



Impacts of EU Sanctions Levied in 2014 on Individual European Countries' Exports to Russia: Winners and Losers

Morad Bali¹ · Thanh T. Nguyen² · Lincoln F. Pratson¹

Published online: 23 February 2024
© EEA 2024

Abstract

We analyse the effects of sanctions implemented by the European Union against Russia following the latter's annexation of Crimea in 2014. Indirect effects of sanctions on its non-prohibited exports to Russia are examined using a gravity model of trade that includes a time varying sanction index. A per country analysis is also incorporated to increase the granularity of the results. We find that sanctions led to a decrease in exports of non-prohibited products from certain European countries (i.e., the “losers”) while increasing such exports from others (i.e., the “winners”), an outcome that qualifies as an “unintended consequence” of the sanctions.

Keywords Economic sanctions · Sanction index · Gravity model · Russia · European union

JEL Classification F · C1 · C51

Introduction

Economic sanctions are an increasingly popular policy tool used by one or more “sender” countries to force a “target” country to stop or reverse an action (George et al. 1994). Of considerable interest to scholars and policy makers alike is whether sanctions are effective at achieving the sender's goals (Hufbauer et al. 1990a, 1990b, 2007), (Naghavi and Pignataro 2015), (Pape 1997, 1998), (Peksen 2019), (Timofeev 2019), (Weber and Schneider 2020). The focus of this study is not the effectiveness of sanctions implemented by the European Union (EU) against the Russian Federation (hereafter referred to as Russia) following the annexation of Crimea by the

✉ Morad Bali
morad.bali@irnc.org

¹ Nicholas School of the Environment, Duke University, Durham, USA

² Faculty of Economics and Management, Leibniz Universität Hannover, Hannover, Germany



Russian Federation on Feb. 20th, 2014, but instead the impact of the sanctions on non-prohibited exports from the EU to Russia.

Russia's annexation of the Crimean Peninsula and its military assistance to Pro-Russia separatists in the Donbass was opposed by many Western countries. To both punish Russia and pressure it to return Crimea back to Ukraine, the USA, the EU and many other countries imposed international economic sanctions on Russia starting in the spring of 2014. As of this writing these sanctions are still in force, and Russia has not changed its position. On the contrary, Russia's state Duma recognised Donetsk People's Republic and Luhansk People's Republic on the 21st of February 2022. Three days later, Russia's president announced: "the beginning of a special military operation in Ukraine". The recognition of Donbass self-proclaimed republics and the entry of Russian troops in Ukraine started a second wave of international sanctions against Russia. These new sanctions are not examined in this paper. Nonetheless, this study helps elucidate the potential unintended consequences (Vernon 1979) of the EU's approach to sanctions.

While a number of studies have already examined the effectiveness of the 2014 sanctions (Doornich and Raspotnik 2020), (Klinova and Sidorova 2019), (Nguyen and Do 2021), (Orlova 2016), (Pak and Kretzschmar 2016)), certain issues are still not fully resolved. For example, in response to restrictive measures imposed by the EU, Russia implemented countersanctions, including an embargo on European agri-food exports. Some studies report that Russia's counter sanctions successfully reduced these European exports (Harrell and Rosenberg 2016), (Havlik 2014), (Neuenkirch and Neumeier 2015), but others argue that the impact was minimal (Gros and Mustilli 2016). Complicating matters further is the finding by some authors that much of the decrease in trade between the EU and Russia was in goods not targeted by counter sanctions (Gros and Mustilli 2016). A possible reason for the latter is that European sanctions, or even Russian counter-sanctions, ended up having indirect effects on goods not targeted by the sanctions, a prospect that to our knowledge has not been further examined. Additionally, the findings of many of the studies of the 2014 sanctions derive from gravity models in which the sanctions were represented by a dummy variable (Nguyen and Do 2021). This method is very effective for simulating the onset of sanctions and analysing their immediate impacts but fails to account for changes in their effectiveness over time as the target country adapts to and works to mitigate these impacts.

We address the latter shortcoming by replacing the dummy variables of sanctions used in the gravity model approach with sanctions indices that simulate how the impact of economic sanctions varies over time (Bali and Rapelanoro 2021). We then use the model to analyse the effect of the 2014 EU sanctions on trade between European countries and Russia in goods not specifically targeted by the sanctions nor Russia's embargo. We also conduct the analysis on a per country basis following (van Bergeijk et al. 2019). This allows us to separate out which EU countries' exports to Russia were increased or decreased following implementation of the sanctions. The remainder of the paper is structured as follows: Section "[Background and Literature](#)" provides background information for our study and reviews the literature; Section "[Methodology](#)" introduces our data and methods; Section "[Results](#)"



presents our results; Section "[Discussion](#)" discusses findings; and Section "[Conclusion](#)" concludes.

Background and Literature

Given the past work on sanctions, including that associated with Russia's annexation of Crimea, it is essential that we distinguish how we are addressing sanctions in this study as compared to previous studies. There are two schools of thought regarding sanctions. The first uses datasets such as those created by (Hufbauer et al. 1990a, 1990b, 2007), (Morgan et al. 2009, 2014), (Soest and Portela 2012), (Biersteker et al. 2018), (Felbermayr et al. 2020), or (Weber and Schneider 2022). These studies focus on the extent to which sanctions achieve the implementers' stated goal. In this type of approach, an assessment is made of the sanctions' contribution towards achieving the sender's desired policy outcome (since many cases go hand in hand with military actions or other factors). This school thus follows a political science approach that was initially created in order to draw policy conclusions for informing debate on whether and how sanctions should be used (Hufbauer et al. 1990a). The second school aims at measuring sanctions economic effects with the help of econometric models (Fritz et al. 2017), (Gros and Mustilli 2016), (Dong and Li 2018), (Doornich and Raspotnik 2020), etc. These types of studies investigate economic changes that occur following the implementation of coercive diplomacy irrespective of whether the goals of the diplomacy are achieved. Thus, these studies are broader in that they also assess sanctions' impacts outside the context of the goals for the sanctions. Our study belongs to the second school of thought.

Details regarding the 2014 EU coercive measures against Russia are documented in the EU Council Regulations No. 692/2014 and No. 833/2014, as well as in the Council Decision 2014/145/CFSP. As regards Russia's 2014 counter-sanctions, Presidential decree No. 560 (Aug. 6th, 2014) enacted an embargo of certain agricultural products, raw materials and foodstuffs against countries that sanctioned Russia. Further details about the embargo are available in government resolutions No. 778 (Aug. 6th, 2014) and No. 830 (Aug. 20th, 2014). These measures can be subdivided into four categories: economic, financial, technological, and individual. Their impacts have been studied intensively. For example, the Russian economy has been found to suffer from an annual deceleration in the gross domestic product (GDP) of between 1% (Aalto and Forsberg 2016) and 3.8% (Davis 2016). Regarding international trade, several studies report that the sanctions caused losses for both the EU and Russia. (Fritz et al. 2017) estimate a trade loss between Russia and the EU (plus Switzerland) that oscillates between thirty four and ninety two billion euros. (Dragoi and Balgar 2016) find that EU-Russia trade shrank by seventy-five billion euros, costing to the European Union around thirty billion euros in lost exports. (Nureev and Petrakov 2016) find that Russia's import share from the EU decreased by 48.8% between January and October 2014. (Szczepański 2015) calculates a forty-one billion total trade value decline, and a 43% decline in European agri-food exports to Russia. There are also other studies that conclude that the impact of sanctions on



trade flows between Russia and the EU has been small (Havlik 2014), (Gros and Mustilli 2016).

One influence on the variance among estimated effects of sanctions on trade between the EU and Russia is that past studies have used different methods of quantitative analysis, making it difficult to compare results. Some use descriptive statistics (Nureev and Petrakov 2016), others short-term vs long-term forecasting (Fritz et al. 2017), and still others econometric modelling such as gravity models, logistic regressions, etc., among others (Bělin and Hanousek 2021), (Dong and Li 2018), (Fedoseeva and Herrmann 2019), (Bali 2018), (Fritz et al. 2017), (Nguyen and Do 2021). The way in which sanctions are simulated in the econometric studies can also influence results (Bali 2020), (Kauffmann et al. 2023). Often in such studies, economic sanctions are represented by a constant, binary dummy variable, which is constantly “on” over the period of sanctions. In reality, the impact of one or more sanctions changes over time as the target nation adapts to them and/or undertakes measures to counteract or work around the sanctions (Afesorgbor 2019), (Peksen 2019), (Secrieru and others, 2015), (Hellquist 2016), (Shagina 2018), (Vorotnikov et al. 2019), (Stash 2019), (Hastings 2022). (Crozet and Hinz 2020) simulate sanctions with a binary dummy variable in a gravity model to gauge the global effects of sanctions. In their study, they also use a general equilibrium counterfactual analysis (observed vs. predicted trade flows) disaggregated to the country level, comparing trade flows of sanctioning countries to those of non-sanctioning countries. Through this approach, the authors conclude that the bulk of “lost trade” (82.9%) during the sanction period is in effect collateral trade damage from the sanctions (Crozet and Hinz 2020, p. 21)¹. Their study is highly relevant to our work and even close to our preliminary calculations². Moreover, their research rejects the possibility that the decline in non-sanctioned goods was due to a boycott of European goods by Russian consumers, and instead find evidence that it was due to increased legal and political uncertainty over all exports to Russia. Of course, it is possible that Russian counter-sanctions inspired a boycott of EU goods by Russian citizens, but Crozet and Hinz’s finding parallels that of (Early and Preble 2020), who argue that the USA has chosen a strategy of keeping sanctions purposely vague so that exporters to a target nation over comply with the sanctions. (Giumelli 2017) is also interesting to our work as the author looks at the effects of EU sanctions on individual EU countries’ exports and argue that sanctions had a redistributive impact across the EU. Nonetheless, our modelling goes further as it replaces the need to use a counterfactual analysis (which lies on the overall forecast quality and de facto exclude the influence of unobserved exogenous variables) by time-varying sanction indices. As these indices evolve over time in parallel with other variables in our gravity model of trade, they also provide

¹ [Crozet and Hinz 2020, p. 12] state that between Dec. 2013 and Dec. 2015 “US\$5.4 billion, or 12.7% of Western lost trade, are accrued in embargoed products”. They also state that the EU bears 95% of all lost trade in non-embargoed products. Thus: $(1 - 0.127) * 0.95 = 0.82935 = 82.9\%$.

