) regions (Figure 4). This is mainly due to the agricultural specialisation of these economies and the limited demand for high-value, technologically sophisticated French goods.

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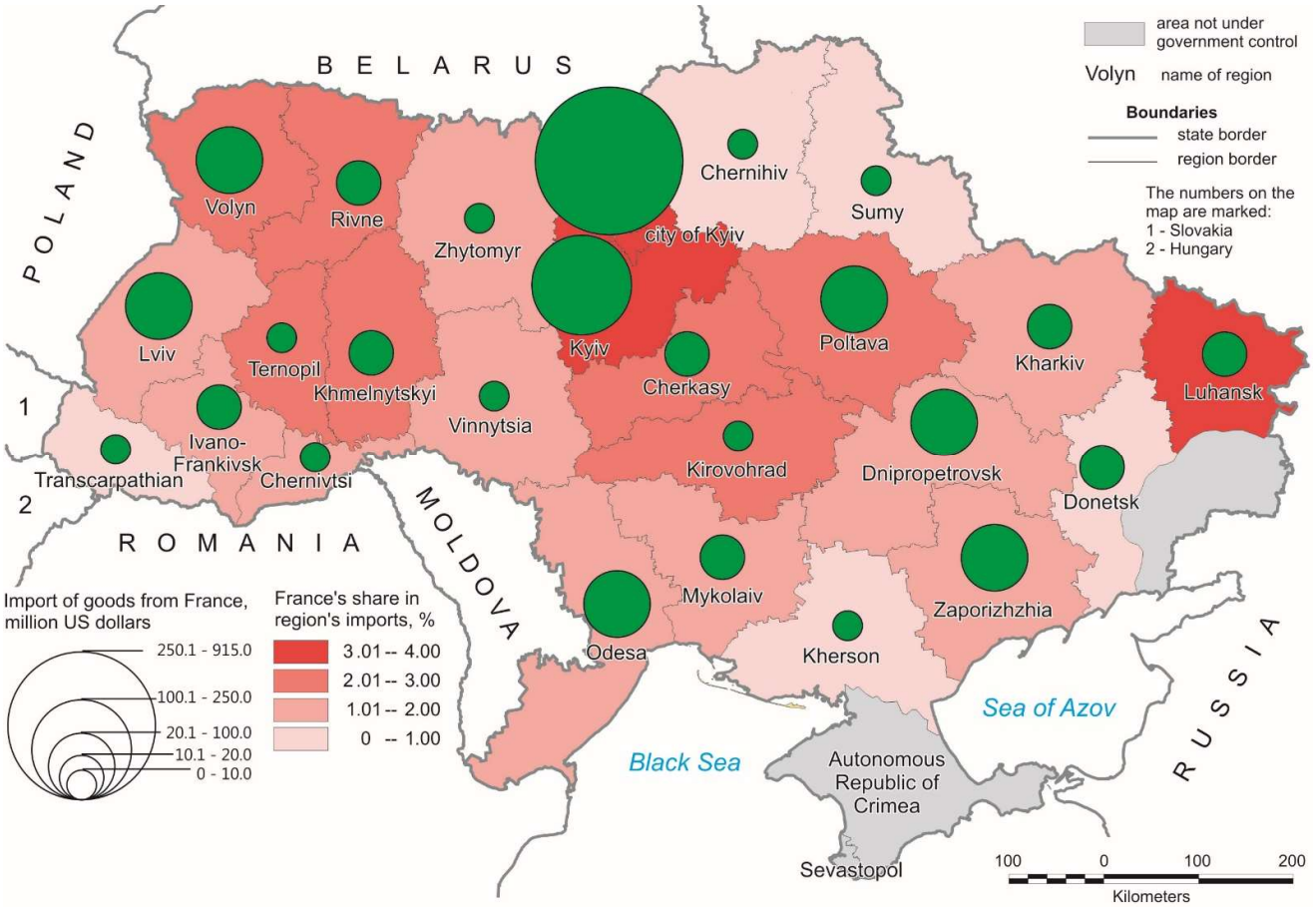

Figure 4. Imports of French goods to Ukraine: regional differentiation (annual average for 2017–2021).

During the period covered by the study, imports of French goods into Ukrainian regions increased slightly. The French share of imports increased only in eight regions, while in seventeen regions the volume of French imports decreased. In regions such as Cherkasy, Rivne, Zhytomyr, Zaporizhzhia and Mykolaiv, France's share decreased more in 2021 than in 2017. At the same time, in Khmelnytskyi, Dnipropetrovsk and Donetsk regions, France's share of imports increased from 2017 to 2021.

