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Determinants of export activities in Ukrainian regions in the pre-conflict and the first-stage conflict periods

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ABSTRACT

Objective: The article aims to explore the impact of main factors on the export dynamics of Ukrainian regions in the pre-conflict and conflict periods.

Research Design & Methods: The article investigates the relationship between the regional export performance and main factors influencing its development in Ukraine, based on regional data of the State Statistics Service of Ukraine and the National Bank of Ukraine for 2003-2019. The article focuses on the analysis of export dynamics in Ukraine. Moreover, the analysis investigated the impact of the war conflict on the export development, which was estimated as the change in the level of export. It was evaluated using the differential intercept dummy variable, as well as the change in the slope coefficient, the extent and significance of which were assessed employing slope dummy variables for every explanatory factor. The analysis was performed for coastal, non-coastal regions, and the country level separately. The modelling procedure included all standard methods for panel data analysis. Based on its results, the one-way fixed effects model was selected as the most suitable for the performed analysis.

Findings: The obtained results confirmed that the export dynamics in coastal and non-coastal regions was affected by the spread of the war conflict to a different extent. This was expected due to the closer location of coastal regions to the war zone. This disparity was especially seen because of significantly different relationships between exports and imports in coastal and non-coastal regions, which deepened even further during the conflict period. Another interesting finding was the decrease of the production's influence on exports in coastal regions in the conflict period, which was strongly linked with the spread of the conflict.

Implications & Recommendations: We suggest that the decline of the industry's impact on export trade was a consequence of the war in Ukraine. Thus, new priorities should be identified in terms of the development of Ukrainian industry to minimize the negative influence of the conflict on this economic sector, enhance the quality of manufactured goods, and improve the access of the country's companies to international markets. In this context, it is important to continue Ukraine's further integration with the European Union and to deepen industrial cooperation with the EU, the USA, and other countries. Taking into account the existing situation in the country, the mechanism for attraction of foreign direct investment should be also improved.

Contribution & Value Added: The novelty of our article is that the influence of industry on exports of Ukrainian regions was investigated, considering coastal and non-coastal regions in the pre-conflict and conflict periods separately. The article contributes to the development of the theory and practice, because it enhances the understanding of how the conflict impacts relationship between the selected determinants and regional export activities. The change of the export dynamics in coastal and non-coastal regions can be used as the case study for comparison of regions which are more (coastal) and less (non-coastal) affected by the war conflict.

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INTRODUCTION

Industry plays an important role in the economic development of Ukraine. It satisfies country's needs in raw materials and finished products, creates job positions for local residents, and provides a significant share of the country's export earnings. In regard to industry, the following activities were considered in our research: (i) mining and quarrying, (ii) manufacturing, and (iii) electricity, gas, steam, and air conditioning supply.

Russia launched its military aggression against Ukraine in 2014. It annexed Crimea and occupied parts of Donetsk and Luhansk oblasts. Since February 2022, Russia has started a full-scale war in the country. It caused the significant damage to the Ukrainian population and economy, including the industrial sector (Vasyltsiv *et al.,* 2022; Fiszeder & Małecka, 2022). Therefore, the important task is the recovery of this economic sector with the maintenance of existing export channels and expansion to new markets. Thus, it is necessary to adapt the industry to existing economic conditions.

There is a lack of publications on the effect of industry, foreign direct investment (FDI), or other factors on the export performance of Ukrainian regions. Moreover, it is important to investigate how the war conflict influences relationship between the chosen determinants and regional export activities. That is why we decided to prepare this article and explore the impact of selected indicators on export trade of Ukraine's regions. Two periods were examined: the pre-conflict period (2003-2013) and the conflict period (2014-2019). Furthermore, we evaluated how the location proximity of Ukrainian oblasts to seas and seaports affects export activities of regions. Due to this research direction, we explored two categories of oblasts, namely coastal regions and non-coastal regions. In our study, a 'coastal region' means a region, which borders the sea. Based on received results, we compared these two categories of regions and characterized the influence of location proximity on regional trade performance.

The novelty of our article is that the influence of the industry on export trade of Ukrainian regions was investigated considering coastal and non-coastal regions in the pre-conflict and conflict periods separately. The article contributes to the development of the theory and practice, because it enhances the understanding of how the war conflict impacts relationship between the selected determinants and regional export activities. In this field, there is a lack of studies devoted to Ukraine, because most of published articles focus on the conflict's impacts on other countries or groups of countries. This is especially the case for export and factors affecting it. Besides, all similar research articles investigate export trade only in peace conditions. The aim of the article was to explore the impact of main factors on export dynamics of Ukrainian regions in the pre-conflict and conflict periods. To estimate relationship and effects between export activities, their explanatory factors, and the war conflict, the panel model was estimated for coastal and non-coastal regions separately. The impact of conflict was included in the model as dummy variables.

The article is organized as follows: in the section literature, we will review contains publications related to the impact of the industrial sector on export activities of different countries, including Ukraine, as well as hypotheses development. In the section research methodology, we will describe the used data, variables, and statistical models. Main findings of our research will be presented in the section results and discussion. The section conclusions will present a general overview of obtained results, policy implications, research limitations, and suggestions for future research directions.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

There are various publications on the industrial sector and its impact on export activities at the national and regional levels. These studies were carried out for countries with different economic characteristics (Pini & Tchorek, 2022). For instance, Ndubuisi and Owusu (2022) explore the influence of trust, measured as the development of informal contracting institutions, on the export performance, using the industry-level data of 71 countries. Employing the generalized difference-in-difference method, it was discovered that countries with the higher trust levels have the significant rise of production and export of higher-quality product, compared to countries, which have insufficient informal institutions. Zhylinska *et al.*

(2020) investigate relationships between gross domestic product (GDP) per capita, manufacturing value added, and terms of trade adjustment, calculating their annual percentage growth in 51 countries with predominantly manufacturing exports. Using the vector autoregression model, positive interactions are found between these indicators. However, their levels differ substantially among the indicators.