² Changes in EU exports to Russia are estimated by comparing a pre-sanctions period (May 2005 to Aug. 2014) to the period after the implementation of coercive measures (Sep. 2014 to Dec. 2019). We find a decrease in EU exports to Russia of €111B, in which embargoed products (Appendix A) account for just €16B or only 14% of this decrease. Data from Eurostat, value in euros, extracted on 17.02.20.



better estimates of their potential effects (causality) on our variable of interest, i.e., non-prohibited EU exports to Russia.

We aim at isolating sanctions' impacts, that is impacts that are due to the sanctions and not the result of emerging exogenous factors. Consequently, we incorporate time-varying sanction indices in our gravity modelling allowing us to simulate sanctions using time series analysis. The use of a composite sanction index in econometric models was first introduced by (Dreger et al. 2016) and updated in (Kholodilin and Netšunajev 2019). The "K-N" index is the aggregation of dummy variables over time whose values are relative to three sanction types: (i) "1" for a sanction against an individual; (ii) "2" when an entity is targeted; (iii) "3" for restrictions against an industry. These dummies are then weighted by the issuing country's share in the target's foreign trade.

As good as this methodology can be for a first try, it contains three important issues detailed in (Bali and Rapelanoro 2021). The first pertains to the three-tier scaling of the three types of sanctions. For example, sanctions against three individuals in this scheme would equal the value of a single sanction on an entire industry, which if the latter is critical to the target country would presumably be a far more susceptible to coercion. Secondly, although this methodology successfully simulates the implementation of new sanctions, the index either grows with the arrival of new measures or stagnates in their absence. This means that K-N index never decreases, implying that a sanction implemented in 2014 has the same impact in 2022 or later. However, as mentioned earlier, previous studies have shown that the impact of sanctions declines with time. Finally, sanctions as modelled using the K-N index are not treated independently from each other and no guidance is provided on how to adjust the K-N index in the event of lifted (or adjusted) restrictions.

All of these issues are addressed in the alternative framework for modelling sanction indices introduced in (Bali and Rapelanoro 2021). In this newer framework, each sanction is independent and defined by three parameters: (i) " α ", the initial impact of the sanction as defined by the user for different sanction types; (ii) " β ", which represents the sender's ability to inflict economic pressure on its target based on their trade interdependence and the sender's share of the target's economy; and (iii) " χ ", the decay rate at which the initial impact of the sanction wanes with time since onset. Additional details on the methodology are given in Section "Modelling".

In this study, we use time-varying indices to assess whether the EU's sanctions on Russia resulted in any "unintended consequences" for the EU. As (Herbert 2022) notes, while the term "unintended consequences" is frequently used in sanction literature it is rarely explicitly defined. For instance, in its basic principles on the use of restrictive measures³, the Council of the EU states that: "Targeting should reduce to the maximum extent possible any adverse humanitarian effects or unintended consequences for persons not targeted or neighbouring countries". What these consequences are and whether the EU could face them because of its own actions are not addressed. This appears to have led (Jones and Whitworth 2014, p. 22) to point out that while the EU accepted the direct costs of sanctions, it is unclear whether European policymakers recognised the sanctions' unintended consequences. Among

³ Document 10198/1/04 REV 1.



the possible consequences mentioned by (Jones and Whitworth 2014, p. 27), several became manifest as Russia sought new institutions around which to structure its economic interdependence (Eichengreen 2022). (Crozet and Hinz 2020) also mention that the strongest negative economic consequences for Western countries in absolute terms were not caused by Russia's embargo in response to the sanctions but were instead due to the unintended result of EU measures. In a broader perspective, (Herbert 2022) examines multiple sanction cases and finds that the pressure applied by sanctions through economic damage leads to unintended economic disruption.

Our work follows Vernon's (1979) definition of unintended consequences. They are "consequences which step beyond the boundaries of knowledge at the time of acting". Vernon identifies three mechanisms that generate unintended consequences: (i) cumulative; (ii) simultaneous or consecutive; and (iii) contextual change. The first refers to "the cumulative outcome of similar actions performed simultaneously or consecutively by a number of actors" (Vernon 1979, p. 59). The second is defined as "the simultaneous or consecutive performance of dissimilar actions by individuals or groups" (Vernon 1979, p. 63). And the third is described as "constantly shifting relation between instruments, eventual end, and mediate end" where "as the context shifts, projects and instruments acquire unforeseen uses and meanings" (Vernon 1979, p. 68). EU sanctions against Russia meet the criteria of being type (i) and type (iii) unintended consequences. They are type (i) because the sanctions were identical and imposed simultaneously by the 27–28 member countries, and they are type (iii) because the conditions for which the sanctions were implemented did not remain constant over time; Russia's destabilisation of Ukraine (within the Ukraine crisis), the entry of Russian troops in Crimea and its annexation, the downing of flight MH17, the indiscriminate shelling of residential areas (especially Mariupol), and the escalation of fighting in the Donetsk and Luhansk regions of Ukraine. Thence, sanctions were imposed for a long time and both their mediate ends and their ultimate ends changed significantly overtime. Thereby, as the context shifts, projects and instruments acquire unforeseen uses and meanings (Vernon 1979); changing context and ends could thus have led to unintended consequences. Thus, our assumption is that the sanctions levied by the EU against Russia in 2014 led to unintended economic consequences.

More specifically, we consider the possibility that the EU sanctions had unintended consequences on the EU's non-prohibited exports to Russia following the latter's annexation of Crimea. European prohibition on the export of dual-use and energy-related goods to Russia may have led to a lot of confusion for exporters given that these products are not clearly defined following the Standard International Trade Classification (SITC) scheme. Our analysis focuses on the EU countries' total exports to Russia reduced by all goods targeted by EU sanctions excepting dual-use and energy-related products because they cannot be identified with absolute certainty in SITC. More specifically, emphasis is placed on the EU exports to Russia net of goods targeted by the Russian embargo (Appendix A) and net of exports of arms and ammunition (SITC 891). This approach enables us to create counterfactuals for products that may have been indirectly impacted by the European sanctions, thereby quantifying the potential unintended consequences of the sanctions.



Methodology

This section first introduces the variables selected for our analysis and the source of our data. We then describe the construction of the sanction index used in our analysis (as introduced by (Bali and Rapelanoro 2021)) and our gravity model of trade. Because it is the first time that a time-varying sanction index is used in a gravity model of trade, a total of twelve versions of our model are run to assess its robustness. We first create two variants of the sanction index to assess the sensitivity of our results to changes of the amplitude of its values. We then create four model formulations using different variable combinations (which reflect different economic information) to guarantee the robustness of our model. Each of these four model formulations is firstly run with the untransformed sanction index, and then with its two variants distinctively.

Model's variables

The study period of our econometric analysis starts in 2003q1 and ends in 2019q4. The data are quarterly in frequency and include 68 observations per variable per country. The countries are the 28 that make up the EU during the study period. These countries are ordered alphabetically by country code⁴ (Appendix B) and identified as $i = 1, \dots, 28$. The variables include country-specific European exports to Russia ($XRU_{t,i}$), harmonised index of consumer prices ($HICP_{t,i}$), labour productivity ($LP_{t,i}$), producer prices in industry ($PPI_{t,i}$), the exchange rate of the considered country's currency against the Russian rouble ($ER_{t,i}$), the marginal lending key interest rate ($ML_{t,i}$), and the real effective exchange rate ($REER_{t,i}$). There are also two non-country-specific variables, the European sanction index (S_t) and Russia's GDP ($GDP_{t,r}$). Of these, the dependent variable in our model is European exports to Russia.

The basis for choosing the nine independent variables is as follows. The country's currency exchange rate against the Russian rouble ($ER_{t,i}$) affects trade with Russia since domestic currency depreciation increases exports and vice versa (Lerner 1952). The marginal lending key interest rate ($ML_{t,i}$) is selected because changes in key interest rates can lead to the appreciation or depreciation of exchange rates through the monetary transmission mechanism (Calvo and Reinhart 2002), (Christiano and Eichenbaum 1992), (Conway 1998), (Jeanne and Rose 2002), and (Lahiri and Végh 2002). Based on the findings of (Bournakis 2012), (Chaudhry and Bukhari 2013), (Lapp et al. 1995), we include real effective exchange rates ($REER_{t,i}$) in our model because in indicating the strength of a country's currency against a basket of other currencies, it helps reveal the price competitiveness of EU exports to Russia relative to those of exports from other countries. Given the evidence that high inflation can lead to low exports, particularly under persistent high inflation (Sonaglio et al. 2016), (Ahmed et al. 2018), (Gylfason 1999), (Edwards 1992, 1993), (Lovasy 1962), our model also includes the harmonised index of consumer prices ($HICP_{t,i}$),

⁴ ISO 3166 Alpha-2 code.



which measures the change over time in the prices of consumer goods and services purchased by euro area households⁵.