In 2017–2021, twelve regions of Ukraine (68%) had a positive average trade balance with France. Mykolaiv region had the highest average positive trade balance with France (+US$26.2 million). Rivne (+16.7 million US dollars) and Donetsk (+14.0) regions had significantly lower average trade surpluses. At the same time, this value is less than 10 million US dollars in 10 regions. The city of Kyiv (the main importer of French goods) had the most negative average trade balance (-US$688.8 million). It was also larger in Kyiv (-US$ 112.6 million), Dnipropetrovsk (-US$ 38.9), Poltava (-US$ 30.5) and Volyn (-US$ 28.9) regions (Table 1). The negative trade balance (deficit) in these and other regions is related to the concentration of logistics centres in the big cities (Kyiv, Dnipro, Lviv, Odesa, Poltava, etc.) and the way imported goods are distributed among the regions. The volume of regional trade is also highly dependent on the volume of the regions' gross regional product (pair correlation coefficient R is 0.93 (t_{st} = 12.13; $t_{23;\,0.05}$ = 2.07) and the available income of the population per person (R is 0.90 (t_{st} = 9.90; $t_{23;\,0.05}$ = 2.07).

The calculations of the balance coefficient of bilateral trade in goods (Kzb_i) in the context of Ukraine's regions showed that foreign trade with France was most balanced in 11 regions, while it was very unbalanced in four others (Fig. 5). At the same time, the average balance ratio of interstate trade in goods between Ukraine and France in 2017-2021 was -0.454, reflecting the overall negative trade balance in bilateral trade with a general upward trend for Ukraine. In 2017–2021, commodity trade with French trading partners was most balanced in the Transcarpathian (Kzb_i = 0.062) and Chernivtsi (Kzb_i = 0.134) regions, with exports slightly exceeding imports. In the regions of Zhytomyr (Kzb_i = -0.043), Odesa (Kzb_i = -0.046) and Kirovohrad (Kzb_i = -0.013), imports slightly exceeded exports (Fig. 5, Table 1). This means that the spatial differentiation of the balance coefficient of regional trade in goods with France is less pronounced, both in the indicators and in the shares of export and import flows of goods.

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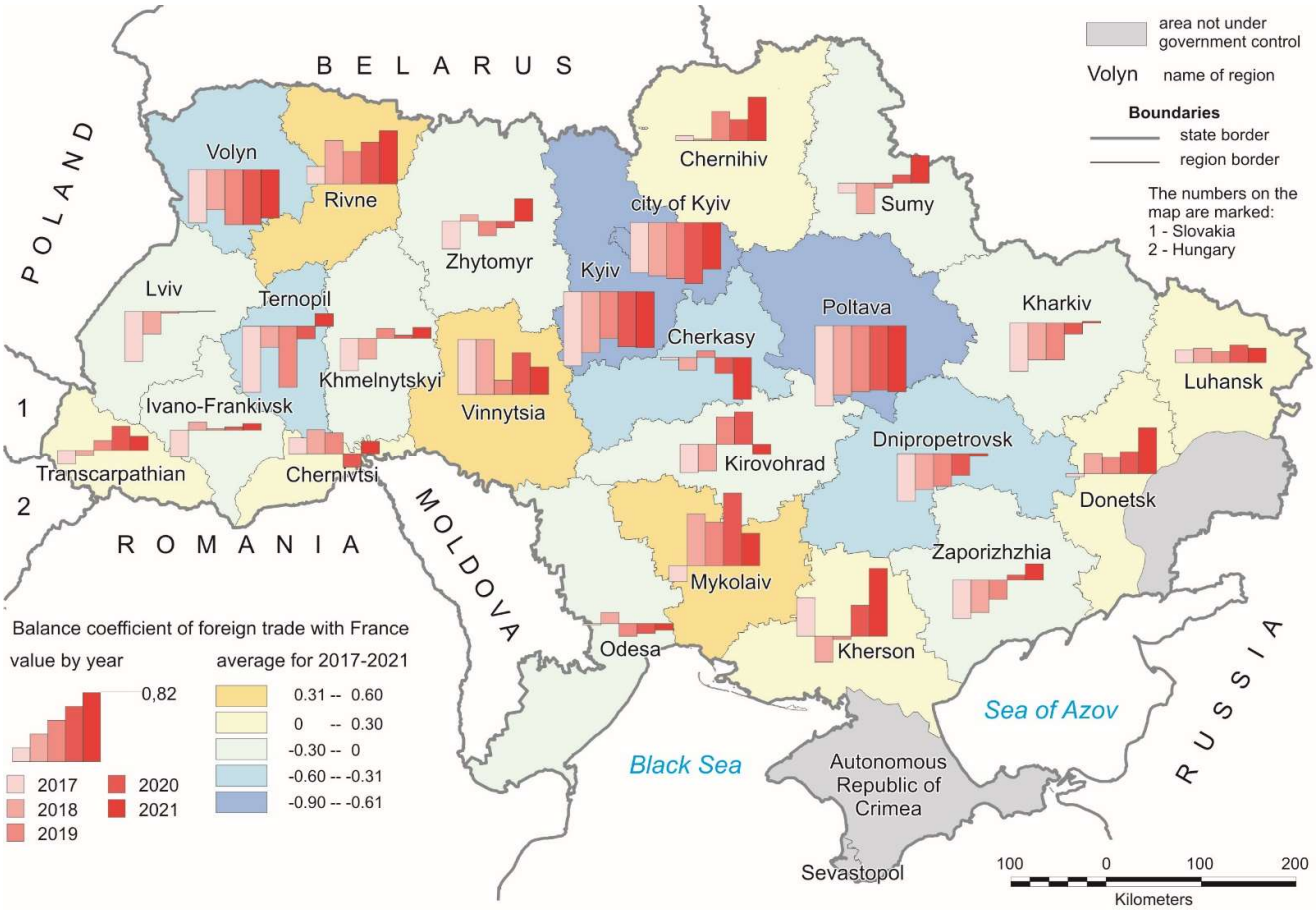

