

THE IMPACT OF EUROPEAN UNION SANCTIONS AGAINST RUSSIA ON EU EXPORT PERFORMANCE

Agnė Kološinskaitė¹, Monika Didžgalvytė-Bujauskė²

¹ MSc in Economics, Vytautas Magnus University, K. Donelaičio str. 58, Kaunas, Lithuania, Email address: agne.kolosinskaite@outlook.com

² PhD in Economics, Asst. Prof., Vytautas Magnus University, K. Donelaičio str. 58, Kaunas, Lithuania, Email address: monika.didzgalvyte-bujauske@vdu.lt

Received 30 07 2026; Accepted 18 08 2026

Abstract

Growing geopolitical tensions and the increasing use of sanctions as instruments of foreign policy in the 21st century highlight the relevance of this study. **Research problem:** The impact of European Union sanctions on Russia on the exports of EU member states, considering their economic dependence on the Russian market. **Research objective:** To assess the impact of EU sanctions on exports, considering the degree of economic dependence on Russia. **Research methods:** Analysis of scientific literature and panel data regression analysis, using the First-Differences method. **The results** indicate that sanctions imposed after the 2022 war in Ukraine reduced EU exports to Russia more significantly than those introduced after 2014. Additionally, greater geographical distance and higher GDP contributed to greater export stability. Paradoxically, countries that are more economically dependent on the Russian market experienced a milder decline in exports.

Keywords: Economic Dependence, European Union, Export, Panel Data Analysis, Russia, Sanctions.

JEL Codes: F14, C33, F51.

Introduction

Sanctions are economic and political measures designed to influence the behaviour of a state, group, or individuals. They may be imposed to alter the policies of a state that threatens international peace and security, or to encourage the cessation of systematic human rights violations. The methods of implementing international economic sanctions and the debates surrounding their effectiveness are central issues in international politics.

The imposition of sanctions represents an exceptional economic policy instrument aimed at achieving specific political objectives. According to the literature, sanctions undermine the performance of target countries by disrupting trade, investment, economic growth, poverty levels, and political stability (Morgan et al., 2023). Their negative effects may persist even after sanctions are lifted. The magnitude and nature of these impacts vary depending on the type of sanctions, their implementation, and the broader context – and their

consequences often extend to the countries that impose them.

Scholars such as Allen and Lektzian (2013), Drapkin et al. (2022), and Morgan et al. (2023) have contributed significantly to the development of the theoretical analysis of sanction mechanisms. Sanctions against Russia are particularly significant, given the high level of economic interdependence between the EU and Russia. For decades, Russia has been one of Europe's primary suppliers of energy resources. Geopolitical events – most notably the annexation of Crimea in 2014 and the war against Ukraine in 2022 – have underscored the strategic importance of EU sanctions.

Research problem: what is the impact of EU sanctions against Russia on EU exports, taking into account the economic dependence of individual member states? **Research object:** the impact of EU sanctions imposed on Russia during the period 2010–2023 on EU exports, with particular attention to the different sanction packages implemented following the annexation of Crimea in 2014 and the

onset of the war in 2022. The **objective** of the study is to identify and evaluate the impact of EU sanctions on EU exports, considering the varying levels of economic dependence among EU member states. **Research methods:** the research employs a comprehensive literature review and panel data regression analysis, applying the first-differences method using the *Gretl* software package. This study provides an assessment of how sanctions affect economic dependence, trade flows, and the resilience of EU economies. The findings are relevant for EU member states seeking to reduce their dependence on the Russian market, strengthen economic and energy security, and engage more effectively in the formulation of sanctions policy. Moreover, the results hold significance for academia, policymakers, and the business community, as they contribute to a deeper understanding of the mechanisms and economic consequences of sanctions.

Literature review

The literature review examines the objectives of the European Union's economic sanctions against Russia, their underlying mechanisms, and their impact on international trade and export performance. Previous research indicates that sanctions have historically functioned as non-military instruments of coercion employed to achieve diplomatic or economic objectives. Sanctions are typically classified into trade, financial, and targeted measures, which can be evaluated according to their scope and the degree of economic pressure they impose (Hufbauer et al., 2007; Mulder, 2022).

International trade – the exchange of goods, services, and capital across national borders – is widely regarded as one of the key indicators of economic development, as it fosters competition, innovation, technological advancement, and productivity (Peterson, 2018). Classical and modern trade theories explain the rationale behind cross-border exchange and the determinants of countries' trading partners. Trade policy can be restricted by protectionism, whereby states impose tariffs or other barriers to shield domestic industries from external competition. Although such policies

can have certain benefits, including job preservation and the enhancement of national security, they also tend to increase prices, reduce consumer choice, and impede innovation (Abboushi, 2010; Potrafke et al., 2020).

Exports generate substantial economic benefits by contributing to GDP growth and employment creation; however, they may also serve as instruments of political influence in the context of international conflicts (Peterson, 2018). Within this framework, sanctions can be understood as a form of trade policy restriction, the effectiveness of which depends on the target country's level of integration into the global trading system and its dependence on external partners (Caprile, Delivorias, 2023; de Souza et al., 2024). Consequently, analyzing the impact of sanctions is crucial not only for evaluating their effects on the targeted economy but also for mitigating potential adverse outcomes for the sanctioning countries themselves.

The effectiveness of sanctions largely depends on the targeted country's capacity to adapt, which may involve seeking alternative partners, reorienting trade flows, and developing technological substitutes. Within this context, two fundamental paradigms of international economics – realism and liberalism – are particularly relevant. From a realist perspective, sanctions are viewed as instruments of power politics, employed to maintain or alter the balance of power. In contrast, liberal theorists interpret sanctions as mechanisms for regulating international markets through coordinated state policies and institutional frameworks (Filipenko et al., 2020). Moreover, scholars emphasize that the inappropriate or excessive application of sanctions can have adverse economic repercussions for the sanctioning states themselves (Filipenko et al., 2020).