The inclusion of labour productivity ($LP_{t,i}$) addresses the potential for different nations' comparative economic advantage in labour for producing certain goods for export (Ricardo 1817), (Heckscher 1919), (Zwick 2004). Moreover, labour productivity is a determinant of firms' competitiveness in the export market (Deshmukh and Pyne 2013), (Wagner 2007). Factor endowments also include capital, which is reflected in the model with producer prices in industry ($PPI_{t,i}$) and can impact the cost of a nation's exports relative to those of other nations (Guillaumont and Guillaumont 1990). Finally, foreign income (here represented by ($GDP_{t,r}$)) is a traditional component of models analysing trade as it represents the purchasing power. The logic is that a decrease in the importer's GDP leads to a decrease of its imports (and thus foreign exports) and vice versa (Bournakis 2012), (Fountas and Bredin 1998), (Sonaglio et al. 2016), (Shane et al. 2008). This variable is the Russian GDP since exports in our model head towards Russia.

Data

Appendix C lists the source of the data used in this study, while Table 1 provides a descriptive summary. All data are stationary. To have a common currency among all series, Russia's GDP was converted from roubles to euros using the European Central Bank (ECB) reference exchange rate. Currency conversions to euros were also done in calculating the value of exports to Russia from countries outside the Euro Area (EA) (the UK pound, the Czech koruna, the Danish krone, the Croatian kuna, the Polish zloty, the Swedish krona, the Hungarian forint, and the Bulgarian lev), and for countries that joined the EA after 2003. For instance, Slovenia joined the EA on January 1, 2007, so the currency exchange rate used from 2007q1 on is the ECB's euro/Russian rouble, while from 2003 to 2006, the conversion involved exchanging the Slovenian tolar into euro, and then euro/Russian rouble. The same approach was used for the Cyprus pound and the Maltese lira (from 2003 to 2007), the Slovak koruna (from 2003 to 2008), the Estonian kroon (from 2003 to 2010), the Latvian lats (from 2003 to 2013), and the Lithuanian litas (from 2003 to 2014). For data involving EU members that joined the EA prior to 2003, the euro/Russian rouble rate is used.

The databases used for key interest rates ($ML_{t,i}$) varied depending on when the country joined the EA. For example, the official lending rate was used for Denmark and the short-term interest rate from the OECD for Estonia prior to them officially becoming members of the EA. For Croatia, the interbank market interest rate (ZIBOR) from the Central Bank of Croatia was used, while for Sweden, it was the key lending rate from Central Bank of Sweden. Day-to-day money market interest rate (averages) from Eurostat served as the rates for Austria, Belgium, Bulgaria, Czech Republic, Germany, Ireland, Greece, Spain, France, Italy, Luxembourg, Hungary, Netherlands, Poland, Portugal, Romania, Finland and the UK. Finally, rates for

⁵ https://www.ecb.europa.eu/stats/macroeconomic_and_sectoral/hicp/html/index.en.html



Table 1 Descriptive summary of the data

	Whole sample (n = 1904)	Before the introduction of sanctions (n= 1232)	After the introduction of sanctions (n = 672)
Exports to the RF (Million EUR)	242.16 (417.62)	237.02 (427.65)	251.57 ^a (398.71)
European sanctions index	32.68 (89.57)	0.00 (0.00)	92.60 ^{***, a} (131.14)
GDP of the RF (Million EUR)	433214.39 (90999.91)	489193.40 (49428.30)	330586.20 ^{***, a} (51975.30)
GDP of the EU countries (Million EUR)	117501.09 (176178.47)	113201.34 (169950.38)	125383.99 ^a (186932.53)
Distance between capitals (km)	1935.30 (748.12)	1935.30 (748.23)	1935.30 (748.48)
Real effective exchange rate	98.96 (6.18)	99.27 (6.67)	98.39 ^{***, a} (5.11)
Harmonised index of consumer prices	37.33 (24.87)	28.36 (18.32)	53.77 ^{***, a} (26.85)
Marginal lending key interest rate	1.69 (2.36)	2.59 (2.47)	0.04 ^{***, a} (0.60)
Labour productivity	94.90 (10.76)	91.03 (10.25)	102.01 ^{***, a} (7.59)
Exchange rate of the considered country's currency against the Russian rouble	93.00 (10.10)	88.13 (9.30)	101.93 ^{***, a} (2.70)
Producer prices in industry	95.83 (10.93)	92.44 (12.02)	101.98 ^{***, a} (4.00)

Standard deviation in parentheses; ^a: Two-sample *t*-test; ****p*<0.01, ***p*<0.05, **p*<0.1

Cyprus, Latvia, Lithuania, Malta⁶, Slovenia and Slovakia were obtained by merging two databases: (i) the day-to-day rate for Euro Area countries from Eurostat prior to these countries joining the EA, and (ii) EA day-to-day money market rate from Eurostat afterwards.

Sanction Index Construction and Sensitivity Test

Following (Bali and Rapelanoro 2021), S_t is the aggregation of sanctions over time and is written:

⁶ Values of 2007m1 and 2007m4 were missing and have been replaced by marginal lending key interest rate from Malta Central Bank.



Table 2 Values of sanction indices

Date	S_t	S_t^a	S_t^b	Date	S_t	S_t^a	S_t^b
2003q1 to 2013q4	0	0	0	2017q1	40.47	3.35	150.23
2014q1	0.74	0.74	0.74	2017q2	23.34	1.47	103.5
2014q2	12.53	12.35	12.97	2017q3	13.9	0.68	74.79
2014q3	233.29	209.69	247.35	2017q4	9.5	0.36	63.12
2014q4	334.76	262.4	382.38	2018q1	6.82	0.34	55.46
2015q1	471.62	319.75	581.04	2018q2	4.41	0.25	45.22
2015q2	332.35	180.39	458.25	2018q3	3	0.37	37.15
2015q3	235.5	100.77	366.19	2018q4	1.72	0.28	27.53
2015q4	172.54	57.38	305.07	2019q1	1.21	0.42	20.62
2016q1	132.23	34.06	266.41	2019q2	0.6	0.23	11.47
2016q2	86.96	16.96	201.79	2019q3	0.19	0.02	5.82
2016q3	58	8.49	156.16	2019q4	0.04	0	2.97
2016q4	46.65	5.09	147.46				

S_t is the unadjusted sanction index; S_t^a is the variant which translates a faster adaptation of Russia’s economy, while S_t^b induces a slower adaptation to sanctions

$$S_{t,k} = \sum_i s_{t,k,i} = \sum_i (\alpha_{t,k,i} * \beta_{t,k,j,i} * \chi_{k,i,u}) \tag{1}$$

Here, $s_{t,k,i}$ is sanction i imposed by country k on a target country j at time t , $\alpha_{t,k,i}$ is the sanction type, $\beta_{t,k,j,i}$ the economic leverage, and $\chi_{k,i,u}$ the time factor, which is given by:

$$\chi_{k,i,u} = (1 - u_{k,i}/U_{k,i})^{o_{k,i}} \tag{2}$$

with u ($u \in \mathbb{R}$) being a point in time during a sanction’s duration U . $\alpha_{t,k,i}$ is described by (Bali and Rapelanoro 2021) as a constant for which the value depends on the type of sanction and its ability to inflict economic pressure to their target (“0” when no sanctions; “1” for a sanction against an individual, and so on). Their logic is that a sanction against one individual (e.g. Putin’s daughter) is unlikely to inflict economic pressure, while a sanction against an entire sector (e.g. the EU’s ban to export oil exploration technologies to Russia) is more capable of creating economic pressure. $\beta_{t,k,j,i}$ is introduced by (Bali and Rapelanoro 2021) as a two components coefficient that includes (i) the trade intensity between the EU and Russia; (ii) the weighting of the EU’s total exports to Russia in Russia’s GDP. $o_{k,i}$ defines the slope of $\chi_{k,i,u}$ and thus the waning effectiveness of $s_{t,k,i}$. Note that the higher $S_{t,k}$, the stronger the cumulative impact of all sanctions $\sum_i s_{t,k,i}$ at time t . Since the time-varying indices used by (Bali and Rapelanoro 2021) were developed for EU sanctions against Russia, we use these authors’ values for $\alpha_{t,k,i}$ and $\chi_{k,i,u}$ (Appendix N). Their indices, however, are for a shorter period than we are analysing in this study (their study ends in April 2018 while ours ends in December 2019), so we have updated the sanction list, which is presented in Appendix O. We have also updated the economic



leverage ($\beta_{t,k,j,i}$) using trade data collected from Eurostat (EU imports from and exports to Russia), Russia's Federal State Statistics Service (Russia's GDP), and the Federal Reserve Economic Data (Russia's exports to the world) (see Appendix P). The updated indices used in this study are provided in Table 2.

As a time-varying sanction index has never been used in gravity modelling before, it is important to determine the best form (i.e. stationary and without multicollinearity) in which to cast the sanction index. Different options were explored (Appendix K.1., and D-J), leading us to use the first difference of the logarithm of the sanction index. This is the only form we tested that was stationary and did not suffer from multicollinearity. Additionally, this lagged form of the model ends up being particularly appropriate for our analysis as there is often a delay in the impact of sanctions (Klinova and Sidorova 2019).