Maciejewski and Wach (2019) estimate the impact of the intensity of production factors on the export structure of the EU countries. Based on the gravity model, the authors confirmed that trade liberalization and the development of high-tech industries have the positive effect on international trade of EU member states. Moreover, the authors revealed that the memberships in the EU and European Monetary Union are important for export trade activities. However, the research findings showed that resources of production factors do not affect the export structure of EU countries. Using the Bayesian model averaging framework, Bierut and Dybka (2021) examine factors that influence manufactures' exports in the EU countries. As a result of the study, the direct and indirect types of impact on export trade were revealed. The researchers argue that the main reason of export differences is connected with technological factors. Kordalska and Olczyk (2014) investigate how the export competitiveness is affected by the competitiveness of processing industries of EU countries, applying the spatial panel analysis. The research findings showed that the manufacturing sector has a substantial effect on EU export competitiveness. It also determined that factors which affect exports and the ratio of exports to imports are not the same, excluding foreign demand and unit labour costs.

Studnicka *et al.* (2019) consider how European regional trade agreements affect European export patterns. Utilizing a simple fixed effects estimation approach, the authors identified that the influence of these agreements on the total exports and intensive margin is mostly insignificant. Their effect was positive in the case of extensive margin only. At the same time, the authors identified that deeper trade agreements do not have the significant impact on European exports. Employing standard panel unit root tests, Stöllinger and Holzner (2017) studied the influence of state aid on manufacturing export competitiveness in the EU countries. The research results showed that, at least in the short-run, subsidies have a positive impact on value added exports of the manufacturing sector of EU-15. Though, this impact is not found for new EU Member states. Doulos *et al.* (2020) evaluated the effect of internal devaluation on industrial exports competitiveness, using as an example the state of trade relations between Greece and Portugal. Applying the export volume and export price equations, the authors found that the internal devaluation by itself is not a sufficient measure to promote exports and enhance competitiveness of Greek manufactured products on international markets. Moreover, the important factor is that compared with Greece, Portugal has a better business environment which stimulates the attraction of FDI and ensures the country's economic growth based on the development of export activities.

Stojčić *et al.* (2012) explore the approaches on export competitiveness of manufactured products from Slovenia and Croatia in the EU-15 market. Based on the dynamic panel analysis, the authors identified that these countries have different competitiveness patterns. While Slovenian manufactures focus on the quality of export products, Croatian producers still give attention to labour costs as the major trade factor. Under these circumstances, the growth possibilities of export activities are quite limited, especially for Croatia. Using the synthetic control method, Stojčić *et al.* (2018) analyse the impact of trade liberalization on export competitiveness of new member states of the European Union. It is identified that trade liberalization has a favourable impact on the countries' manufacturing export performance, structure, and quality (the few other studies confirmed the same results e.g. Vološin *et al.*, 2011; Svatoš & Smutka, 2012; Smutka *et al.*, 2015; Náglova *et al.*, 2017). Though, this influence is less significant for countries which received preferential access to EU markets later, including Slovenia and Croatia. Besides, its largest effect is seen for high technology-intensive industries. Salamaga (2020) investigate the effect of innovation on the export competitiveness of industries with different levels of technological development in Central and Eastern European countries, applying the dynamic panel models. The study results showed that while there is a significant positive impact of innovation on export competitiveness of industries with the high and medium-high technological levels, it is not found in industries with the low level of technological advancement.

Sato *et al.* (2020) propose the usage of the industry-specific real effective exchange rate to estimate export competitiveness of selected Asian countries. Based on the static common-correlated effects estimator and cross-sectionally augmented distributed lag estimator, the authors analyse the influence of real effective exchange rate appreciation on industrial exports. The obtained results confirmed the decline of unfavourable impact of real effective exchange rate on the countries' export performance. The authors argue that this situation could be linked to further development of global value chains and the strengthening of economic ties and regional integration between Asian economies. Using several statistical models (the system general methods of moments, ordinary least squares and three-stage least squares approaches), Fu *et al.* (2012) assess the impact of China's manufactured export on export prices from countries with the various levels of economic development. The researchers revealed the existence of close price competition between Chinese export products and traded products from middle-income countries, as well as between China and high-income countries in regard to low-technology products. At the same time, the authors confirmed that China's exports affect low-income countries in another way, namely: not through price competition, but through market expansion. The findings also showed that the growth of China's export competitiveness is observed in different types of markets because the country pays more attention not to price characteristics, but to the quality and variety of products. Anwar and Sun (2018) investigated the influence of foreign direct investment on the industry export quality in China. Employing the seemingly unrelated regression approach, the authors proved that the presence of foreign industrial firms has a positive and statistically significant effect on the country's industrial export quality. The results also indicated that due to FDI, the growth of industry average wage leads to the substantial increase in the export quality both directly and indirectly. Li *et al.* (2021) research the effect of China's relaxation of FDI regulation on the industry's export sophistication. The authors found that FDI liberalization has a favourable impact on export sophistication for manufacturing industries as a result of the export share growth of foreign-invested companies and processing trade firms. However, the study did not confirm that this liberalization affects the product quality positively.

There are some publications devoted to regional industrial activities and their effects on export trade. Applying the modified Balassa's revealed comparative advantage index and regression analysis, Piekkola (2018) explores the impact of various factors related to knowledge investment on export growth of Finnish regions. The study findings showed that the effect of elements of intangible capital investments on the export performance is not homogeneous. The most active role is played by research and development (R&D), which contributes substantially to the export growth and enhancement of trade balance. The influence of tangible investments on export activities has its own specific features depending on the distribution of capital investment growth. That is why it is necessary to elaborate a new policy that could ensure competitiveness and export growth of the country's industrial sector. Andersson and Johansson (2010) investigate how accessibility to human capital affects export trade in Swedish municipalities, using the cross-regional regression model. The results confirmed that regions with a high level of human capital are more specialized in terms of industry structures and have greater export diversification. Cross-regional variations in human capital lead to the growth of extensive margin. Human capital endowment also has an effect on intensive margin causing higher prices of export products.

Based on the panel model with fixed-effects, the random effect model, and the pooled ordinary least squares model, Jakšić *et al.* (2019) explore the influence of FDI and labour productivity on the development of manufacturing export sector of Croatian regions. The authors found that while this sector has an important role in the internationalization of Croatia's economy, its export activities do not promote macroeconomic convergence of the country due to the lack of domestic demand effect and low labour productivity. Moreover, the authors discovered that FDI flows have a negative impact on manufacturing exports because they are mainly oriented towards the service sector. Stojčić *et al.* (2014) analyse the effect of regional factors on export competitiveness of Croatian manufacturing companies. Using the spatial Durbin model, the authors revealed that regional concentration of exporting firms affects unfavourably the export intensity of manufacturing exporters in neighbouring regions. Moreover, the significant inter-regional development gap in terms of export intensity was

observed between the strongest and weakest Croatia's regions. In addition, the positive impact of factors that are considered as drivers of regional competitiveness (innovation potential, urbanization, and localization economies) was only partly proved.