Economic dependence constitutes one of the key determinants of the effectiveness of sanctions. Prior to the onset of the war, Russia exhibited a high degree of dependence on imports of high-technology goods, food products, pharmaceuticals, and engineering equipment from the European Union (Shevchenko, 2017; Sinyakov et al., 2015). This structural vulnerability amplified the impact of

the imposed sanctions. Empirical studies indicate that the sanctions have incentivized Russia to decrease its external dependence, particularly in the agricultural sector (Lukyanova, Zeynalov, 2022). At the same time, the European Union's economy has also experienced negative repercussions, albeit to a comparatively lesser extent.

Empirical evidence confirms that, following the sanctions imposed in 2014 and 2022, trade flows between Russia and the European Union declined by more than one quarter, with the impact falling disproportionately on Russia (a reduction of up to 1.8% of GDP) compared to the EU (approximately 0.2% of GDP). Moreover, Russia has thus far been unable to adequately compensate for these losses in the high-technology sector (Drapkin et al., 2022).

According to Caetano et al. (2023), Bapat et al. (2013), Jeong and Peksen (2017), among others, the effectiveness of sanctions depends on several interrelated factors, including the magnitude of economic losses, the precision of implementation, the involvement of third countries, and domestic policy responses. Sanctions have also been found to stimulate the expansion of the shadow economy (Early, Peksen, 2018) and frequently fail to achieve their intended political objectives (Neuenkirch, Neumeier, 2015; Morgan et al., 2023).

In summary, the European Union's sanctions against Russia represent a complex and multifaceted policy instrument whose effectiveness depends on their scope, targeted application, degree of international coordination, and the level of

economic interdependence. Although the EU also incurs economic costs, the long-term effects have been considerably more pronounced for the Russian economy, particularly within the high-technology sector. Sanctions, therefore, remain one of the EU's principal non-military tools for influencing Russia's foreign policy and behaviour in the international arena.

Research methods

Given the current geopolitical context and the increasing significance of sanctions as an instrument of economic policy, this study seeks not only to quantify the effects of sanctions but also to evaluate how these effects are influenced by countries' economic dependence on Russia, as well as by macroeconomic conditions and geographical factors. The primary objective is to examine how successive stages of EU sanctions have affected member states' exports to Russia, considering varying levels of economic interdependence. The analysis covers the period from 2010 to 2023, which is divided into three distinct phases: the pre-sanctions period (2010–2013), the post-annexation phase following Crimea's incorporation into Russia (2014–2021), and the wartime period corresponding to Russia's full-scale invasion of Ukraine (2022–2023). The dataset encompasses all 27 EU member states. Table 1 provides an overview of the dependent and independent variables employed in the study.

Table 1. Overview of research variables

Variable type	Variable	Description	Data type	Data source
Dependent	EXP	Exports to Russia, EUR	Quantitative (primary)	Eurostat
Independent	GDP	Gross domestic product, EUR	Quantitative	World Bank
	INF	Inflation, annual consumer price index, %	Quantitative	
	SC	Binary sanctions indicator (0 – sanctions not imposed, 1 – in force; Crimea annexation period)	Qualitative (binary)	
	SU	Binary sanctions indicator after the 2022 invasion (0 – before the war, 1 – after).	Qualitative (binary)	EU documents
	DE1	Share of exports to Russia in total exports (first economic dependency)	Quantitative	
	DE2	Exports to Russia as a percentage of GDP (second economic dependency)	Quantitative	Calculated by the authors based on World Bank data.
	EXR	Currency exchange rate EUR/RUB	Quantitative	
	DIST	Distance to Russia, km	Quantitative	GeoDist database
	FSU	Binary variable: 1 – former USSR country; 0 – not a former USSR country	Qualitative (binary)	Classification by authors

The choice of variables allows the model to assess both the direct effects of sanctions and the structural and macroeconomic factors that may mediate these effects. Economic dependence on Russia is measured using two indicators: DE1, defined as the share of exports to Russia in total exports, and DE2, calculated as the ratio of exports to Russia relative to GDP. The moderating influence of economic dependence on the impact of sanctions is examined through interaction terms, specifically SC×DE1, SC×DE2, SU×DE1, and SU×DE2.

Drawing on the scientific literature and the empirical context under consideration, four primary research hypotheses have been formulated. Each hypothesis is grounded in theoretical reasoning and supported by insights from prior studies on the impact of economic sanctions on international trade.

H1. *Sanctions imposed following the annexation of Crimea and Russia's invasion of Ukraine have had varying degrees of impact on European Union countries' exports to Russia.* This hypothesis is based on the fact that, after Russia's large-scale invasion in 2022, sanctions were applied more broadly, covering not only specific sectors but also a wider range of goods, technology areas, and financial transactions. Consequently, it is anticipated that the sanctions introduced in 2022 had a more pronounced impact than those imposed in 2014 in the aftermath of Crimea's annexation. This distinction is further supported by the findings of Felbermayr et al. (2020), among others, who demonstrate that the effectiveness of sanctions depends critically on their scope and nature.

H2. *Countries with higher levels of economic dependence on trade with Russia experienced a greater decline in exports due to the imposed sanctions.* This hypothesis assumes that greater reliance on a specific market increases a country's vulnerability when access to that market is restricted. According to Galtung (1967), interdependence constitutes a key factor in determining the effectiveness of sanctions. Accordingly, countries that directed a substantial share of their exports to the Russian market are likely to have incurred more significant economic losses when trade was constrained.