Because there is subjectivity inherent to the adjustment of Bali's and Rapelano's (2021) calibrated values of $S_{t,k}$ (equation (1), we create two variants of $S_{t,k}$ by adjusting the time factor ($\chi_{k,i,u}$). To do so, we change the value of $o_{k,i}$, which again defines the slope of $\chi_{k,i,u}$ (equation (2) and thus the rate at which the impact of each sanction declines with time⁷. In one case, $o_{k,i}$ was increased twofold, which decreased $\chi_{k,i,u}$ and thus the sanction index (leading to variant S_t^a). In the other case, $o_{k,i}$ was decreased by half, which increased the sanction index and led to variant S_t^b . The initial index $S_{t,k}$ and its two variants S_t^a and S_t^b are displayed in Figure 1, which shows that S_t^b is larger than S_t , which in turn is larger than S_t^a . Thus, we will refer to S_t^a as the "weaker" sanction index (the one whose effects decrease faster over-time) and to S_t^b as the "stronger" index. Note that our use of the terms "weaker" and "stronger" is different from traditional use in political economics (Doxey 1980), (Morgan and Schwebach 1997a), (Hufbauer et al. 1990a, 1990b, 2003, 2007).

Modelling

We opt for a gravity model of trade because it is well suited to the study of sanctions' impact (Nguyen and Do 2021), (Rasoulinezhad 2019), (Le et al. 2022), or (Larch et al. 2022). Where this study differs from earlier work using such a model is our inclusion of a time-varying sanction index, which gives us the ability to quantify how trade flows measured by the gravity model change in response to the implementation of sanctions and the target country's adjustment to them. Gravity modelling was first established by (Tinbergen 1962) based on Newton's law of universal gravitation. The most basic form of the model (Shepherd and others, 2013) can be written as:

$$\log X_{ij} = c + b_1 \log \text{GDP}_i + b_2 \log \text{GDP}_j + b_3 \log \tau_{ij} + e_{ij} \quad (3)$$

⁷ Another possibility would have been to adjust the values of the α parameter provided by [Bali and Rapelano 2021], since it can also influence the shape of the index. However, because of the higher number of models that we have to run, multiplying these by a large number of different α values would have been a tremendous task that could be a full study by itself. As for the β parameter, adjusting it was not an option as its values are calculated with trade and GDP data.



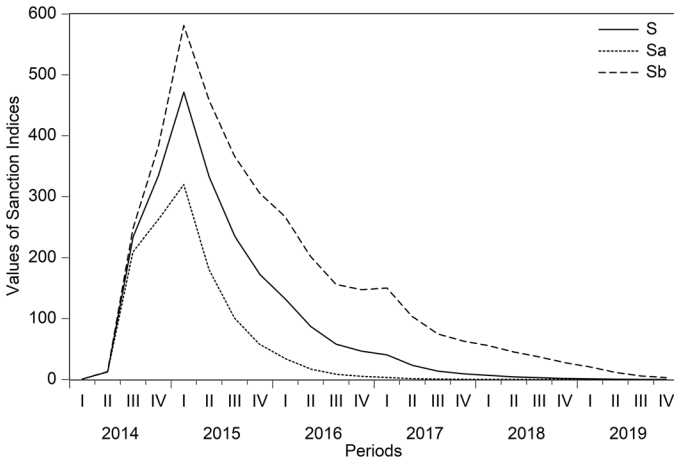


Fig. 1 Sanction Indices overtime. *Note:* Adjusting the χ parameter affects the adaptation time of Russia’s economy to sanctions (S_t^a translates a faster adaptation, S_t^b induces a slower adaptation) while preserving the initial (S_t) shape of the sanction index

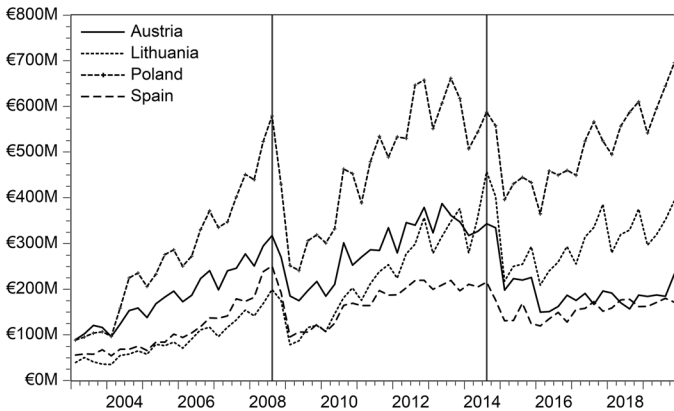


Fig. 2 Examples of EU nation exports for products not prohibited by sanctions (Austria / Lithuania / Spain / Poland). *Note:* EU nation exports to Russia strongly decreased twice, following the 2008-2009 economic crisis (left vertical line) and following the beginning of EU sectorial sanctions (right vertical line)

$$\log \tau_{ij} = \log (\text{distance}_{ij}) \tag{4}$$

where X_{ij} indicates country i exports to country j , GDP is the gross domestic product for each country, τ_{ij} is the trade costs between countries, distance_{ij} is the geographical distance between i and j , and e_{ij} is a random error term. The regression constant is c and coefficients to be estimated are b_1, b_2 , and b_3 .

Our model is a variation of equation (3). Again, the dependent variable in our case is European exports to Russia ($XRU_{t,i}$). $GDP_{t,r}$ is Russia’s GDP while $GDP_{t,i}$



are the GDPs of the EU exporting nations i , each of which is separated from Russia by the distance $dist_{r,i}$ between their capitals and Moscow (Appendix L). EU's sanctions are represented by the sanction index S_t . A dummy variable, $time_t$, is also included and represents whether the trade flow was before or after the imposition of sanctions in 2014. Assembling all these variables results in the following equation:

$$\begin{aligned} XRU_{t,i} = & \alpha + \beta FD(\ln_S_t) + \gamma \ln_{GDP_{t,r}} + \delta \ln_{GDP_{t,i}} + \theta \ln_{dist_{r,i}} + \vartheta REER_{t,i} \\ & + \rho HICP_{t,i} + \varphi ER_{t,i} + \lambda PPI_{t,i} + \zeta ML_{t,i} + \phi LP_{t,i} + \psi time_t + \varepsilon_{t,r,i} \end{aligned} \quad (5)$$

Because equation (5) has two price indices ($HICP_{t,i}$ and $PPI_{t,i}$) and two exchange rate measures ($ER_{t,i}$ and $REER_{t,i}$), we try four different combinations of these variables to avoid variable redundancy (Appendix K.2., Eqs. 6–9). The different combinations also serve as a robustness test as these variables reflect different information. As results from these four model formulations end up being really close (Table 3), for the sake of simplification we focus only on equation (6)⁸. Note that we also conducted additional robustness tests in which (i) the price of oil was added to our models; (ii) our independent variables were lagged to avoid potential endogeneity issues; (iii) the price of oil was added to our models and our independent variables were lagged. The outcome of these robustness test does not go against our findings and do not significantly change our results. Details are available in Appendix Q.

$$\begin{aligned} XRU_{t,i} = & \alpha_{c1} + \beta_{c1} FD(\ln_S_t) + \gamma_{c1} \ln_GDP_{t,r} + \delta_{c1} \ln_GDP_{t,i} + \theta_{c1} \ln_dist_{r,i} \\ & + \vartheta_{c1} REER_{t,i} + \lambda_{c1} PPI_{t,i} + \zeta_{c1} ML_{t,i} + \phi_{c1} LP_{t,i} + \psi_{c1} time_t + \varepsilon_{t,r,i}^{c1} \end{aligned} \quad (6)$$

Several methods could be used to estimate gravity models such as ordinary least squares (OLS), panel random-effects, and panel fixed-effects. We opt for the Poisson pseudo-maximum likelihood (PPML) estimator proposed by (Silva and Tenreiro 2006) because of its advantages over heteroscedasticity and zero trade flows (Yotov et al. 2016). Furthermore, to prevent spatial autocorrelation, our estimation at the country level is clustered to have robust standard errors.

Results

This section begins with an analysis of the main trends that surround EU exports to Russia. We then proceed with results from our sensitivity tests and the impact of sanctions on non-prohibited EU exports at the scale of the entire European Union (Table 3, 4 and 5). The last subsection provides results of our per country analysis, in which models 6-17 are rerun for each EU country independently from each other (28 estimations for each type of model)—results are displayed in Tables 6, 7, and 8.

⁸ It is also the only one that leads to results statistically significant for $p < 0.001$, while others are passing either $p < 0.05$ or $p < 0.1$.