Figure 5. Foreign trade of Ukrainian regions with France: spatial differentiation of the balance coefficient.

External trade in goods with France is the most unbalanced, with exports exceeding imports in Vinnytsia (Kzb_i = 0.436), Rivne (Kzb_i = 0.423) and Mykolaiv (Kzb_i = 0.421) regions (Figure 5). At the same time, imports of goods exceeded exports in Poltava (Kzb_i = -0.784), Kyiv (Kzb_i = -0.662), Volyn (Kzbi = -0.568) and Kyiv City regions with Kzb_i = -0.608 (Fig. 5). In 2017—2021, the balance coefficient of trade in goods in Donetsk, Zhytomyr, Zakarpattia, Transcarpathia, Ivano-Frankivsk, Lviv, Mykolaiv, Sumy, Ternopil, Kharkiv and Khmelnytskyi regions shifted from a negative to a positive value (Fig. 5).

According to the results of the calculation of the coefficient of connectivity of trade flows (Kzv) between the regions of Ukraine and France using formula (2), nine regions of Ukraine have a high level of interconnectivity in bilateral commodity trade, as the value of the coefficient Kzv is above 1.0 (Table 1, Fig. 6). At the same time, the average connectivity coefficient of interstate commodity trade between Ukraine and France is low (Kzb_i = 0.435). As for the connectivity coefficient in commodity trade with France, the western and border regions of Ukraine dominate in terms of spatial distribution. Similarly, the central Ukrainian regions have limited trade connectivity with France (Fig. 6).