H3. *Key macroeconomic factors, including gross domestic product, exchange rates, and inflation, have a significant impact on changes in export volumes during periods of sanctions.* This hypothesis is based on economic theory, which posits that macroeconomic conditions shape a country's capacity to adapt to external shocks. For example, a country with stable economic growth and excellent GDP indicators can compensate for a decline in exports through alternative markets, while inflation or currency fluctuations can change the competitiveness of goods in the international market. Kaempfer and Lowenberg (2007) also highlight the importance of these macroeconomic variables in analyses of sanctions' economic impacts.

H4. *Geographical distance from Russia has a significant impact on exports.* This hypothesis stems from the logic of economic gravity models, which argue that physical distance between countries directly affects trade volume, with closer countries typically exhibiting stronger economic ties (Head, Mayer, 2014). Countries closer to Russia often engage in more regional initiatives, cooperation frameworks, or integrated logistics networks, which may render their trade flows more susceptible to disruption from sanctions than those of more distant countries.

The models use annual data transformed into logarithmic form to reduce data asymmetry, stabilize dispersion, and facilitate the interpretation of results. Logarithmic transformation was applied to the primary dependent variable, as well as to the most significant quantitative independent indicators.

Common components of all models and their explanations:

- $\ln(\text{EXP}_{it})$ – dependent variable showing logarithmic exports from the country to Russia. This is the main object of analysis.
- $\ln(\text{GDP}_{it})$ – the country's gross domestic product, which shows the economic scale and potential for exports.
- SC_{it} , SU_{it} – binary variables indicating periods of sanctions (after the annexation of Crimea and after the start of the war in Ukraine).
- $\ln(\text{DE1}_{it})$, $\ln(\text{DE2}_{it})$ – measures of

economic dependence: the first assesses the share of exports in the country's total exports, while the second – assessed the ratio of exports to Russia relative to GDP.

• $\ln(SC_DE1_{it})$, $\ln(SC_DE2_{it})$, $\ln(SU_DE1_{it})$, $\ln(SU_DE2_{it})$ – interaction terms between sanctions and economic dependence. They allow us to assess whether the impact of sanctions differed according to the level of dependence of the countries.

• $\ln(EXR_{it})$ – the exchange rate between the euro and the ruble, which may affect the value of exports.

• INF_{it} – annual inflation, reflecting the macroeconomic environment.

• FSU_i – an indicator indicating whether the country belonged to the former USSR, which is an important factor due to historical ties with Russia.

• $\ln(DIST_i)$ – distance from the country to Moscow, used as a measure of geographical proximity.

• μ_i – variables not included in the model that do not change over time and may influence the dependent variable.

• θ_t – time pseudo-variables.

• ε_{it} – error term.

Based on the objective of the study – to assess how different stages of sanctions have affected EU countries' exports to Russia depending on their level of economic dependence – four econometric model specifications were developed. Each specification employs panel data for the 27 EU member states over the period 2010–2023. Based on an analysis of the literature and indicators, a preliminary empirical model (Equation 1) is presented. Equation (1) reflects the impact of sanctions imposed following the annexation of Crimea, taking into account each country's dependence on the Russian market, measured as the share of exports to Russia in total exports.

$$\ln(EXP_{it}) = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 SC_{it} + \beta_3 \ln DE1_{it} + \beta_4 \ln SC_DE1_{it} + \beta_5 \ln(EXR_{it}) + \beta_6 INF_{it} + \beta_7 FSU_i + \beta_8 \ln(DIST_i) + \mu_i + \theta_t + \varepsilon_{it} \quad (1)$$

Equation (1) analyzes whether the sanctions imposed after 2014 had a statistically significant

effect on EU exports to Russia. The interaction term (SC_DE1) helps to assess whether the level of dependence on the Russian export market strengthened or weakened the impact of these sanctions. Equation (2) extends the analysis by incorporating an alternative measure of dependence – defined as the ratio of exports to GDP – to assess the sanctions' effects following the annexation of Crimea.

$$\ln(EXP_{it}) = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 SC_{it} + \beta_3 \ln DE2_{it} + \beta_4 \ln SC_DE2_{it} + \beta_5 \ln(EXR_{it}) + \beta_6 INF_{it} + \beta_7 FSU_i + \beta_8 \ln(DIST_i) + \mu_i + \theta_t + \varepsilon_{it} \quad (2)$$

The models specified in Equations (1) and (2) are structurally similar, but in Equation (2), economic dependence is measured differently – by the share of exports to Russia in a country's GDP. Equation (3) captures the impact of sanctions imposed following the outbreak of the war in Ukraine, while accounting for economic dependence as measured by the share of exports to Russia in total exports.

$$\ln(EXP_{it}) = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 SU_{it} + \beta_3 \ln DE1_{it} + \beta_4 \ln SU_DE1_{it} + \beta_5 \ln(EXR_{it}) + \beta_6 INF_{it} + \beta_7 FSU_i + \beta_8 \ln(DIST_i) + \mu_i + \theta_t + \varepsilon_{it} \quad (3)$$

Equation (3) evaluates the second wave of sanctions imposed following the onset of the war in Ukraine in 2022. It investigates whether this more coordinated and intensive phase of sanctions affected EU exports to Russia differently compared to the sanctions implemented in 2014. Equation (4) captures the impact of the post-2022 sanctions while incorporating economic dependence, measured as the ratio of exports to GDP.

$$\ln(EXP_{it}) = \alpha + \beta_1 \ln(GDP_{it}) + \beta_2 SU_{it} + \beta_3 \ln DE2_{it} + \beta_4 \ln SU_DE2_{it} + \beta_5 \ln(EXR_{it}) + \beta_6 INF_{it} + \beta_7 FSU_i + \beta_8 \ln(DIST_i) + \mu_i + \theta_t + \varepsilon_{it} \quad (4)$$

Equation (4) extends the analysis presented in Model 3 (Equation 3) by employing an alternative measure of economic dependence. This specification allows for an assessment of whether varying definitions of economic dependence yield differing results regarding the estimated impact of sanctions.