Table 3 Impact of EU countries' sanctions on export to Russia: the first difference of sanction values

	Export of European countries to Russia			
	Model (6)	Model (7)	Model (8)	Model (9)
European sanctions index (First difference of logarithm of sanction values)	-0.058*** (0.018)	-0.033* (0.018)	-0.051* (0.029)	-0.050** (0.020)
GDP of the RF (ln)	1.834*** (0.321)	1.854*** (0.273)	2.145*** (0.180)	1.796*** (0.315)
GDP of the EU countries (ln)	0.892*** (0.083)	0.873*** (0.075)	0.874*** (0.072)	0.892*** (0.082)
Distance between capitals (ln)	-1.924*** (0.290)	-1.991*** (0.292)	-1.998*** (0.293)	-1.919*** (0.284)
Real effective exchange rate	0.001 (0.012)		-0.009 (0.013)	
Harmonised index of consumer prices		0.006 (0.006)	0.006 (0.007)	
Marginal lending key interest rate	-0.089** (0.042)	-0.053 (0.039)	-0.078* (0.040)	-0.078* (0.044)
Labour productivity	0.009* (0.005)	0.008* (0.004)	0.011** (0.005)	0.009* (0.005)
Exchange rate against the Russian rouble		0.017*** (0.006)		0.011 (0.021)
Producer prices in industry	0.008 (0.009)			0.002 (0.016)
Sanction time (Dummy)	0.384*** (0.099)	0.196* (0.113)	0.386** (0.162)	0.306** (0.139)
_cons	-2.039 (3.529)	-2.387 (3.151)	-4.003 (2.870)	-1.926 (3.770)
Number of observations	1888	1904	1904	1888
R-squared	0.876	0.890	0.889	0.879

Robust standard errors clustered at country level in parentheses; ln: natural logarithm; In model (6.3) and (6.4), 16 observations are excluded due to the missing data in producer prices in industry (the total observations decrease from 1904 to 1888); *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Trend Analysis

We identified that EU exports to Russia of products not targeted by sanctions from most EU countries follow similar trends (Appendix M). These are illustrated with four countries: Austria, Lithuania, Spain, and Poland (Figure 2). Between 2003q1 and 2008q2, seasonally varying exports from these countries increased. A marked decline then occurs in 2008q3 (left vertical line in Figure 2), most likely due to the global financial crisis when Russia's GDP collapsed between 2008 and 2009. Exports then resumed increasing until 2014q3 (right vertical line in Figure 2). A potential cause here is the collapse of Brent oil price (Figure 3), which affected



Table 4 Impact of EU countries' sanctions on export to Russia: the first difference of sanction values with a target economy that adapts twice faster to sanctions

	Export of European countries to Russia			
	Model (10)	Model (11)	Model (12)	Model (13)
European sanctions index (S_t^e)(First difference of logarithm of sanction values with twice-weaker economic pressure over time)	-0.043*** (0.013)	-0.023* (0.014)	-0.036 (0.023)	-0.036** (0.015)
GDP of the RF (ln)	1.729*** (0.285)	1.793*** (0.268)	2.064*** (0.181)	1.700*** (0.280)
GDP of the EU countries (ln)	0.892*** (0.083)	0.873*** (0.075)	0.874*** (0.072)	0.892*** (0.082)
Distance between capitals (ln)	-1.923*** (0.291)	-1.992*** (0.292)	-1.999*** (0.293)	-1.918*** (0.284)
Real effective exchange rate	0.001 (0.012)		-0.010 (0.013)	
Harmonised index of consumer prices		0.006 (0.006)	0.007 (0.007)	
Marginal lending key interest rate	-0.087** (0.042)	-0.051 (0.038)	-0.076* (0.039)	-0.076* (0.043)
Labour productivity	0.009* (0.005)	0.008* (0.004)	0.012** (0.005)	0.009* (0.005)
Exchange rate against the Russian rouble		0.017*** (0.006)		0.012 (0.021)
Producer prices in industry	0.009 (0.009)			0.002 (0.016)
Sanction time (Dummy)	0.330*** (0.082)	0.160 (0.099)	0.340** (0.144)	0.254** (0.127)
_cons	-0.753 (3.206)	-1.651 (3.129)	-2.940 (2.749)	-0.769 (3.387)
Number of observations	1888	1904	1904	1888
R-squared	0.875	0.890	0.889	0.879

Robust standard errors clustered at country level in parentheses; ln: natural logarithm; In model (K.3) and (K.4), 16 observations are excluded due to the missing data in producer prices in industry (the total observations decrease from 1904 to 1888); *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Russia's GDP (Mikhaylov 2019) and may have led to the reduction in Russia's EU imports. The decline, however, may also have been due to unintended consequences of the EU sanctions. Our analysis goes on to address this second decline in EU exports, which ended up being as steep as the decline across the 2008 financial crisis.



Table 5 Impact of EU countries' sanctions on export to Russia: the first difference of sanction values with a target economy that adapts twice slower to sanctions

	Export of European countries to Russia			
	Model (14)	Model (15)	Model (16)	Model (17)
European sanctions index (S_t^b) (First difference of logarithm of sanction values with twice-stronger economic pressure over time)	-0.062*** (0.019)	-0.036* (0.019)	-0.054* (0.030)	-0.054*** (0.020)
GDP of the RF (ln)	1.841*** (0.319)	1.863*** (0.269)	2.149*** (0.179)	1.806*** (0.315)
GDP of the EU countries (ln)	0.892*** (0.083)	0.873*** (0.075)	0.874*** (0.072)	0.892*** (0.082)
Distance between capitals (ln)	-1.924*** (0.290)	-1.991*** (0.292)	-1.998*** (0.293)	-1.919*** (0.284)
Real effective exchange rate	0.001 (0.012)		-0.009 (0.013)	
Harmonised index of consumer prices		0.006 (0.006)	0.006 (0.007)	
Marginal lending key interest rate	-0.089** (0.042)	-0.053 (0.039)	-0.078* (0.040)	-0.078* (0.043)
Labour productivity	0.009* (0.005)	0.008* (0.004)	0.011** (0.005)	0.009* (0.005)
Exchange rate against the Russian rouble		0.017*** (0.006)		0.011 (0.021)
Producer prices in industry	0.008 (0.009)			0.002 (0.016)
Sanction time (Dummy)	0.399*** (0.101)	0.207* (0.114)	0.398** (0.169)	0.319** (0.139)
_cons	-2.144 (3.509)	-2.513 (3.093)	-4.065 (2.859)	-2.063 (3.758)
Number of observations	1888	1904	1904	1888
R-squared	0.876	0.890	0.889	0.879

Robust standard errors clustered at country level in parentheses; ln: natural logarithm; In model (K.7) and (K.8), 16 observations are excluded due to the missing data in producer prices in industry (the total observations decrease from 1904 to 1888); *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Sensitivity Tests and Overall Impact of Sanctions

Prior to applying our model in analysing the impact of EU sanctions on European exports, we first put the model through a series of sensitivity tests. In total, eight sensitivity tests are run, that is two sanction indices (S_t^a , S_t^b) for each of the four model formulations (Appendix K.3, Eqs. 10–17). The outcome of these tests (Tables 4 and 5) confirms that differences in either of these factors does not affect the trends in our results. Thence, when the four model formulations (Appendix K.2, Eqs. 6–9)



Table 6 Decomposed impact of EU countries' sanctions on export to Russia with the first difference of sanction values

Country	Export of European countries to Russia			Country	Export of European countries to Russia		
	Model (6)	Model (7)	Model (8)		Model (6)	Model (7)	Model (8)
Austria				Hungary		3.7%	
Belgium		-2.9%		Ireland			
Bulgaria			-7.2%	Italy	-2.4%		
Cyprus	-17.4%		-17.1%	Lithuania			
The Czech Republic				Luxembourg			
Germany	2.2%	2.4%	2.4%	Latvia			
Denmark				Malta		-54.9%	-67.3%
Estonia	4.3%			Netherlands	-6.5%	-5.3%	-6.4%
Spain		3.3%		Poland	-5.6%		-5.5%
Finland			3.9%	Portugal	-5.9%		-4.7%
France				Romania	5.3%	6.9%	12.0%
The United Kingdom	-4.9%		-3.9%	Sweden			6.8%
Greece	-18.4%	-10.1%	-16.5%	Slovenia	-4.8%	-4.6%	-5.9%
Croatia				Slovakia		6.0%	8.3%

Only significant impacts are reported



Table 7 Decomposed impact of EU countries' sanctions on export to Russia with the first difference of sanction values and twice-weaker economic pressure over time (S_t^2)

Country	Export of European countries to Russia			Country	Export of European countries to Russia						
	Model (10)	Model (11)	Model (12)		Model (10)	Model (11)	Model (12)				
	Model (10)	Model (11)	Model (12)		Model (10)	Model (11)	Model (12)				
Austria											
Belgium		-3.4%		Hungary							
Bulgaria				Ireland							
Cyprus				Italy			-2.6%				
The Czech Republic			2.8%	Lithuania							
Germany		1.8%		Luxembourg							
Denmark				Latvia							
Estonia				Malta				-41.1%			-48.2%
Spain		2.9%		Netherlands			-6.1%				-5.0%
Finland			2.8%	Poland			-4.4%				
France				Portugal			-5.0%				
The United Kingdom		-4.1%		Romania			4.8%	6.2%			6.4%
Greece		-13.1%		Sweden							
Croatia				Slovenia			-4.4%				-3.5%
				Slovakia							7.7%

Only significant impacts are reported



Table 8 Decomposed impact of EU countries' sanctions on export to Russia with the first difference of sanction values and twice-stronger economic pressure over time (S^p)

Country	Export of European countries to Russia			Country	Export of European countries to Russia		
	Model (14)	Model (15)	Model (16)		Model (14)	Model (15)	Model (16)
Austria				Hungary	3.6%	4.1%	
Belgium		-3.1%		Ireland			
Bulgaria	-8.2%		-9.6%	Italy	1.7%		
Cyprus	-19.3%		-19.2%	Lithuania	-4.1%		
The Czech Republic			2.9%	Luxembourg			
Germany		2.2%		Latvia			
Denmark				Malta			-63.9%
Estonia				Netherlands	-5.3%	-5.3%	-4.9%
Spain		3.2%		Poland	-5.6%		-4.0%
Finland			3.5%	Portugal	-5.2%		
France				Romania	4.6%	6.1%	5.9%
The United Kingdom	-6.1%		-5.3%	Sweden			
Greece	-18.7%	-10.3%	-16.8%	Slovenia	-5.2%	-5.1%	-4.4%
Croatia				Slovakia	4.9%	7.3%	