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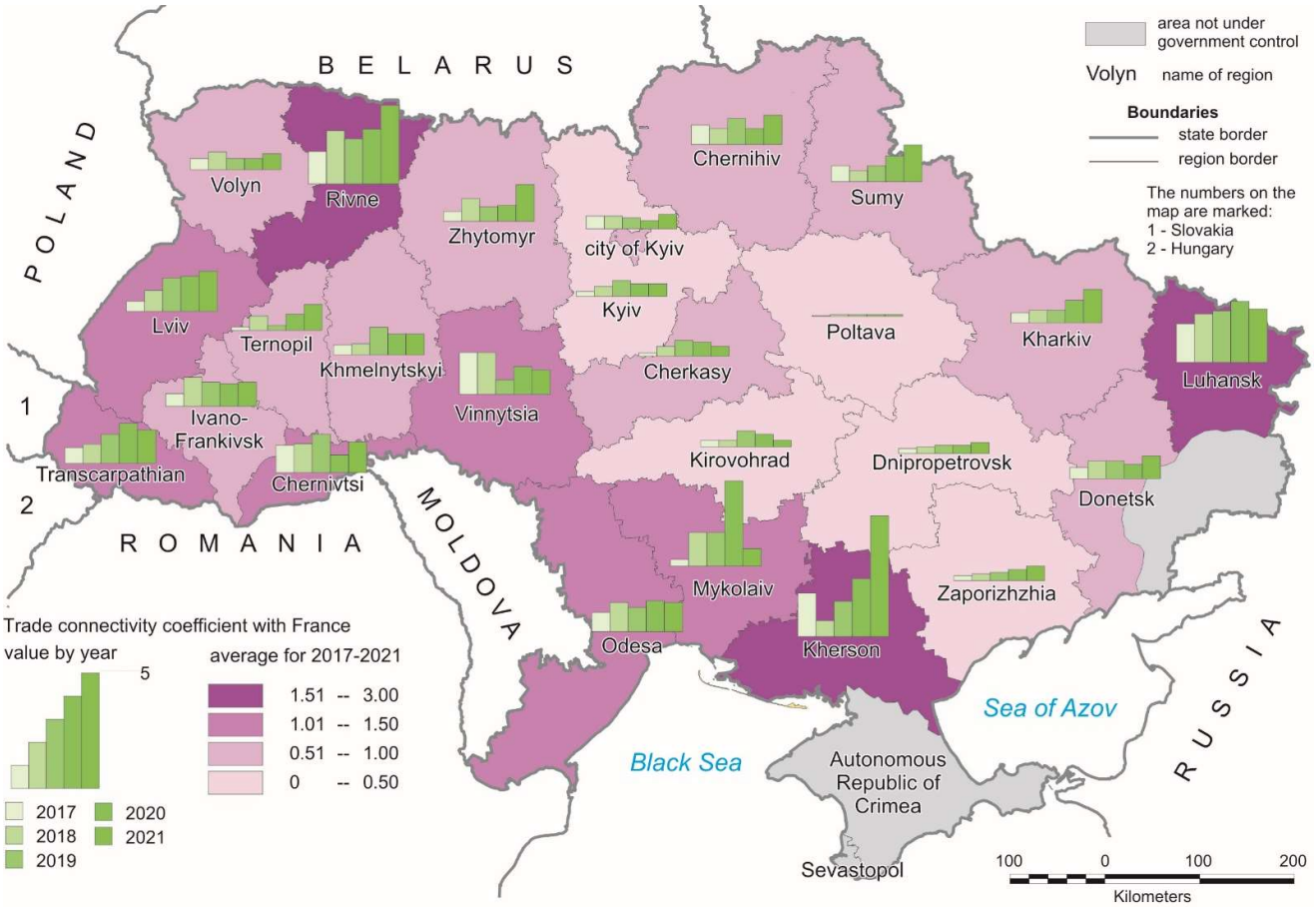

Figure 6. Foreign trade of Ukrainian regions with France: spatial differentiation of the trade connectivity coefficient.

Kherson (Kzv = 2.24), Rivne (Kzv = 2.16) and Luhansk (Kzv = 2.07) regions had the highest average trade connectivity ratios in 2017–2021 (Figure 6). This is due to the fact that exports of engineering, chemical and food products from these regions to France exceed imports of French goods from these regions. At the same time, the Kzv connectivity coefficient in the Zhytomyr, Ivano-Frankivsk and Sumy regions is close to one (from 0.81 to 1.00), indicating balanced trade in goods (Table 1). The regions with the lowest coefficients for the goods trade link with France (Kzv below 0.50) are Poltava (Kzv = 0.08), Dnipropetrovsk (Kzv = 0.32), Kirovohrad (Kzv = 0.40) and Zaporizhzhia (Kzv = 0.38) (Figure 6). They import far more French goods than they export to France. With the exception of Vinnytsia and Kirovohrad, the degree of merchandise trade linkages with France increased significantly over the period. Kherson, Rivne, Lviv, Zhytomyr and Kharkiv regions recorded the largest increase in the value of trade linkage coefficients Kzv (above 1.0). (Fig. 6). This has also led to increased connectivity of interstate trade. For example, the connectivity coefficient in trade in goods between Ukraine and France increased from 0.31 in 2017 to 0.54 in 2021.

Based on a comparison of the connectivity coefficients for bilateral trade with the balance coefficients, it is advisable to identify the different types of regions in Ukraine according to the specifics of the dominance of certain commodity flows in bilateral trade. This approach is valid because the pair correlation coefficient between the two coefficients is 0.74 (t_{st} = 5.28; $t_{23;\ 0.05}$ = 2.07). The following characteristics distinguish Ukrainian regions based on the nature of commodity trade with France: 1) the region's dependence on exports and imports from France; 2) France's dependence on export and import supplies of goods from the region; and 3) no trade dependence on the part of the region or France.