The four above specified equations are designed to test the research hypotheses outlined in the previous section. As each model incorporates the relevant dependent variable, the second hypothesis – regarding the role of economic dependence on exports to Russia during sanction periods – can be evaluated across all equations. Similarly, the influence of macroeconomic factors (third hypothesis) and geographical distance (fourth hypothesis) on export performance can be assessed and compared using all four models. To test the first hypothesis, which examines differences in the impact of sanctions during the annexation of Crimea and the war in Ukraine, the results of Equations (1) and (2) (Crimea sanctions) are compared with those of Equations (3) and (4) (Ukraine sanctions) to determine which period had a greater effect on EU exports to Russia.

To evaluate the adequacy of the econometric models and ensure the robustness of the results, a series of diagnostic tests were conducted. Each test targets potential model specification issues, thereby supporting the selection of the most appropriate model and the correction of possible structural errors. All models were estimated using Ordinary Least Squares (OLS), Fixed Effects (FE), and Random Effects (RE) approaches, with the following tests applied:

- Fixed effects test – to determine the need for fixed effects;
- Hausman test – to choose between FE and RE;
- LM test – to assess the suitability of the RE model;
- Autocorrelation (Wooldridge test);
- Heteroscedasticity (Koenker or Breusch–Pagan test);
- Interdependence (Pesaran CD);
- Nonlinearity (SQ/LOG tests).

In cases of assumption violations, robust standard errors were applied: Panel-Corrected Standard Errors (PCSE) to address heteroscedasticity, *Arellano* robust errors for autocorrelation, and Driscoll–Kraay (SCC) corrections for cross-sectional dependence.

Research results and discussion

To assess the impact of sanctions on exports to Russia, a dynamic analysis of the dependent variable – export volume to Russia – was first conducted. The indicator is expressed as export volume per capita to account for differences in economic size across countries and to ensure comparability of results. The findings are illustrated in Figure 1.

As shown in Figure 1, per capita exports to Russia vary considerably among EU Member States over the period 2010–2023. By 2023, most countries (22 out of 27) remain below the 2023 EU average of EUR 166.44 per capita. The closest trade relations with Russia are maintained by the neighboring Baltic states, reflecting historical ties from the former Soviet Union bloc. Overall, EU exports to Russia declined by approximately 50% during the period, with notable exceptions: Bulgaria, Croatia, Latvia, and Slovenia experienced increases of 6%, 17%, 45%, and 47%, respectively. These gains primarily reflect higher export values rather than population changes (e.g., Bulgaria), indicating strengthened trade relations with Russia, particularly in Latvia and other Baltic countries. Conversely, Luxembourg experienced a 98% decline in exports to Russia, with the steepest drop occurring in 2021–2022 following the outbreak of the war in Ukraine. While EU-wide exports to Russia have fallen, certain countries continue to maintain significant trade links with the Russian market.

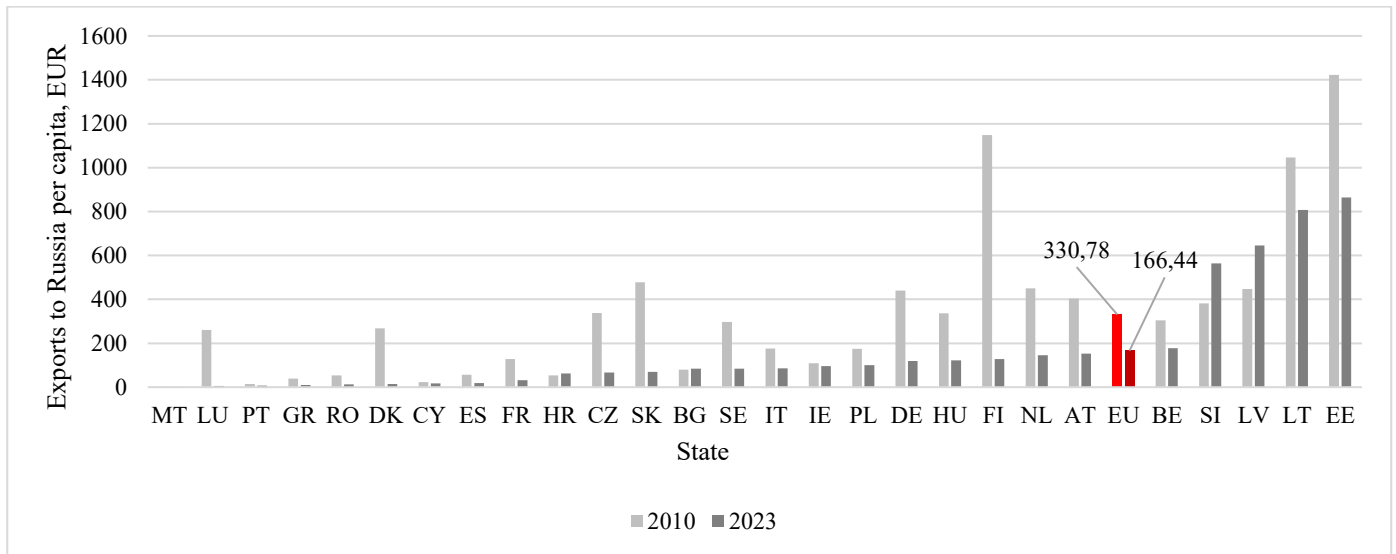


Figure 1. Exports to Russia per capita in European Union countries in 2010 and 2023, EUR

*Source: Eurostat (2025) data.