Employing a dynamic gravity approach, Nsiah *et al.* (2012) evaluate the influence of various factors on manufacturing export performance from US states to chosen Asian countries. Research outcomes showed that well-defined legal systems and good infrastructure have a positive effect on state's exports. On the contrary, high levels of union density, corporate tax rates, pollution abatement cost, and employment density affect the state's manufacturing trade exports negatively. Yoshida (2013) gives attention to specific features of intra-industry trade between Japanese prefectures and Korea, applying the Grubel-Lloyd index and regression models. The research results revealed that the increase of sub-regional intra-industry trade is encouraged by the introduction of new kinds of export products. At the same time, intra-industry trade is negatively affected by the growth of export trade values. Tang and Zhang (2016) estimate how manufactured exports in Chinese regions are impacted by absorptive capacity and foreign direct investment, concentrating on three indicators: export capacity, intensity, and quality. The authors found absorptive capacity to be an important factor which promotes the export growth of manufacturing sectors, because FDI along has only a limited influence on the export performance. Moreover, the authors identified that absorptive capacity is substantially linked with effective FDI policy and high-quality infrastructure. Besides, they argue that a higher positive impact of FDI on the sector's export quality is seen in the case of appropriate investment in human capital and R&D.

There is a limited number of empirical studies on the effect of industry on Ukraine's export trade. For instance, Cieslik *et al.* (2015) examine factors that influence export performance of Ukrainian firms, using data from the survey on the manufacturing and services sectors. Based on the probit regressions, the authors determined that the probability of firm's export activities increases with the growth of the productivity level and the enhancement of other firm-level characteristics, including the firm size, firm internationalization, and innovativeness. Reggiani and Shevtsova (2018) consider the role of industry technology intensity and export destination in export-related productivity benefits of Ukrainian manufacturing firms, using the OLS regression with firm-clustered standard errors. The researchers identify that while exporters in high technology sectors have stable long-term productivity growth in advanced markets, firms in low-technology sectors get only short-term productivity enhancements which are not linked to the export destination. To some extent, these consequences for low-technology firms may be linked with the high level of illegal activity in this sector which, in turn, leads to negative social consequences (Mishchuk *et al.*, 2018; Androniceanu *et al.*, 2022) and appropriate results for public finance (Shkolnyk *et al*., 2020). However, the links between FDI and the shadow economy are strong and interrelated (Tiutiunyk *et al*., 2022).

We found only two publications, in which export and other indicators are examined in the periods before and during the conflict in Ukraine. Horská *et al.* (2019) investigate relationships between the chosen indicators of Ukrainian regions (export of goods per capita, foreign direct investment per capita, and the average resident population) and gross regional product per capita in the pre-conflict period (2010) and conflict period (2015). Employing the multiple linear econometric model, the authors revealed that gross regional product has positive correlation with foreign direct investment and export of goods in both periods, while the demographic indicator does not have any impact on the variable. Rovný *et al.* (2021) studied how the demographic structure of the population affects the selected economic indicators (export of goods per capita, gross regional product per capita, and others) of Ukrainian coastal regions in the pre-conflict period (2004-2013) and conflict period (2014-2018). Using Pearson's correlation coefficient, the authors determined that the military conflict has a negative effect on the demographic structure, which in turn hampers the economic development of the country's coastal regions.

The aim of our article is to explore the impact of main factors on export dynamics of Ukrainian regions in the pre-conflict and conflict periods. During the conflict period (2014-2019), coastal regions were mostly located closer to the war zone, compared to non-coastal regions. Due to this reason and based on previous empirical studies, in particular by Jakšić *et al.* (2019), Horská *et al.*

(2019), Lee and Fernando (2020), Rovný *et al.* (2021), Anwar and Sun (2018), and Tang and Zhang (2016), we will verify the following research hypotheses:

H1: Output per employee has a significant positive impact on the export development in both the pre-conflict and conflict periods.

H2: Output per employee has a lower positive impact on the export level in coastal regions in comparison to non-coastal regions.

H3: Foreign direct investment has a substantial positive effect on the export performance during the pre-conflict and conflict periods.

H4: Foreign direct investment has a lower positive influence on the export level in coastal regions in comparison to non-coastal regions.

RESEARCH METHODOLOGY

During the preparation of the article, Ukrainian regional data for 2003-2019 were employed, based on publications and the website of State Statistics Service of Ukraine (www.ukrstat.gov.ua). Since 2014, data on the Autonomous Republic of Crimea and Sevastopol (city) were not available because of Russia's annexation of these administrative regions. That is why they were not investigated in the article. Thus, our article is based on the data for 25 Ukrainian administrative regions. Regarding foreign direct investment, data from the State Statistics Service of Ukraine for 2003-2014 and National Bank of Ukraine for 2015-2019 (www.bank.gov.ua) were used in this publication. Besides, the analysis was carried out to assess how the location proximity of Ukrainian regions to seas and seaports impacted export trade. Due to this reason, the coastal regions (Donetsk, Kherson, Mykolayiv, Odesa, and Zaporizhzhya oblasts) and non-coastal regions were investigated separately. Data were processed to the panel which was used as the input for mathematical-statistical tools. The analysis was performed in the software SAS Studio 3.8 Enterprise edition.

The selection of variables for investigation of regional export dynamics was based on the model originally proposed by Jakšić *et al.* (2019), in which the dependent variable was the share of export in gross regional product (GRP) and the matrix of regressors consisted of gross value added (GVA), foreign direct investment, productivity, the share of import of goods in GRP and the share of manufacturing in regional gross value added. The share of manufacturing in regional gross value added was also evaluated as the significant factor influencing export by Zhylinska *et al.* (2020). The list of variables with their description can be found in Table 1.