Only significant impacts are reported



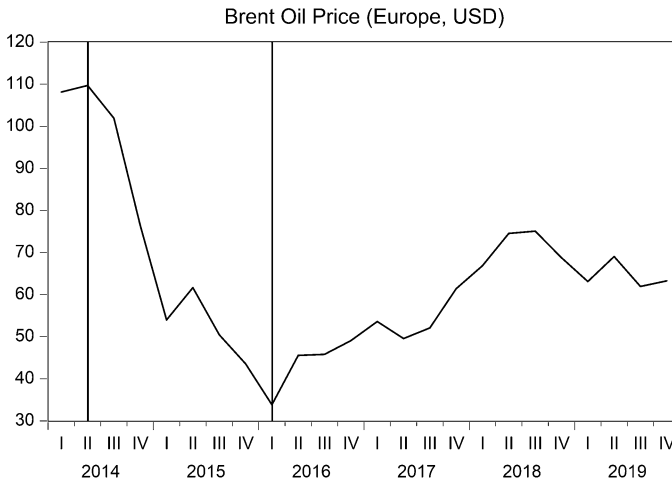


Fig. 3 Evolution of Brent Oil Price (Europe). *Note:* The price of oil decreased sharply right when EU sanctions went in force, potentially affecting Russia's GDP Mikhaylov (2019) and eventually leading to the reduction in Russia's EU imports. The left and right vertical lines respectively mark the beginning and end of oil's collapse. (Data source: U.S. Energy Information Administration, Crude Oil Prices: Brent—Europe)

use the unadjusted sanction index (S_t), all produce statistically significant results that indicate that EU sanctions had an overall effect of decreasing non-prohibited EU exports to Russia. Model formulation (6) produced the greatest decrease, with the average among the twenty-eight European economies being a 5.8% decline in exports when S_t is increased by one per cent (Table 3). Furthermore, this same overall result of decreased exports is also produced when S_t is replaced by either S_t^a or S_t^b , confirming the negative impact of European coercive measures on its own non-prohibited exports to Russia. Under “weaker” sanctions, a one per cent increase of (S_t^a) decreases exports by 2.3–4.3% (Table 4 and Appendix K.3., Eqs. 10–13). Under “stronger” sanctions, a one per cent increase of (S_t^b) decreases exports by 3.6–6.2% (Appendix K.3., Eqs. 14–17). In other words, model results are consistent even when the initial calibration of the index's time factor is oversized or undersized. This outcome complements the results of such previous studies as (Doxey 1980), (Hufbauer et al., 2003) and (Whang 2010). In summary then, sensitivity tests indicate that the main trends of our results are not affected by different variable combinations nor by adjustments of the sanction index, indicating that our modelling approach is robust.

Per Country Analysis

While EU sanctions are associated with a negative effect on EU exports to Russia overall, the European Union is composed of countries with different economic structures and trade patterns, and whose level and types of trade with Russia differ. For example, among European countries, Italy was the second largest exporter to Russia



in 2012 at €10B, while Denmark's trade was an order of magnitude less (€965M). Given these differences, we follow the recommendation of (van Bergeijk et al. 2019) and also analyse the impact of the sanctions on a per country basis. Applying our models at this level (Appendix K.2, Eqs. 6–9), we find that EU sanctions reduced exports to Russia from Belgium, Bulgaria, Cyprus, The United Kingdom, Greece, Italy, Malta, Netherlands, Poland, Portugal, and Slovenia. The export declines of non-prohibited products from Malta, Greece and Cyprus are the greatest, being up to 67.3%, 18.4%, and 17.4%, respectively, for a one per cent increase of the sanction index. Other EU countries that are also negatively impacted by EU sanctions suffer trade losses ranging from -2.4% to -7.2%, with an average of -5.2%, when S_t increases by one per cent.

Over the same period, however, EU sanctions appear to have stimulated exports from the Czech Republic, Germany, Estonia, Spain, Hungary, Romania, and Slovakia. In particular, when sanctions increase by one per cent Romania's exports to Russia increase by 7.8% while for Slovakia, they increase by 7.2%. Other countries that gain from sanctions have an average increase of 3.4%. Comparing all countries whose non-prohibited exports decrease (by an average of -13.1%) to all those whose exports increase (by an average of 4%), there are more of the former (eleven countries) than the latter (seven countries).

We note that of these, the results for Germany, Romania, Greece, Netherlands, and Slovenia are statistically significant in all four model formulations (Appendix K.2, Eqs. 6–9). Furthermore, the results produced with S_t for Greece, Netherlands, Romania, and Slovenia are statistically significant for each variable combination used and have similar trends with those produced with S_t^a and S_t^b (Tables 7 and 8, respectively). The latter also applies to the results for Belgium, The Czech Republic, Germany, Spain, The UK, Malta, Poland, and Portugal, except that not all model runs were statistically significant. In the cases of Bulgaria, Cyprus, Hungary, Italy, and Slovakia, our results using S_t trend like those when either S_t^a or S_t^b is used, suggesting these results are still robust, though somewhat less so. The results for the ten remaining countries analysed—Austria, Denmark, Finland, France, Croatia, Ireland, Lithuania, Luxembourg, Latvia, and Sweden—lack of statistical significance (see Table 6 and Figure 4).

Discussion

Previous studies of the 2014 Ukraine crisis have revealed that EU sanctions and Russian countersanctions caused trade losses for both sides (Dragoi and Balgar 2016), (Fritz et al. 2017), (Nureev and Petrakov 2016), (Szczepański 2015). A fundamental point raised by (Crozet and Hinz 2020) is that 82.9% of the total loss in Western trade is recorded for non-prohibited products⁹. Using their results, we calculate that the average monthly decrease of non-prohibited EU exports to Russia

⁹ [Crozet and Hinz 2020] integrate the EU and other western countries that implemented sanctions against Russia.



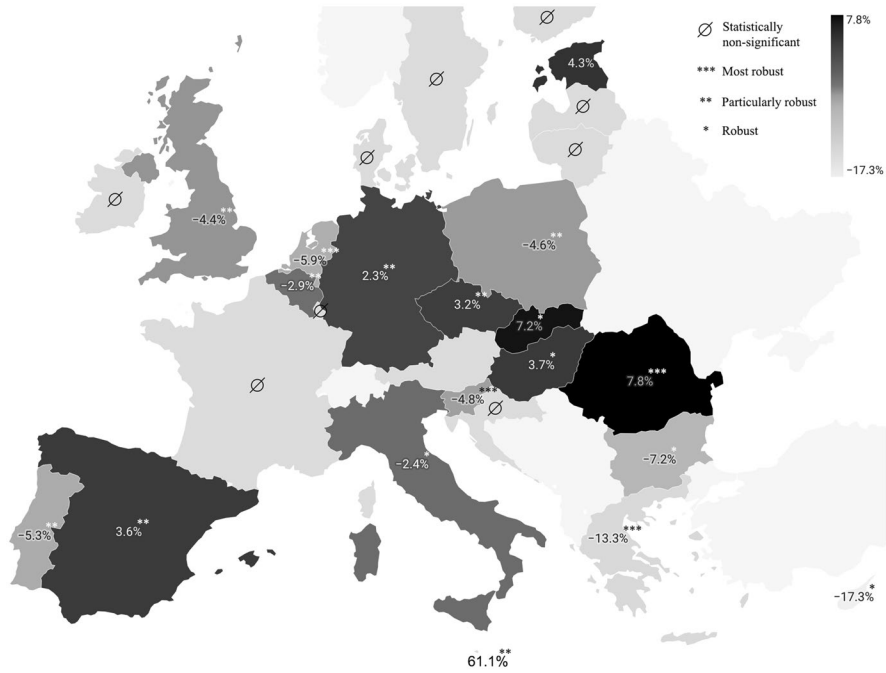


Fig. 4 Impact of EU Sanctions on European Exports to Russia. Note: Values displayed are the average of results of models 6-9 (full results reported in Table 5). EU countries respond differently to an increase of sanctions, with nations whose exports increased under sanctions tend to be closest to Russia (Estonia, Germany, The Czech Republic, Slovakia, Hungary, and Romania), while those whose exports decreased tend to be furthest away (Malta, Greece, Cyprus, The UK, and Portugal). Poland and Spain, however, are respective exceptions to both trends

was US\$2.04B¹⁰. (Crozet and Hinz 2020) attribute these losses to the sanctions based on their comparison of predicted trade flows (assuming sanctions did not happen) to observed trade flows. However, as they do not use a time-varying sanction index in their model, it is not certain that their counterfactual analysis fully isolates the effects of the sanctions from those of other unpredicted exogenous factors that might have affected EU-Russia trade during the sanction period. For example, Russia’s GDP and in turn imports were negatively impacted by the 2014–15 drop in the price of Brent oil (Mikhaylov 2019). While we cannot directly compare our results to those of (Crozet and Hinz 2020), our findings suggest that the decrease of non-prohibited EU exports to Russia due to sanctions might be much lower than (Crozet and Hinz 2020) postulated. What we find is that when the intensity of sanctions increases by one per cent, the quarter-on-quarter average decline in non-prohibited EU exports to Russia equals 5.8% or €968.64M (around US\$1.075B in 2015¹¹). On

¹⁰ [Crozet and Hinz 2020, p. 48]: “We find that the global “lost trade” [...] amounts to US\$3.2 billion per month. [...] with European Union member states bearing 76.7% of the overall impact. Interestingly, the bulk of the “lost trade,” 83.1%, is incurred through non-embargoed products, and can hence be considered “collateral damage.””. Thus, $[3.2 * 0.767 * 0.831] = 2.04$.