Building on the results of the dynamic analysis, which revealed substantial variation in EU countries' export volumes to Russia alongside an overall downward trend, the subsequent analysis focuses on the impact of sanctions. The empirical investigation examines how varying levels of dependence on the Russian market influenced export changes during the periods following the annexation of Crimea (2014) and the outbreak of the war in Ukraine (2022 onward).

To assess the impact of sanctions during the annexation of Crimea, the assumptions of the Gaussian–Markov model were first tested. The

initial model, using logarithmic variables, failed to satisfy several statistical requirements; consequently, an adjusted model was adopted, incorporating differentiated indicators and Driscoll–Kraay (SCC) robust standard errors. This approach mitigated issues of heteroscedasticity and autocorrelation, yielding more reliable coefficient estimates. Based on this specification, Table 2 presents the results of the first dependency model, which measures the share of exports to Russia in total exports.

Table 2. Impact of sanctions during the annexation of Crimea, primary dependence (share of exports to Russia in total exports) and other factors on EU exports: aggregate estimates of the MKM model of differentiated variables (dependent variable: exports to Russia $\Delta \ln_EXP$)

Indicator	Title	Coefficient	p-value
const	Constant	-2,3841	0,1613
$\Delta \ln_GDP$	GDP change (logarithmic)	0,8849	0,1370
SC	Sanctions indicator during the annexation of Crimea (0 – no, 1 – yes)	-0,9677**	0,0035
$\ln_DE1$	Share of exports to Russia in total exports (logarithmic) (how EU international trade depends on exports to Russia)	0,0565	0,9498
$\ln_SC_DE1$	Interaction between sanctions during the annexation of Crimea and primary dependence (as EU international trade depends on exports to Russia in the context of Crimea sanctions)	3,7936***	0,0069
$\Delta \ln_EXR$	Currency exchange rate EUR/RUB (logarithmic)	-0,2768	0,4985
$\Delta \ln F$	Inflation	0,0186*	0,0891
FSU	Indicator for former USSR countries (1 – former, 0 – not former)	0,0046	0,9393
$\ln_DIST$	Distance to Russia (logarithmic)	0,3330**	0,0178

θ_{2016}	Time variable reflecting the year 2016	0,1954***	0,0004
θ_{2018}	Time variable reflecting the year 2018	0,2760***	<0,0001
θ_{2019}	Time variable reflecting the year 2019	0,2845***	0,0006
θ_{2020}	Time variable reflecting the year 2020	0,1702***	0,0019
θ_{2021}	Time variable reflecting the year 2021	0,2249***	0,0085
θ_{2022}	Time variable reflecting the year 2022	-0,5378***	0,0041
Sample size			351
Adapted R²			0,3334

Note: ** indicates the significance of the indicator, with a 95% probability of falling within the confidence interval; *** – 99% probability. Although not all time variables are shown in the table, as some do not have a statistically significant effect on the dependent variable, they are included in the model as indicated in the models analyzed above.

Based on the results in Table 2, sanctions imposed during the annexation of Crimea had a negative and statistically significant effect: exports from EU countries to Russia declined by approximately 97%, indicating a substantial restriction of trade. Export dependence itself is not significant; however, the positive and significant interaction term suggests that more export-dependent countries experienced a smaller reduction in exports following the sanctions. The distance variable is also statistically significant – a 1% increase in distance is associated with a 0.33% increase in exports. Several time dummies are significant: exports were higher in 2016–2021 than in the base period but declined sharply in 2022, likely reflecting new sanctions linked to the war in

Ukraine. Other macroeconomic variables (GDP, exchange rate, inflation) and former USSR membership show no significant effects. The adjusted R² indicates that the model explains roughly one-third of the variation in exports, and the results are economically consistent.

Taking into account the results of the first economic dependency model, the second economic dependency model examines the ratio of exports to Russia to national GDP. This analysis aims to assess how the sanctions imposed during the annexation of Crimea affected not only trade relations but also the broader economic context, highlighting the significance of exports to the national economy. The results are presented in Table 3.

Table 3. Impact of sanctions during the annexation of Crimea, second dependency (share of exports to Russia in GDP) and other factors on EU exports: aggregate estimates of the MKM model with differentiated variables (dependent variable: exports to Russia $\Delta \ln_EXP$)

Indicator	Title	Coefficient	p-value
const	Constant	-2,8378*	0,0617
$\Delta \ln_GDP$	GDP change (logarithmic)	0,7680	0,1951
SC	Sanctions indicator during the annexation of Crimea (0 – no, 1 – yes)	-0,8411***	0,0035
$\ln_DE2$	Exports to Russia as a percentage of GDP (logarithmic) (how the EU economy depends on exports to Russia)	0,4333	0,5000
$\ln_SC_DE2$	Interaction between sanctions during the annexation of Crimea and secondary dependence (how the EU economy depends on exports to Russia in the context of Crimea sanctions)	2,2976**	0,0116
$\Delta \ln_EXR$	Currency exchange rate EUR/RUB (logarithmic)	-0,2643	0,4923
ΔINF	Inflation	0,0193*	0,0903
FSU	Indicator for former USSR countries (1 – former, 0 – not former)	-0,0348	0,6428
$\ln_DIST$	Distance to Russia (logarithmic)	0,3609**	0,0165
θ_{2016}	Time variable reflecting the year 2016	0,2058***	0,0005
θ_{2018}	Time variable reflecting the year 2018	0,2888***	<0,0001
θ_{2019}	Time variable reflecting the year 2019	0,2886***	0,0003
θ_{2020}	Time variable reflecting the year 2020	0,1769***	0,0027
θ_{2021}	Time variable reflecting the year 2021	0,2429***	0,0061
θ_{2022}	Time variable reflecting the year 2022	-0,5362***	0,0038