Table 1. List of variables with their description

Variable name	Description	Source of data	Role
ExpShareonGRP	Share of export in gross regional product – the quantitative variable expressed in %	State Statistics Service of Ukraine	Dependent variable
GVA	Gross value added – the quantitative variable measured in millions of USD	State Statistics Service of Ukraine	Explanatory variable
FDI	Inward foreign direct investment – the quantitative variable measured in millions of USD	State Statistics Service of Ukraine, National Bank of Ukraine	Explanatory variable
OurperEmp	Output per employee – the quantitative variable used as an approximation of productivity measured in USD	State Statistics Service of Ukraine	Explanatory variable
ImpShareonGRP	Share of import in gross regional product – the quantitative variable expressed in %	State Statistics Service of Ukraine	Explanatory variable
GVA_industry	Share of industry in regional gross value added – the quantitative variable expressed in %	State Statistics Service of Ukraine	Explanatory variable

Source: own study.

The values of some indicators were available in Ukrainian hryvnias. To better analyse these indicators, their values were recalculated to US dollars (USD), using information from the National Bank of Ukraine on the annual average official exchange rate between the currencies. In order to improve the prediction ability and to include export dynamics into the model, the lagged value of the dependent variable ExpShareonGRP was also used as the explanatory variable as suggested by Jakšić *et al.* (2019).

The impact of conflict was included in the model with dummy variables. They were created automatically by the software based on the qualitative variable period which could take two values for the conflict period and pre-conflict period. This led to creation of two dummy variables for the mentioned periods, which took values 0 or 1. These two dummy variables could not be employed together to prevent perfect multicollinearity, but their usage was optimized by the software, according to the current model and variable properties. The inclusion of dummy variables was more efficient than the separate estimation of two models in order to save degrees of freedom. Models were estimated for the entire panel dataset and for coastal and non-coastal regions separately. In order to remedy bias caused by possible heteroscedasticity or autocorrelation, robust standard errors were applied. The pooled regression model, one-way random effects model and one-way fixed effects model were considered for the analysis.

Verification of estimated fixed effect models included the F-test for no fixed effects, which compared the pooled regression model with the fixed effect model. A low p-value indicated rejection of the null hypothesis, and that the pooled regression model is adequate in favour of the fixed effects model. For the random effects model, the presence of individual effects was tested employing the Breusch-Pagan test for random effects, which compares the performance of pooled regression with the random effects model. In this case, the low p-value indicated rejection of the null hypothesis, and that the pooled regression model is adequate in favour of the random effects model.

The decision between the fixed and random effects models was based on the test suggested by Hausman (see Matuszewska-Pierzynka, 2021). The test examines differences between coefficients estimated from the fixed effects and random effects models. The low p-value counts against the null hypothesis that fixed and random effects estimates do not differ substantially, and random effects estimates are consistent in favour of the alternative hypothesis to prefer the model with fixed effects. The threshold value for the decision about the hypothesis was the significance level of 0.05. When the result of the Hausman test suggested that both models are consistent, the explanatory ability of both models and the type of data was also considered. In the case of the long panel dataset, the decision was made in favour of the fixed effects model as stated in Gujarati (2011).

Based on the above-mentioned test results, one-way fixed effects models were selected as the most appropriate. Models were estimated in the following form:

$$Y_{it} = \alpha_0 + \sum_{j=1}^{m} \beta_j X_{it} + \sum_{k=1}^{d} \gamma_k D_{it} + \sum_{j=1}^{m} \delta_j X_{it} D_{it} + \varepsilon_{it} \quad (1)$$

where:

i - number of cross-sectional units, $i = 1,2, \dots, n$;
t - number of time periods, $t = 1,2, \dots, T$;
j - number of explanatory factors, $j = 1,2, \dots, m$;
k - number of intercept differential dummies, $k = 1,2, \dots, d$;
α_0 - Intercept;
β_j - estimated parameters for explanatory factors, slope coefficients measuring the effect of explanatory variables on the dependent variable;
γ_k - estimated parameters for differential intercept dummies that evaluate the difference between the intercept of the model in the pre-war period and war period. Results can be found for the periods before and during the conflict, only one value is estimated, and its significance measures the difference between intercepts of models in two periods
δ_j - estimated parameters for differential slope dummies, which evaluate the difference in slope between the periods before and during the conflict
Y_{it} - dependent variable *ExpShareonGRP*

X_{it} - explanatory variables: *ExpShareonGRPi$_{t-1}$, GVA, FDI, OutperEmp, ImpShareonGRP, GVA_industry*

D_{it} - dummy variables denoting the periods before and during the conflict, two possible variables, only one can be used in the estimated model, the usage of these variables was optimized by the software in order to avoid the collinearity problem and to get the best performing model;

$X_{it}D_{it}$ - differential slope dummies, the product of explanatory factors and dummy variables, the estimated parameter of one dummy for the explanatory variable evaluates the difference in slope between periods, sometimes they could be estimated parameters for two dummies instead of slope (β_j) for the explanatory factor, which measures the influence of the factor in two periods separately

ε_{it} - random error.

The article includes only the final models with the highest prediction ability, which were selected from nine finally optimized panel models. These models were validated and used to verify previously formulated research hypotheses.

RESULTS AND DISCUSSION

The article investigates the relationship between the export performance and main factors influencing its development in Ukraine. Figure 1 presents the comparison of the share of export and the share of import in the country's GDP. The export's share in GDP exceeded the import's share for almost the entire investigated period. The war conflict with Russia started in 2014 and the significant decline of the share of import was observed in this period. In 2015, the share of export was higher than the share of import. The performed analysis investigated not only the influence of selected factors on the share of export but also the effect of the war conflict on the export's development, considering the pre-conflict and conflict periods. Panel models were estimated for coastal and non-coastal region separately, in which the impact of selected factors on the export's share was expected to be different.