¹¹ Using a yearly average closing price of 1€=1.11US\$.



a monthly basis then, this reduction is only 17.6% of that predicted by (Crozet and Hinz 2020).

Additionally, by using a per country analysis, our study shows that EU sanctions likely contributed to an increase in exports to Russia from some EU nations even as exports from other EU nations decreased. We use the term “likely” because other factors may have also influenced the measured changes in exports among the EU nations. One is Russia’s countersanctions, which like the EU sanctions may have also had negative indirect impacts on trade in non-sanctioned goods. Hence, Russian importers may have been unsure which goods should not be imported and so out of caution reduced imports of a broader range of EU goods. Another one is that, as previously noted, we are unable to separate out the dual-use goods that the EU also blocked from being sold to Russia, and it is possible that part of the impact to EU exports stem from those sanctions. Yet, while the export value of dual-use goods for military use in such areas as electronics, computers and communications can be significant, it seems unlikely that the 2014 EU sanctions would have led to an increase in exports to Russia from some EU nations of these types of goods.

Despite these additional factors, we believe the majority of changes in EU exports to Russia of non-sanctioned goods stem from the EU sanctions. Russia’s response to the 2014 international economic sanctions mainly took the form of a ban of agri-food products from countries that had imposed sanctions against Russia¹². If this embargo was initially strong and had an impact on EU exporters, its effect unavoidably decreased as EU economic actors found alternative trade opportunities (Cheptea and Gagné, 2020). Russia did not impose other measures of similar strength until the second wave of sanctions (Feb. 2022). In that manner, Russian sanctions can be considered as “shorter” and “weaker” than EU sanctions during the first wave, as a one-time embargo (imposed on Aug. 7th, 2014) was facing a total of fourteen sectorial sanctions imposed over nine months (Appendix O). Thus, it seems reasonable to assume that EU sanctions had more chances to lead to unintended consequences (as linearly captured overtime by the models introduced in this study) than the Russian embargo.

Assuming then that the export changes are in fact indirect effects of the EU sanctions on the EU’s own exports, an outstanding question is why the effects varied among EU nations. One possible reason for this is differences in distance and thus shipping costs to Russia. As Figure 4 shows, nations whose exports increased under sanctions tend to be located closest to Russia and would have had the lowest shipping costs (Estonia, Germany, The Czech Republic, Slovakia, Hungary, and Romania), while those whose exports decreased tend to be located furthest away and would have had the highest shipping costs (Malta, Greece, Cyprus, The UK, and Portugal). Poland and Spain, however, are respective exceptions to both trends. Poland borders Russia yet its exports decreased, while Spain is among the countries furthest away from Russia, and its exports increased. A second possible reason for the difference in exports among EU nations is that whose exports increased under sanctions included substitutes for products targeted by the sanctions. Support for this

¹² Russia also imposed diplomatic and individual sanctions but such sanctions *per se* do not have much ability to inflict a large scale economic pressure.



hypothesis, however, requires a proper sectorial analysis, which is beyond the scope of this study. Lastly, not all exports are domestically produced. Netherlands, Portugal, Greece, Malta, and Cyprus, have ports where goods from outside of Europe come in, and are then distributed to countries within Europe, i.e. re-exported. And since re-exports are included in countries' total exports¹³, it may be that sanctions led to a re-direction of goods away from these EU distribution ports out of fear that certain merchandise would fail to clear customs for re-export from the EU to Russia. There is also the possibility that the EU sanctions ended up having a weaker effect on some European countries' exports while having a stronger effect on those of others. Our sensitivity tests show that the adaptation time of the targeted economy is an essential determinant of sanctions' effects. When $o_{k,i}$ is increased twofold (which simulates a faster adaptation time of the economy), the resulting index (S_i^a) is a smaller version of S_i , as in a situation where "weaker" sanctions are implemented. In this scenario, the negative effects of EU sanctions on non-prohibited exports (at the country level) are reduced by 25.9%¹⁴. In the opposite situation, when $o_{k,i}$ is weakened by half, S_i^b is equivalent to the implementation of "stronger" sanctions. In that case, the negative effects of EU sanctions on non-prohibited exports are increased by 6.9%¹⁵. It might suggest that sanctions' collateral damage is a function of the sanction type (strong vs. weak), and that weak sanctions are less costly for the sender than strong sanctions. Nonetheless, this is hypothetical and requires further work to be verified.

A particularly noteworthy result of our study is that when 2014q1 is used as a reference period (before the implementation of EU sanctions), the estimated value of the quarterly shortfall due to a one per cent increase of S_i for countries whose exports decline is equal to €106M, while for the countries whose exports increase, the total change is €110M. Interestingly, the two estimates differ by only €4M. This suggests—*ceteris paribus*—that the countries whose exports increased under the sanctions may have done so at the expense of the countries whose exports decreased. This speculative idea involves two uncertainties. First, this result is limited to the European Union only, and does not extend to Russia's other trading partners during the study period, such as Ukraine, China, Brazil, Turkey, or countries of the Eurasian Economic Union. In fact, trade flows from these latter countries may have contributed to the balance between export increases and decreases among EU nations, making the latter more a coincidence than a direct result of the sanctions. And second, a more thorough per country per sector analysis may produce results that are even more diverse and complex. For instance, such an analysis might show that an overall increase/decrease of total exports involve only one sector with the exports from other sectors remaining unchanged. If true, then why such a new trade order emerged between Russia and EU nations following sanctions is unclear and beyond

¹³ "Re-exports are exports of foreign goods in the same state as previously imported; they are to be included in the country's exports", United Nations Statistics Division.

¹⁴ Comparison of model 6 to model 10.

¹⁵ Comparison of model 6 to model 14.



the scope of this analysis¹⁶. A proper investigation of the cause(s) would probably require the use of a multi-country dynamic stochastic general equilibrium model that integrates a time varying sanction index. Regardless, we still observe changes in the trade of products not prohibited by sanctions. Ab hinc, the trend analysis introduced in Section "Trend Analysis". As along with the results of our modelling indicates that sanctions are the cause for these changes. Given that these consequences emerged after sanctions were implemented, we classify them as unintended per se (Vernon 1979).

Understanding "why" trade reorganised itself the way that it did following sanctions' imposition is an important area of future research, for it would aid policy-makers in better designing sanctions that avoid self-infliction of negative externalities. For instance, our study raises the question as to whether the Council of the EU fully considered the different trade characteristics of each EU country when imposing sanctions. Comprehensive sanctions could be designed to minimise the economic costs they may cause to each EU member country, while simultaneously maximising potential benefits for these countries and the overall effectiveness of the sanctions. By doing so, sanctions could be better optimised to have maximum effect on the target country while minimising deleterious side effects for the sender countries. Besides, the latter would not go against the basic principles on the use of restrictive measures (Council documents 10198/1/04 Rev 1; 5664/18; 10572/22). This of course assumes that not only direct but also indirect impacts of sanctions can be adequately anticipated in advance. There is also the constraint that optimisation should not lead to scattered sanctions that divide and thus weaken their collective capacity to inflict economic pressure (Morgan and Schwebach 1995, 1997b), (Rodman 1995). The EU already demonstrated that this balance is possible with the suspension of the visa facilitation agreement with Russia on the 9th of September 2022 (Council document 12039/22). At first, EU countries were divided around the visa question. Some countries were for a full visa ban while others were against it because the cost of a full visa ban to each EU country would have varied based on that country's exchanges with Russia. The suspension of the visa agreement allowed Poland, Estonia, Latvia, and Lithuania to opt for a full visa ban on the 20th of September 2022, while the remaining EU countries implemented measures that better fit their situation.

Finally, we note that, according to our sanction indices, the new wave of EU sanctions levelled against Russia in early 2022 are much stronger than the sanctions levied following the 2014 Ukraine crisis. This new round of sanctions involves bans on the trade in sectoral goods critical to the Russian economy and financial sanctions, such as a ban from the Society for Worldwide Interbank Financial Telecommunication (SWIFT). As a result, the economic disruptions to Russia and the EU are expected to be greater than they were following the 2014 Ukraine crisis. How much greater, however, remains to be established. This study along with others of the 2014

¹⁶ F.A. Hayek described the notion of economic order as "a state of affairs in which a multiplicity of elements of various kinds are so related to each other that we may learn from our acquaintance with some spatial or temporal part of the whole to form correct expectations concerning the rest, or at least expectations which have a good chance of proving correct" [Hayek 1978, p. 36].



Crimean crisis provide a baseline for future research for gauging how much more impactful the 2022 EU sanctions in fact end up being.

Conclusion

The EU implemented sanctions against Russia following the latter's annexation of Crimea and Sevastopol. This paper aimed at measuring the impact of European sanctions on individual European countries' exports to Russia, with emphasis placed on exports that were not directly sanctioned. A new methodology was introduced through the use of a gravity model that includes an economic sanction index that allows us to isolate sanctions' effects (Bali and Rapelanoro 2021). Our model's robustness was demonstrated using four different variable combinations and two alternative versions of the sanction index. Results show that the European Union as a whole was negatively impacted by its own sanctions. We find that the share of sanctions in the quarterly decrease of EU non-prohibited exports to Russia (average among EU countries) equals 5.8% (US\$1.075B). This is lower than the findings of previous studies (Crozet and Hinz 2020), (Fritz et al. 2017), etc.). Furthermore, our sensitivity test shows that simulated stronger sanctions seem to slightly increase this number (by 6.9%), while simulated weaker sanctions decrease it by a fourth (by 25.9%). This suggests that the weaker sanctions are, the more disruption of trade by the sanctions is minimised.