Sample size	351
Adapted R²	0,3329

*Note: ** indicates the significance of the indicator, with a 95% probability of falling within the confidence interval; *** – 99% probability. Although not all time variables are shown in the table, as some do not have a statistically significant effect on the dependent variable, they are included in the model as indicated in the models analyzed above.*

The results indicate that sanctions imposed during the annexation of Crimea had a significantly negative effect, reducing exports to Russia by approximately 84%. Economies more dependent on exports to Russia experienced a milder impact than less dependent countries, although this effect was limited to the sanction period. Distance also exhibits a significant positive relationship with exports, suggesting that greater distance may be associated with more profitable trade arrangements. The time variables show that exports to Russia were higher in 2016–2021 compared to the base period, while in 2022, coinciding with the onset of the war in Ukraine, the effect turned significantly negative. Other macroeconomic variables and the indicator

for former Soviet countries are not significant. The adjusted R² of 0.33 indicates that the model explains roughly one-third of the variation in exports.

For the period of the war in Ukraine, a differentiated variable model is employed to more accurately assess the impact of sanctions on EU exports. The model detects heteroscedasticity and intergroup correlation; therefore, SCC robust standard errors are applied to ensure the reliability of the estimates. The analysis begins with the first dependency – the effect of exports to Russia on total EU exports – and the results are presented in Table 4.

Table 4. Impact of sanctions during the war in Ukraine, primary dependence (share of exports to Russia in total exports) and other factors on EU exports: aggregate estimates of the OLS model of differentiated variables (dependent variable: exports to Russia $\Delta \ln \text{EXP}$)

Indicator	Title	Coefficient	p-value
const	Constant	-4,4385	0,1277
$\Delta \ln_GDP$	GDP change (logarithmic)	1,4277***	0,0002
SU	Sanctions indicator after the start of the war (0 – before the war, 1 – after)	-0,9810**	0,0188
$\ln_DE1$	Share of exports to Russia in total exports (logarithmic) (how EU international trade depends on exports to Russia)	2,4311	0,2583
$\ln_SU_DE1$	Interaction between sanctions after the start of the war and primary dependence (how EU international trade depends on exports to Russia in the context of the application of sanctions in the Ukraine war)	4,0838**	0,0288
$\Delta \ln_EXR$	Currency exchange rate EUR/RUB (logarithmic)	-0,9412*	0,0812
$\Delta \ln F$	Inflation	0,0014	0,8662
FSU	Indicator for former USSR countries (1 – former, 0 – not former)	-0,0307	0,6515
$\ln_DIST$	Distance to Russia (logarithmic)	0,3310**	0,0342
θ_{2023}	Time variable reflecting the year 2023	0,5399**	0,0344
Sample size			351
Adapted R²			0,3277

*Note: ** indicates the significance of the indicator, with a 95% probability of falling within the confidence interval; *** – 99% probability. Although not all time variables are shown in the table, as some do not have a statistically significant effect on the dependent variable, they are included in the model as indicated in the models analyzed above.*

As shown in Table 4, the impact of sanctions during the war in Ukraine is negative and statistically significant, with exports to Russia declining by approximately 98%. The positive and significant interaction term indicates that sanctions

had a relatively smaller effect on countries more dependent on exports to Russia. GDP also exerts a significant influence, as a 1% increase in GDP corresponds to an estimated 1.43% rise in export volumes. Distance from Russia is likewise

significant, suggesting that more distant countries engaged in more profitable trade relationships. The time variable for 2023 is statistically significant, reflecting modest export growth, likely due to alternative trade channels or sanction exemptions. Inflation, exchange rates, and former USSR membership are not significant. The adjusted R^2 of about 0.33 indicates that the model adequately captures the main trends in export dynamics.

Following the analysis of the first economic dependency during the war in Ukraine, the second economic dependency – the ratio of exports to Russia to GDP – is examined. This model aims to assess whether the sanctions imposed after the outbreak of the war significantly affected not only international trade but also the broader national economies. The results are presented in Table 5.

Table 5. Impact of sanctions during the war in Ukraine, second dependency (share of exports to Russia in GDP) and other factors on EU exports: aggregate estimates of the OLS model with differentiated variables (dependent variable: exports to Russia $\Delta \ln \text{EXP}$)

Indicator	Title	Coefficient	p-value
const	Constant	-3,7696*	0,0773
$\Delta \ln_GDP$	GDP change (logarithmic)	1,3861***	<0,0001
SU	Sanctions indicator after the start of the war (0 – before the war, 1 – after)	-0,9266***	0,0044
$\ln_DE2$	Exports to Russia as a percentage of GDP (logarithmic) (how the EU economy depends on exports to Russia)	1,7596	0,2134
$\ln_SU_DE2$	Interaction between sanctions after the start of the war and secondary dependence (how the EU economy depends on exports to Russia in the context of sanctions against Ukraine)	3,0301***	0,0084
$\Delta \ln_EXR$	Currency exchange rate EUR/RUB (logarithmic)	-0,9478*	0,0757
$\Delta \ln F$	Inflation	0,0010	0,8978
FSU	Indicator for former USSR countries (1 – former, 0 – not former)	-0,0744	0,3437
$\ln_DIST$	Distance to Russia (logarithmic)	0,3529**	0,0282
θ_{2023}	Time variable reflecting the year 2023	0,7470**	0,0220
Sample size			351
Adapted R^2			0,3261

Note: ** indicates the significance of the indicator, with a 95% probability of falling within the confidence interval; *** – 99% probability. Although not all time variables are shown in the table, as some do not have a statistically significant effect on the dependent variable, they are included in the model as indicated in the models analyzed above.