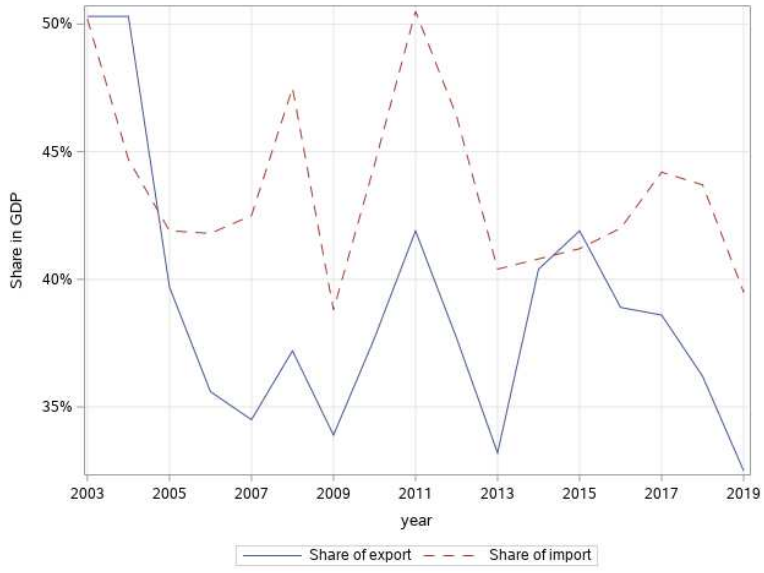

Figure 1. Share of export and share of import in Ukraine's GDP in the years 2003-2019
Source: own elaboration based on data from the State Statistics Service of Ukraine.

From all analysed factors, which could influence export performance substantially, the share of industry in gross value added was considered as the most important indicator. Figure 2 shows relationship between the share of industry in gross value added and the shares of export and import in gross regional product. It is obvious that there was no substantial relationship between both pairs of variables over the whole period. Only some partial significant relationships could be found in the

case of several regions or groups of regions, or some periods. The Figures are very similar in the case of both export and import trade.

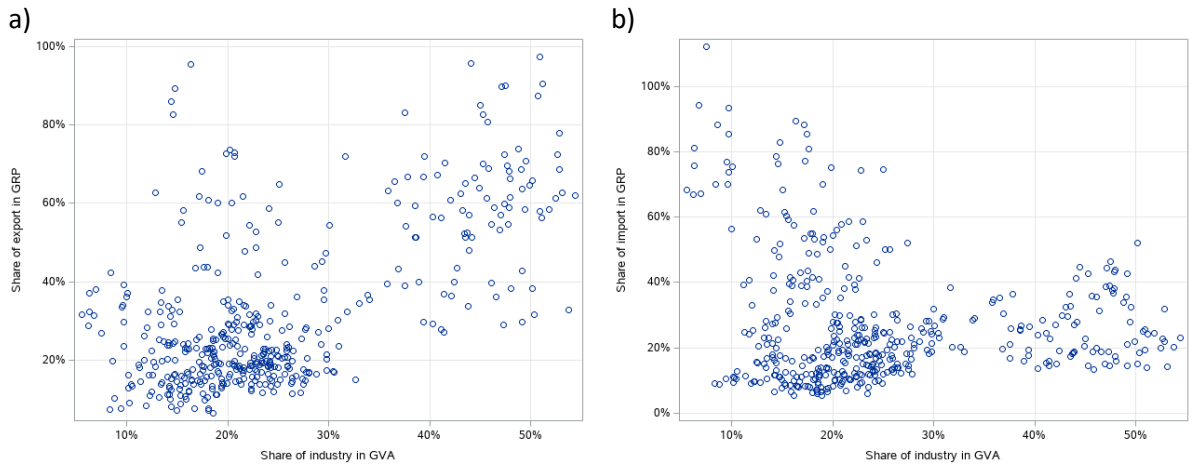

Figure 2. Relationship between the shares of export and import in GRP and industry in GVA
Note: a) share of export in GRP vs. share of industry in GVA; b) share of import in GRP vs. share of industry in GVA.
Source: own elaboration based on data from the State Statistics Service of Ukraine.

Both relationships were divided into the periods before and after 2014, when the war conflict started in Ukraine. The comparison of both periods is given in Figure 3. In the case of import, significant relationship with the share of industry in GVA was not observed in both periods. The scatter plot in the periods before and during the conflict was similar.

Regarding export, a substantial difference was identified between Figures a and b. For the pre-conflict period, the presented scatter plot suggests that some relationship existed between export and the share of industry in gross value added. In the conflict period, however, the spread of values was greater and did not follow any significant pattern. This result suggests that GVA in industry did not play an important role in export after the conflict began in Ukraine. Thus, the role of industry in export decreased in the conflict period.

The similar situation was also observed in the case of other variables. Our analysis focused on Ukraine's export and it was based on the assumption that the country's export could be significantly influenced by the export value in the previous period, gross value added, foreign direct investment, output per employee, the share of import on gross regional product and gross value added in industry. The conflict was also used as a dummy variable to improve the explanatory ability of estimated models. To uncover some specific relationships between the variables, the analysis was performed on panel data for all Ukrainian regions, as well as for coastal and non-coastal regions separately.

Table 2 presents basic descriptive statistics for variables used in the conducted analysis. It allows us to compare indicators' values of coastal and non-coastal regions and to have the overall statistics for the country. In the case of the export's share in GRP, the higher value was recorded in coastal regions, and it even exceeded the country's average value.