The *first type of Ukrainian regions* is characterised by a high dependence on the supply of goods to France, while France relies on these regions for the import of certain raw materials. In this group of regions, the connectivity coefficient of trade relations with France is significantly higher than 1.0. (Table 1). This category includes the following four regions: Rivne, Vinnytsia, Kherson and Mykolaiv, which are heavily dependent on exports to France and have significantly unbalanced trade with France (Kzb above 0.20).

The *second type of regions in Ukraine* consists of three regions that have a sufficient level of commodity trade links with France, with balanced trade and a slight preponderance of commodity exports over import flows from France. The Transcarpathian, Luhansk and Chernivtsi regions belong to this category.

The Odesa and Lviv regions represent the *third type of regions*, characterised by not being significantly dependent on trade with France. In particular, the Odesa region has low trade connectivity with an average coefficient of Kzv = 1.07 and balanced trade in goods (Kzb = -0.05), with import transactions slightly outweighing export transactions in bilateral trade. The connectivity coefficient for commodity trade in the Lviv region is 1.31, with exports of French goods to the region's commodity markets being more pronounced with Kzb = -0.17 (Table 1).

Ukrainian regions with a commodity trade connectivity coefficient of less than 1.0 (one) are divided into different types based on the ratio of export-import flows in trade with France and the average volume of exports and imports to other partner countries. For example, the Donetsk and Chernihiv regions (the *fourth type of regions*) are heavily dependent on goods deliveries to French commodity markets, which leads to a

significant imbalance in mutual trade. The average coefficient of trade relations with France ranges from 0.68 (in Donetsk region) to 0.86 (in Chernihiv region). At the same time, the Dnipropetrovsk, Volyn, Kyiv, Poltava, Kharkiv, Ternopil and Cherkassy regions, as well as the city of Kyiv, form the *fifth type of regions* characterised by an unstable nature of trade relations with France, a significant imbalance in trade turnover and the dominance of French import expansion with Kzbi ranging from -0.33 to -0.78 (Table 1). The *sixth type of regions* is characterised by low commodity connectivity and insignificant differences in the level of the balance of bilateral commodity transactions, with imports of French goods insignificantly outweighing exports to France (Sumy, Kirovohrad, Zhytomyr, Ivano-Frankivsk, Khmelnytskyi, Zaporizhzhia regions) (Table 1).

Examination of the results in relation to the typology of Ukrainian regions based on the nature of trade in goods with France shows that the majority of regions depend both on exporting their goods to the French market and on receiving French high-tech goods. In particular, Ukrainian regions with a high level of socio-economic development are dependent on the volume of goods exported to France. At the same time, regions with a lower level of industrial development and a focus on agricultural products are dependent on the import of French high-tech products.

Overall, the dynamics of trade and economic cooperation between Ukraine and France have accelerated recently. An examination of export-import transactions between the two countries' markets shows an increase in the volume of exported and imported goods. The French market is attractive for most Ukrainian regions. A large variability, disproportion, and imbalance in the volumes of exports and imports of goods are clearly manifested in the spatial differentiation of Ukrainian trade with France, with its high level of trade connectivity in Ukrainian regions. The pair correlation coefficient between the volume of trade with France and the gross regional product of Ukrainian regions is 0.93 (t_{st} = 12.13; $t_{23;\,0.05}$ = 2.07), which illustrates this dependence. At the same time, the correlation coefficient between GDP and export shipments to France is 0.94 (t_{st} = 13.21; $t_{23;\,0.05}$ = 2.07). There is also a direct relationship between the volume of imported French goods and the volume of gross regional product produced in each Ukrainian region. The correlation coefficient for these two indicators is 0.93 (t_{st} = 12.13; $t_{23;\,0.05}$ = 2.08). In general, a positive tendency has developed for more Ukrainian regions to have a favourable trade balance and a surplus in trade in goods with France (7 regions in 2017 and 17 regions in 2021), although the country's overall trade balance with France is negative. This indicates that most regional economies are heavily dependent on goods exports to France.

At the same time, the dynamics and structure of Ukraine's external economic relations are undergoing significant changes as a result of the large-scale Russian aggression that began on 24 February 2022. According to preliminary data from the Ukrainian State Statistics Service, the total volume of foreign trade in goods decreased significantly in the first ten months of 2022, while import shipments of military and defence equipment increased. This calls for a more thorough scientific investigation.