The results in Table 5 indicate that the sanctions imposed after the onset of the war in Ukraine had a negative and statistically significant effect, reducing exports to Russia by approximately 93%. These findings align with previous studies (Dreger et al., 2016; Felbermayr et al., 2020; Kholodilin, Netšunajev, 2019). As in earlier models, export dependence alone is not significant, while the positive and significant interaction term suggests that more export-dependent countries experienced a smaller decline in exports, but only during the sanction period. GDP, distance, and the 2023 time variable are also significant: higher GDP increased exports, greater distance from Russia was associated with higher export volumes, and exports in 2023 exceeded those in the base period, likely reflecting adaptation to sanctions and alternative

trade routes. Inflation, exchange rates, and former USSR membership show no significant effects. The adjusted R^2 of approximately 0.33 indicates that the model explains about one-third of the variation in exports and is appropriate for further analysis.

Analysis of the models for both the annexation of Crimea and the war in Ukraine indicates that sanctions had a significantly negative effect on exports to Russia. During the annexation of Crimea, exports declined by approximately 97% (first dependency) and 84% (second dependency), while during the war in Ukraine they decreased by 98% and 93%, respectively. These results suggest that the sanctions imposed during the war in Ukraine had a stronger impact, thereby confirming hypothesis H1.

The analysis of dependencies and interactions

shows that the dependencies themselves are not significant, whereas the interaction terms are: countries more dependent on exports to Russia experienced a smaller decline in exports during sanctions than less dependent countries. Accordingly, hypothesis H2 is rejected.

The examination of macroeconomic factors indicates that exchange rates and inflation have no significant effect, while GDP is significant only during the war in Ukraine – higher GDP is associated with increased exports to Russia. Thus, hypothesis H3 is partially confirmed.

Geographical distance is significant across all models, with greater distance from Russia linked to higher export volumes, confirming hypothesis H4.

In summary, two hypotheses (H1 and H4) are confirmed, H3 is partially confirmed, and H2 is rejected.

Conclusions

Economic sanctions are a key instrument of international policy, employed to achieve political objectives without resorting to military intervention. Their effectiveness is enhanced when sanctions are coordinated internationally and when the target country is economically dependent on the sanctioning states. International trade theory supports that sanctions function as trade barriers, reducing efficiency and generating economic losses for both parties, particularly for larger and geographically proximate countries.

This study employs panel data regression to analyze EU countries over the period 2010–2023, using data collected from reliable databases. Gaussian-Markov assumptions and panel specification tests are assessed, and the results inform variable selection and data transformation for the model.

Based on the results of the differentiated logarithmic MKM model, only some of the research hypotheses were confirmed. Sanctions imposed during the war in Ukraine reduced EU exports to Russia more strongly than those imposed during the annexation of Crimea. Geographical distance also had a significant effect, confirming hypothesis H4:

greater distance is associated with more profitable trade transactions, contributing to higher export volumes.

GDP significantly influenced exports to Russia, with higher GDP linked to increased exports, but only during the sanctions period of the war in Ukraine. Exchange rates and inflation had no significant impact during either period, leading to the rejection of hypothesis H3. Similarly, hypothesis H2, which posited that EU countries more dependent on exports to Russia would experience a greater decline, was rejected. In fact, more dependent countries experienced a milder decline in exports, although dependence itself was not significant as an isolated factor. This likely reflects the efforts of highly dependent countries to stabilize export flows during sanctions.

Other factors, such as historical dependence on the former USSR bloc, showed no significant effect, while some time variables were statistically significant depending on the model specification. Overall, the model explains approximately 33% of the variation in exports, which is adequate given the macroeconomic focus of the analysis.

In the context of the EU, the findings of this study suggest several practical implications. Since sanctions are shown to reduce exports to Russia during their application, policymakers can use these results to guide further actions depending on the desired outcomes. If the objective is to restrict trade between EU countries and Russia, the evidence confirms that the current policy is effective and should be maintained. However, the finding that less dependent EU member states experience a greater negative impact may indicate a need to fine-tune policy implementation. Importantly, sanctions are designed to affect Russia's economy and global influence, not that of the exporting EU countries.

Additionally, the results can assist economists and analysts at both governmental and corporate levels in forecasting potential trade routes and the composition of exported goods. Consequently, individual countries should assess how sanctions on trade with Russia impact their own international trade flows and adjust strategies accordingly.