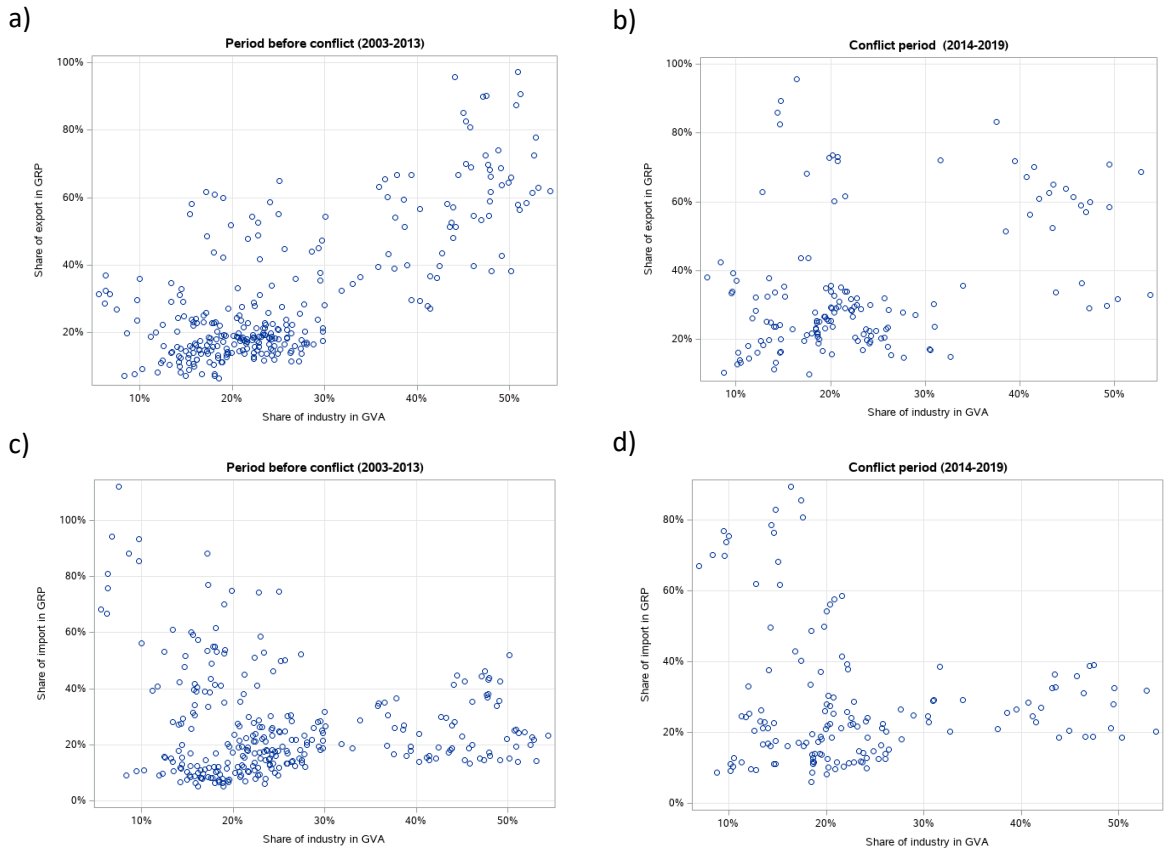

Figure 3. Relationship between the share of industry in GVA vs. the share of export and import in GRP before and after 2014

Note: a) share of export vs. share of industry in GVA in the period before the conflict; b) share of export vs. share of industry in GVA in the conflict period; c) share of import vs. share of industry in GVA in the period before the conflict; d) share of export vs. share of industry in GVA in the conflict period.

Source: own elaboration based on data from the State Statistics Service of Ukraine.

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The similar situation was also observed in the case of other variables. Our analysis focused on Ukraine's export and it was based on the assumption that the country's export could be significantly influenced by the export value in the previous period, gross value added, foreign direct investment, output per employee, the share of import on gross regional product and gross value added in industry. The conflict was also used as a dummy variable to improve the explanatory ability of estimated models. To uncover some specific relationships between the variables, the analysis was performed on panel data for all Ukrainian regions, as well as for coastal and non-coastal regions separately.

Table 2 presents basic descriptive statistics for variables used in the conducted analysis. It allows us to compare indicators' values of coastal and non-coastal regions and to have the overall statistics for the country. In the case of the export's share in GRP, the higher value was recorded in coastal regions, and it even exceeded the country's average value.

Similar results were also seen for GVA, industry's GVA, and output per employee. The opposite situation was found in the case of FDI, for which the larger value was observed in non-coastal regions. The share of import in GRP was similar in both coastal and non-coastal regions. However, the slightly higher value in non-coastal regions was closer to the overall average in Ukraine.

Table 2. Descriptive statistics of analysed variables

Region	Variable	Mean	Standard deviation	Minimum	Maximum
	ExpShareonGRP	31.49	20.2	6.40	97.30
	GVA	4228.33	4998.10	323.30	34561.70
Ukraine	FDI	1291.27	3414.93	20.20	27278.10
	OutperEmp	38255.53	15093.03	7855.50	94748.80
	ImpShareonGRP	26.74	18.73	5.30	112.10
	GVA_industry	1090.28	1427.43	52.10	9765.50
	ExpShareonGRP	27.80	17.11	6.40	95.80
	GVA	4055.98	5169.44	323.30	34561.70
Non-coastal regions	FDI	1392.06	3770.54	20.20	27278.10
	OutperEmp	37845.82	15305.11	7855.50	94748.80
	ImpShareonGRP	26.93	20.7	5.30	112.10
	GVA_industry	947.77	1188.38	52.10	8328.00
	ExpShareonGRP	47.22	23.71	11.20	97.30
	GVA	4962.37	4137.44	712.40	19582.50
Coastal regions	FDI	864.42	807.75	64.50	3789.10
	OutperEmp	39990.78	14113.56	10702.30	70114.20
	ImpShareonGRP	25.95	11.43	7.20	53.40
	GVA_industry	1697.21	2070.99	161.80	9765.50

Source: own elaboration based on data from the State Statistics Service of Ukraine and National Bank of Ukraine.

Based on data described in Table 2, panel models with random and fixed effects were estimated for coastal and non-coastal regions separately in order to compare differences in their export dynamics as well, while the overall panel model was based on observations for all regions. The selection of the final model was based on test results shown in Table 3.

Table 3. Verification of estimated models

Test/model	Coastal regions	Non-coastal regions	All regions
F-test for no fixed effects p-value	<0.0001	<0.0001	<0.0001
Breusch Pagan test for random effects p-value	0.0099	-	-
Hausman test p-value	<0.0001	0.196	0.0549
Pooled R^2	0.8624	0.7728	0.8149
Random effects R^2	0.5348	0.4056	0.3868
Fixed effects R^2	0.9359	0.8309	0.8754

Source: own elaboration based on data from the State Statistics Service of Ukraine and National Bank of Ukraine.

The threshold significance level was 0.05. In the first phase, the performance of panel models and pooled regression with the F-test and Breusch-Pagan test for random effects was compared. The Breusch-Pagan test was estimated for coastal regions only due to the unbalanced panel dataset for non-coastal and all regions. The Breusch-Pagan p-value for coastal regions suggested the existence of significant individual effects in the variance component. A similar result was also obtained using the F-test for no fixed effects, when compared the performance of the pooled regression and fixed effect model. The F-test result was similar for coastal, non-coastal, and all regions models. This result suggests that panel models, which take into account individual effects for cross-sectional units, should be preferred over the pooled regression model. To decide whether the individual effects in data should be estimated as fixed or random effects, the Hausman test was employed. Using 0.05 level of significance, the null hypothesis was rejected for coastal regions only. For the overall model for all regions, the p-value was just slightly higher than the considered threshold. Based on the assumption that the acceptance of the null hypothesis means the non-significant difference between estimated parameters of fixed and random effect models (which means that both of them are consistent and can be used) and requirements that model results should be directly comparable, the fixed effects panel model was

selected for all three datasets. Moreover, it was evaluated better in terms of the character of the dataset (the long panel) and the explanatory ability.