6. Conclusions and Discussion

In summary, the regionalisation of trade flows reflects the rapid growth of interaction between the economies of countries that are increasingly integrated within the framework of interregional organisations and are geographically close to each other. Russia's aggression against Ukraine, which began in 2014, is leading to functional changes on the EU's eastern borders as well as a reorientation of Ukraine's foreign trade relations towards EU countries (Epasto, 2016). The favourable dynamics in trade in goods between Ukrainian regions and France since 2016 has developed due to two important factors. The first is the lifting of EU trade restrictions on Ukrainian exports. The second reason is the favourable situation on foreign markets, which serves as a basis for Ukrainian exports and imports. This allowed Ukrainian products to compete on equal terms with those of EU countries, which led to an increase in exports to France.

The volume of trade with France has increased in 22 Ukrainian regions following the entry into force of the FTA on 1 January 2016. The sharpest increase is typical for regions with advanced socio-economic growth (the regions of Lviv, Kyiv, Donetsk, Dnipropetrovsk and the city of Kyiv). Over the course of the study, only three regions (Vinnytsia, Zhytomyr and Cherkasy) decreased the total volume of trade with France. France's share of total trade turnover has also increased, especially for exports to most Ukrainian regions. This shows the impact of trade creation and confirms the first hypothesis about the strengthening and intensification of trade relations between the regions and France. It is also consistent with the findings of Baldwin at al. (1997), Mann (2015), Montanari (2005) and others, who find favourable changes in the trade of the East-Central European and Western Balkan countries with the EU before their accession to this organisation.

In general, our second hypothesis is partly validated. This is reflected in the high annual average values of the trade connectivity indicator, which are mainly found in more developed regions. This assertion is also supported by the figures of the even correlation coefficients. Thus, the pair correlation coefficient R between average yearly trade volumes with France in 2017-2021 and gross regional product per capita in Ukrainian regions is 0.92 (t_{st} = 10.26; $t_{23;\,0.05}$ = 2.07). There is also a strong relationship between the volume of trade with France and the per capita income of the population (R = 0.90; t_{st} = 9.90; $t_{23;\,0.05}$ = 2.07), and a moderate relationship between trade and the volume of industrial products sold in the regions (R = 0.52; t_{st} = 2.92; $t_{23;\,0.05}$ = 2.07).

Trade in goods between Ukraine and France is highly differentiated regionally, with significant differences and asymmetries in the parameters of bilateral foreign trade activities. Most regions of Ukraine continue to export primarily agricultural raw materials and foodstuffs to France, while relying on imports of high-tech industrial products. Most Ukrainian regions give higher priority to foreign trade than France, as the latter has a more diverse commodity and geographical structure of foreign trade, targeting EU members and French-speaking countries.

UkraineUkrainian-FranceFrench trade is characterised by a spatial asymmetry in interregional collaborationcooperation. The effect of V. Tobler's first geographical law of geography ("Everything is related to everything else, but near things are more strongly related than distantfar things") (Tobler, 1970) is obviously traceableevident in the regional differentiation of Ukrainian regions' trade with France. This supports our third hypothesis regarding the degree of economic connectivity between Ukraine's regions and France. Especially the western border regions of Ukraine are more involved in trade with France. They are characterised by a higher volume of goods exports and imports as well as high values of the trade linkage coefficient. This is due to the shorter geographical distance between these regions and France, the favourable transit conditions, the geographical location on the border and the existence of a dense road and rail network for export-import transport. This is also consistent with the results of other similar studies, which state that Poland's border regions lead in Polish goods exports to neighbouring countries, including Ukraine (Komornicki, 2010). Moreover, this theory is consistent with the claims of Ikonomou (2011), Mackowiak (2011), Montanari (2005), Nuroğlu and Kurtagic (2012) and others regarding the importance of geographical distance for the increase in trade flows.

Obviously, it is clear that at the current stage of the Ukrainian economic development, in the context of Russian military aggression, commodity trading volumes, commoditiesthe volume of commodity trade, goods and geographical structure are changing significantly, with an emphasisa focus on the supply of French strategic and military goods. The dynamics and structure of Ukraine and its regions relative to foreign in terms of external economic relations with the rest of the world are undergoing significant transformations. As a matter of factIndeed, France

remains an important strategic trading partner for Ukraine. It is important to continue working on close cooperation in order to intensify bilateral trade after the end of the Russian-Ukrainian war. This also requires a more thorough scientific investigation.

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