References

- Abboushi, S. (2010). Trade Protectionism: Reasons and Outcomes // *Competitiveness Review an International Business Journal Incorporating Journal of Global Competitiveness*. Vol. 20. No. 5: 384–394. doi:10.1108/10595421011080760
- Allen, S. H., Lektzian, D. J. (2013). Economic Sanctions: A Blunt Instrument? // *Journal of Peace Research*. Vol. 50. No. 1: 121–135. doi: 10.1177/0022343312456224
- Bapat, N. A., Heinrich, T., Kobayashi, Y., Morgan, T. C. (2013). Determinants of Sanctions Effectiveness: Sensitivity Analysis Using New Data // *International Interactions*. Vol. 39. No. 1: 79–98. doi: 10.1080/03050629.2013.751298
- Caetano, J., Galego, A., Caleiro, A. (2023). On the Determinants of Sanctions Effectiveness: An Empirical Analysis by Using Duration Models // *Economies*. Vol. 11. No. 5: 136. doi: 10.3390/economies11050136
- Caprile, A., Delivorias, A. (2023). EU sanctions on Russia: Overview, Impact, Challenges. *EPRS European Parliamentary Research Service*. – [https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI\(2023\)739366](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2023)739366) [2025 09 15].
- de Souza, G., Hu, N., Li, H., Mei, Y. (2024). (Trade) War and Peace: How to Impose International Trade Sanctions // *Journal of Monetary Economics*. Vol. 146(C). doi: 10.1016/j.jmoneco.2024.103572
- Drapkin, I., Sidorov, K., Mariev, O. (2022). The Effect of Sanctions on EU-Russia Trade: The Study for 2015–2019 // *Ekonomický Časopis*. Vol 70. No. 9–10: 743–767. doi: 10.31577/ekoncas.2022.09-10.04
- Dreger, C., Kholodilin, K. A., Ulbricht, D., Fidrmuc, J. (2016). Between The Hammer and the Anvil: The Impact of Economic Sanctions and Oil Prices on Russia's Ruble // *Journal of Comparative Economics*. Vol 44. No. 2: 295–308. doi: 10.1016/j.jce.2015.12.010
- Early, B., Peksen, D. (2018). Searching in the Shadows: The Impact of Economic Sanctions on Informal Economies // *Political Research Quarterly*. Vol 72. No. 4: 821–834. doi: 10.1177/1065912918806412
- Felbermayr, G., Kirilakha, A., Syropoulos, C., Yalcin, E., Yotov, Y. V. (2020). The Global Sanctions Data Base // *European Economic Review*, Vol. 129, No. 103561. doi: 10.1016/j.eurocorev.2020.103561
- Filipenko, A., Bazhenova, O., Stakanov, R. (2020). Economic Sanctions: Theory, Policy, Mechanisms // *Baltic Journal of Economic Studies*. Vol. 6. No. 2: 69–80. doi: 10.30525/2256-0742/2020-6-2-69-80
- Galtung, J. (1967). On the Effects of International Economic Sanctions: With Examples from the Case of Rhodesia // *World Politics*. Vol. 19. No. 3: 378–416. doi: 10.2307/2009785
- Head, K., Mayer, T. (2014). Gravity Equations: Workhorse, Toolkit, and Cookbook // *Handbook of international economics*. 131–195. doi: 10.1016/b978-0-444-54314-1.00003-3
- Hufbauer, G., Schott, J., Elliott, K., Oegg B. (2007). *Economic Sanctions Reconsidered, 3rd Edition*. – <https://tinyurl.com/yvr9vms9> [2025 09 16].
- Jeong, J. M., Peksen, D. (2017). Domestic Institutional Constraints, Veto Players, and Sanction Effectiveness // *Journal of Conflict Resolution*. Vol. 63. No. 1: 194–217. doi: 10.1177/0022002717728105
- Kaempfer, W. H., Lowenberg, A. D. (2007). Chapter 27 The Political Economy of Economic Sanctions. In *Handbook of defense economics*. 867–911. doi: 10.1016/s1574-0013(06)02027-8
- Kholodilin, K. A., Netšunajev, A. (2019). Crimea And Punishment: The Impact of Sanctions on Russian Economy And Economies Of The Euro Area // *Baltic Journal of Economics*. Vol. 19. No. 1: 39–51. doi: 10.1080/1406099x.2018.1547566
- Lukyanova, A., Zeynalov, A. (2022). *Russian Agricultural Industry under Sanction Wars*. arXiv.org. – <https://arxiv.org/abs/2211.09205> [2025 09 16].
- Morgan, T. C., Syropoulos, C., Yotov, Y. V. (2023). Economic Sanctions: Evolution, Consequences, and Challenges // *The Journal of Economic Perspectives*. Vol. 37. No. 1: 3–30. – <https://www.jstor.org/stable/27192407> [2025 09 16].
- Mulder, N. (2022). The Sanctions Weapon // *Finance & development*. Vol. 59. No. 2: 20–23. doi: 10.5089/9781513597300.022
- Neuenkirch, M., Neumeier, F. (2015). The Impact of UN and US Economic Sanctions on GDP Growth // *European Journal of Political Economy*. Vol. 40: 110–125. doi: 10.1016/j.ejpoleco.2015.09.001
- Olayiwola, W. K. (2015). Gravity Model by Panel Data Approach: Empirical Evidence from Nigeria // *International Journal of Trade and Global Markets*. Vol. 8. No. 1: 3–22. doi: 10.1504/IJTM.2015.067972
- Peterson, T. M. (2018). Reconsidering Economic Leverage and Vulnerability: Trade Ties, Sanction Threats, and The Success of Economic Coercion // *Conflict Management and Peace Science*. Vol. 37. No. 4: 409–429. doi:10.1177/0738894218797024
- Potrafke, N., Ruthardt, F., Wüthrich, K. (2020). Protectionism and Economic Growth: Causal Evidence from the First Era of Globalization. In Ifo Institute – Leibniz Institute for Economic Research at the University of Munich & Center for Economic Studies and Ifo Institute (CESifo), *CESifo Working Paper* (No. 8759). – https://www.econstor.eu/bitstream/10419/229577/1/cesifo1_wp8759.pdf [2025 09 16].
- Shevchenko, A. 2017. *Sankcii Zapada protiv Rossii: kto terjaet bol'she?*. – <https://riss.ru/analitica/sanktsii-zapada--protiv-rossii-kto-teryayet-bolshe/> [2025 09 17].
- Sinyakov, A., Roytman, A., Seleznev, S. (2015). Dinamika potencial'nogo VVP Rossii posle neftjanogo shoka: rol' sil'nogo izmenenija otnositel'nyh cen i strukturnyh zhestkostej. In Bank Rossii, Serija Dokladov Ob Jekonomicheskikh Issledovanijah. Bank Rossii. – https://www.cbr.ru/content/document/file/16735/wps_6.pdf [2025 09 17].