The results on estimated fixed effects models are given in Table 4. This Table could be divided into three basic parts: the first part – the effect of explanatory factors, the second part (the variable before and during the conflict) – the difference in the intercept between the pre-conflict and conflict periods, and the third (bottom) part – product variables measuring the effect and significance of slope coefficient difference between the periods before and during the conflict. To compare model results for different regions, the Table also includes insignificant variables. According to expectations, the lagged variable of export share in gross regional product was significant in all estimated models, because the next value in time series was strongly dependent on its previous value. In the model for whole Ukraine, it was identified that output per employee and the share of import in gross regional product influenced the share of export in gross regional product substantially. The similar result was also found in the model for non-coastal regions. In this case, output per employee was significant at 0.1 level of significance only. The models calculated separately for coastal and non-coastal regions showed slightly different results. In the case of coastal regions, the share of import in gross regional product was the only significant explanatory factor. The influence of this factor was estimated in the bottom part of the Table for the pre-conflict and conflict periods separately.

The higher estimated value of intercept means that the portion of export in GRP was a bit larger in coastal regions in comparison with non-coastal regions. During the conflict period, the average level of export share in GRP in coastal regions even increased in contrast with its decrease in non-coastal regions (measured by parameter estimated for the dummy variable conflict). The bottom part of the Table includes parameters for variables created as products of dummy variables and original explanatory factors. Their parameters measure the change in slope between the conflict and pre-conflict periods. In other words, they show the shift on how explanatory factors influence the dependent variable.

In the case of non-coastal regions, the conflict changed substantially the relationship between the dependent variable and output per employee, the share of import in gross regional product, and the share of industry in regional gross value added. The influence of output per employee on the share of export in GRP increased in the conflict period significantly, but the impact of other two variables decreased to a substantial extent.

Estimated results for coastal regions were different. They suggest that the conflict changed the impact of all considered explanatory factors, with the exception of the share of industry on regional gross value added. The change in slope of FDI and output per employee were evaluated as substantial in the conflict period, while these variables were insignificant in the pre-conflict period. In both cases, the obtained results suggest their significant decrease. Besides, the influence of gross value added and the share of import in gross regional product on the share of export in gross regional product increased substantially during the conflict period. Overall results for the whole country in the pre-conflict period were similar to results received for non-coastal regions. On the other hand, the influence of the conflict on slope coefficients of explanatory factors was significant for all variables, with the exception of output per employee. Thus, as in the case of coastal regions, the change in the same direction was identified for non-coastal regions.

Hence, considerable differences were identified between coastal and non-coastal regions in regard to the conflict's impact. Based on the results of estimated models, it can be concluded that the dynamics of export and its relationship with determining factors were influenced in coastal regions to a greater extent. Comparing these results with findings on non-coastal regions, two major differences could be identified. First of all, during the conflict period, the share of export in GRP decreased significantly in non-coastal regions, in contrast with its substantial growth in coastal regions (according to significance of the conflict dummy variable in both models). Second, the significant change was found in both categories of regions in the relationship between export and import, as well as export and output per employee. The influence of output per employee on the share of export in GRP increased in non-coastal regions in the conflict period, but its substantial decline was identified in the case of coastal regions.

Table 4. Parameters of estimated fixed effects models

Region	Coastal regions		Non-coastal regions		All regions	
Variable	**Estimate**	**Pr > |t|**	**Estimate**	**Pr > |t|**	**Estimate**	**Pr > |t|**
Intercept	**36.46725**	**<.0001**	**11.66205**	**<.0001**	**12.09908**	**<.0001**
lagExpSH	**0.246095**	**0.0038**	**0.39244**	**<.0001**	**0.374523**	**<.0001**
GVA	-0.00289	0.1559	-0.00026	0.6238	-0.00036	0.4591
FDI	0.004495	0.2493	-0.00006	0.8872	0.000013	0.9741
OutperEmp	-0.00002	0.8245	**-0.00007**	**0.0946**	**-0.00008**	**0.0293**
ImpShareonGRP	0	.	**0.335217**	**<.0001**	**0.21725**	**0.0006**
GVA_industry	0.001897	0.5807	-0.00017	0.8877	-0.00036	0.7258
before	0	.	0	.	0	.
conflict	**23.19226**	**0.0246**	**-8.30323**	**0.0729**	-4.50557	0.2602
before*GVA	0	.	0	.	0	.
conflict*GVA	**0.007769**	**0.0002**	0.000788	0.2782	**0.001585**	**0.0172**
before*FDI	0	.	0	.	0	.
conflict*FDI	**-0.02244**	**0.0003**	-0.00068	0.4765	**-0.0017**	**0.0531**
before*OUTPEREMP	0	.	0	.	0	.
conflict*OUTPEREMP	**-0.00082**	**0.0009**	**0.000169**	**0.0789**	0.000074	0.3834
IMPSHAREONGRP*before	**0.542695**	**0.0002**	**-0.13824**	**0.0110**	0	.
IMPSHAREONGRP*conflict	**1.028887**	**0.0004**	0	.	**0.12662**	**0.0147**
GVA_INDUSTRY*before	0	.	0	.	0	.
GVA_INDUSTRY*conflict	-0.00291	0.4119	**-0.00362**	**0.0013**	**-0.00442**	**<.0001**
R squared	0.9359		0.8309		0.8754	

Source: own elaboration based on data from the State Statistics Service of Ukraine and National Bank of Ukraine.

Between the shares of export and import in GRP, the estimated slope was 0.34 in non-coastal regions in the pre-conflict period, while it declined by 0.14 in the conflict period. On the other hand, in coastal regions, this slope was estimated to be 0.54 in the pre-conflict period, and it even increased to 1.03 during the conflict period. Other minor differences were also revealed. In the case of coastal regions, the significant change was not found in the slope coefficient for the industry's gross value added. At the same time, the substantially smaller value of this slope coefficient was determined in non-coastal regions in the conflict period, despite it being insignificant in the pre-conflict period. Similarly, gross value added and foreign direct investment were both insignificant factors in the pre-conflict period for both types of regions. According to received results, the conflict changed their slopes substantially, and, in the case of gross value added, the significant growth of its influence was revealed in coastal regions.

Also, the findings confirmed that the war conflict affected Ukrainian coastal and non-coastal regions to a different extent. The results on research hypotheses formulated in our article are the following.

Hypothesis 1 supposed that output per employee had a significant positive impact on the export development in both the pre-conflict and conflict periods – the role of output was insignificant in the model for coastal regions. In the overall model for the country level and the model for non-coastal regions, this variable was significant, but its sign was negative, which was in contrast with expectations. Hypothesis 2, which assumed that output per employee had a lower positive impact on the export level in coastal regions in comparison to non-coastal regions, was not confirmed too. It can be only concluded that the spread of the conflict increased substantially the influence of output on export in non-coastal regions.

Similar results were also obtained for hypotheses 3 and 4. According to hypothesis 3, the significant positive effect of FDI on the export performance was expected to be in the pre-war and war periods. In contrast with this expectation, the substantial influence of foreign direct investment was not found. This finding is also related to hypothesis 4 about the lower positive influence of FDI on export in coastal regions. Therefore, hypothesis 4 was not supported too. It was only confirmed that the slope coefficient was significantly smaller in the case of foreign direct investment for coastal regions in the conflict period, *i.e.* its influence on export was still insignificant.

Models used in this article were based on theoretical assumptions applied by Jakšić *et al.* (2019) in their analysis of export dynamics in Croatia. They obtained results which were similar to our research findings. In their model, the only significant explanatory variable was the share of import in gross regional product, and its coefficient was 0.45 for Croatia. This corresponds to the estimated influence for the pre-conflict period in our article. In our analysis, this variable's coefficients were 0.22, 0.34, and 0.54 for the models on the country level, non-coastal regions, and coastal regions, correspondingly. The insignificance of other explanatory variables is also in accordance with the results of their study. Compared to their results, another difference was identified in the case of the variable output, which was estimated as significant at the country level in our model. Surprisingly, the negative coefficient of this variable is in accordance with insignificant coefficients in their models.

Besides, our findings were different in comparison to results by Zhylinska *et al.* (2020). These authors investigated exports in countries with more than 50% of manufacturer's export. Their research was based on the autoregressive model which included the following variables: terms of trade, GDP and manufacturing gross value added. In contrast with outcomes of this analysis, our results did not find a significant impact of industry's gross value added on the share of export in gross regional product.

Our result regarding the influence of foreign direct investment on export is in accordance with findings of Li *et al.* (2021), who analysed exports in China and did not find its significant effect. A similar result was also seen in the study by Tang and Zhang (2016). They explained this result as the indirect effect of foreign direct investments, which may not automatically appear, but depend on host country's absorptive capacity associated with the country's FDI policy, human capital, R&D, and infrastructure quality. This result is in contradiction with the research conducted by Anwar and Sun (2018), in which it was concluded that the foreign presence in China's manufacturing sector significantly positively influences its export. On the other hand, both results are in contrast with the study by Bierut and Dybka (2021), who investigated export in EU countries and found a surprisingly significant negative effect of FDI. These controversial results in regard to the influence of foreign direct investment on export can be explained by the type of FDI inflows (in EU countries, they were mainly oriented to the service sector) and the resulting transformational impact on the production and export structure of host countries.

The novelty of our article is that the influence of industry on exports of Ukrainian regions was investigated, considering coastal and non-coastal regions in the pre-conflict and conflict periods separately. The article contributes to the development of the theory and practice because it enhances the understanding of how the war conflict impacts the relationship between the selected determinants and regional export activities. The change of the export dynamics in coastal and non-coastal regions can be used as the case study for comparison of regions which are more (coastal) and less (non-coastal) affected by the war conflict.

CONCLUSIONS

Our results showed that the impact on export activities was different in Ukrainian coastal and non-coastal regions. Moreover, the findings confirm that the war conflict affected the country's coastal and non-coastal regions to various extent. Coastal regions were affected more by the spread of war conflict, which was expected due to their geographical proximity to the war zone. In the pre-conflict period, the models' results were also different for coastal and non-coastal regions, and findings on coastal regions were closer to overall results for the country-level model. During the conflict period, more significant changes were found in regard to the influence of explanatory variables on export in coastal regions. The difference in comparison to non-coastal regions was not only in terms of the number of substantial changes in slope coefficients for explanatory variables, but also in their direction. The impact of the most significant variable, the share of import in GRP (in the pre-conflict period, its values were 0.34 for non-coastal regions and 0.54 for coastal regions), decreased in non-coastal regions (by 0.14), while in coastal regions it had the large growth with the slope coefficient equal to 1.03 in the conflict period. This suggests that the war conflict changed significantly the relationship between import and export, and this effect was different in coastal regions, which were more affected by the conflict. The findings showed that export increased from these regions, while it declined from non-coastal regions.

The substantial effect of the conflict on coastal and non-coastal regions was also identified regarding the variable output per employee, but, at the same time, its influence decreased in coastal regions during the conflict period to a substantial extent. In contrast to this finding, the significant rise of the variable's influence was revealed in the case of non-coastal regions in the conflict period. This means that export from coastal regions, which were more affected by the war in the conflict period, was less depend on production in these regions.

We suggest that the reduction of the industry's impact on export trade is a consequence of changes in the Ukrainian economy due to the war conflict. Thus, it is important to support the development of Ukraine's industry. The vital step in this direction is that the country was granted candidate status for EU membership in 2022. It is necessary to continue further integration with the European Union and to deepen industrial cooperation with the EU, the USA, and other countries. It is also needed to determine priority directions of industry in order to minimize the negative influence of the war conflict on this economic branch, enhance the quality of industrial goods, and improve the sector's competitiveness in external markets. Besides, it is essential to improve the mechanism for FDI attraction, taking into account the existing situation in Ukraine.

There are some limitations of our research. Firstly, the impact of the industry on export trade was explored, using the data for Ukrainian regions only. Secondly, the effect of just one economic sector (industry) on export performance was investigated. At the same time, the above-mentioned research limitations could be considered as the basis for further studies. For instance, it would be useful to investigate the regional export performance and main factors influencing its development not just in Ukraine, but in Central European countries as well. In addition to industry, it would be possible to consider how export trade is also affected by other economic branches: agriculture, construction, etc.

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Conflict of Interest

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