In repeating the analysis on a per country basis, however, we find a decline in exports from only eleven out of the 18 EU nations for which our results were statistically significant (results for ten of the 28 EU nations were insignificant). Of the eleven nations whose exports to Russia declined, Malta, Greece, and Cyprus were impacted the most by the EU sanctions. We find that a one per cent increase in the strength of the sanctions would have decreased Malta's exports to Russia by 67.3%, Greece's by 18.4%, and Cyprus' by 17.4%. Declines in exports from the eight other countries (the Netherlands, Poland, Italy, the United Kingdom, Belgium, Slovenia, Bulgaria, and Portugal), were less sensitive to the sanctions. Among these, the trade loss following a one per cent increase in the strength of the sanctions ranged from -2.4 to -7.2%, with an average of -5.2%. In contrast, seven EU nations saw a rise in exports to Russia under the sanctions: Estonia, Hungary, Spain, Romania, the Czech Republic, Slovakia, and Germany. The average increase in exports from these countries was 4.6%, with the highest increases being from Romania (7.8%) and Slovakia (7.2%). Finally, our results also reveal that the value difference in exports between those nations that benefited from sanctions and those that did not is near zero, suggesting that in this case at least, the sanctions ended up being a zero-sum game for the considered EU economies.

In summary, we find that EU sanctions led to "winners" and "losers" among the individual EU nations with respect to their exports to Russia of products not prohibited by sanctions. This is a new finding as previous studies mostly focused on sanctions' impact on total trade between the EU and Russia such as (Dragoi and Balgar 2016), (Nureev and Petrakov 2016), (Szczepański 2015), (Gros and Mustilli 2016), (Havlik 2014). Our findings seem reasonable given that European trade with Russia



differs on a country-by-country basis. Each EU member has different ties with Russia, which implies different trade flow and trade structure. Following Vernon (1979), we also show that these results can be considered as an unintended consequence of EU sanctions. Although the consequences are uncertain, the latter might be avoided if EU sanctions could be tailored to each EU country's trade characteristics with the target nation (Bali 2022). We suggest this while simultaneously acknowledging that our modelling of economic sanctions remains relatively simple. First, our per country analysis is not decomposed to the sectorial level. Second, our analysis does not extend down to the microeconomic level (for example, effects on private households). Third, this research only uses the gravity model—it might be interesting to see if other approaches can change our findings. And fourth, we do not include a sanction index that simulates sanctions from the rest of the world as exogenous variable. These could be proper themes for future research.

Appendices

Due to their excessive length, appendices A, L, M, O, P, and Q, are all available online at <https://www.moradbali.com/publications>. For more information or requests, feel free to write to morad.bali@irnc.org.

Appendix B: European country code and their attributed numbers

Code	Name	Attributed number (i)	Code	Name	Attributed number (i)
AT	Austria	1	HU	Hungary	15
BE	Belgium	2	IE	Ireland	16
BG	Bulgaria	3	IT	Italy	17
CY	Cyprus	4	LT	Lithuania	18
CZ	The Czech Republic	5	LU	Luxembourg	19
DE	Germany	6	LV	Latvia	20
DK	Denmark	7	MT	Malta	21
EE	Estonia	8	NL	Netherlands	22
ES	Spain	9	PO	Poland	23
FI	Finland	10	PT	Portugal	24
FR	France	11	RO	Romania	25
GB	The United Kingdom	12	SE	Sweden	26
GR	Greece	13	SI	Slovenia	27
HR	Croatia	14	SK	Slovakia	28



Appendix C: Data sources

Variable	Details
$XRU_{t,i}$	Countries' Exports to Russia—Eurostat; extracted on 03.06.20; last update 15.05.20; total exports net of arms and ammunition (SITC 891); value in euros; EU trade since 1988 by SITC [DS-018995]. Products targeted by the Russian embargo were also removed from this database.
$LP_{t,i}^1$	Labour Productivity ^[1] (per hours worked)—European Central Bank; total economy; all activities; index; chain linked volume (rebased); non-transformed data; neither seasonally adjusted nor calendar adjusted data; average of observations through period (A).
$PPI_{t,i}$	Producer Prices in Industry—Eurostat; extracted on 04.06.20; last update 03.06.20; total—quarterly data; total output price index—in national currency; industry (except construction, sewerage, waste management and remediation activities); unadjusted data (i.e. neither seasonally adjusted nor calendar adjusted data); index, 2015=100, [sts_inpp_q].
$REER_{t,i}$	Real Effective Exchange Rate—Eurostat; extracted on 04.06.20; last update 03.06.20; deflator: consumer price index—42 trading partners—industrial countries; Index, 2010=100; [ert_eff_ic_q].
$ER_{t,i}$	Country's Currency Exchange Rate Against the Russian rouble—European Central Bank; ECB reference exchange rate; average of observations through period (A).
$GDP_{t,r}$	Russia's GDP—Organization for Economic Co-operation and Development; gross domestic product by expenditure in constant prices: total gross domestic product for the Russian Federation [NAEXKP01RUQ652S], retrieved from FRED, Federal Reserve Bank of St. Louis.
$HICP_{t,i}$	Harmonised Index of Consumer Prices—Eurostat; extracted on 04.06.20; last update 29.05.20; index, 2015=100; neither seasonally adjusted nor calendar adjusted data; all items; monthly data [ei_cphi_m].
$ML_{t,i}$	ECB Marginal lending facility—European Central Bank; euro area (changing composition); key interest rate; date of changes (raw data); level; euro; average of observations through period; per cent per annum.
S_t	Sanction Index (European Sanctions)—Bali and Rapelanoro (2021).
$distance_{ij}$	Distance between capitals of European countries and Russia; extracted from the CEPII Mayer and Zignago (2011).

[1] Regarding $LP_{t,i}$, data for Belgium, Greece, Luxembourg and the United Kingdom were not available as detailed here. Thus, it was necessary to use instead:

- *Greece*: Labour Productivity (per hours worked)—Greece—world (all entities, including reference area, including io), total economy, services, index, chain linked volume (rebased), non-transformed data, neither seasonally adjusted nor calendar adjusted data, ECB.
- *Luxembourg*: Labour Productivity (per persons)—Luxembourg—world (all entities, including reference area, including io), total economy, total—all activities, index, chain linked volume (rebased), non-transformed data, neither seasonally adjusted nor calendar adjusted data, ECB.
- *The United Kingdom*: Labour Productivity (per hours worked)—United Kingdom—world (all entities, including reference area, including io), total economy, services, index, chain linked volume (rebased), non-transformed data, neither seasonally adjusted nor calendar adjusted data, ECB.



- *Belgium*: Labour Productivity (per persons)—Belgium—world (all entities, including reference area, including io), total economy, total—all activities, index, chain linked volume (rebased), non-transformed data, neither seasonally adjusted nor calendar adjusted data, ECB.

[2] Regarding $PPI_{t,i}$, data are not available for Ireland and Portugal between 2003 and 2004. Consequently, there are missing 16 observations (8 quarters for each country).

Appendix D: Impact of EU countries' sanctions on export to Russia: the raw sanction values

	Export of European countries to Russia			
	Model (1.1)	Model (1.2)	Model (1.3)	Model (1.4)
European sanctions index	−0.000 (0.000)	0.000 (0.000)	−0.000 (0.000)	0.000 (0.000)
GDP of the RF (ln)	1.861*** (0.227)	1.635*** (0.267)	1.435*** (0.241)	1.456*** (0.229)
GDP of the EU countries (ln)	0.873*** (0.072)	0.873*** (0.075)	0.893*** (0.085)	0.892*** (0.083)
Distance between capitals (ln)	−2.003*** (0.294)	−1.993*** (0.293)	−1.922*** (0.292)	−1.917*** (0.285)
Real effective exchange rate	−0.011 (0.012)		−0.000 (0.012)	
Harmonised index of consumer prices	0.007 (0.007)	0.006 (0.006)		
Marginal lending key interest rate	−0.072* (0.037)	−0.046 (0.036)	−0.080** (0.040)	−0.069* (0.041)
Labour productivity	0.013*** (0.004)	0.009** (0.004)	0.011** (0.005)	0.010** (0.005)
Exchange rate against the Russian rouble		0.019*** (0.006)		0.014 (0.021)
Producer prices in industry			0.010 (0.009)	0.002 (0.016)
Sanction time (Dummy)	0.250*** (0.085)	0.071 (0.068)	0.199*** (0.066)	0.129 (0.096)
_cons	−0.233 (2.685)	0.185 (3.181)	2.908 (2.658)	2.081 (2.829)
Number of observations	1904	1904	1888	1888
R-squared	0.889	0.889	0.873	0.878

Robust standard errors clustered at country level in parentheses; ln: natural logarithm; In model (1.3) and (1.4), 16 observations are excluded due to the missing



data in producer prices in industry (the total observations decrease from 1904 to 1888); *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix E: Impact of EU countries' sanctions on export to Russia: the lagged sanction values

	Export of European countries to Russia			
	Model (2.1)	Model (2.2)	Model (2.3)	Model (2.4)
European sanctions index	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
GDP of the RF (ln)	1.848*** (0.225)	1.642*** (0.263)	1.434*** (0.234)	1.461*** (0.230)
GDP of the EU countries (ln)	0.873*** (0.072)	0.873*** (0.075)	0.893*** (0.085)	0.892*** (0.083)
Distance between capitals (ln)	-2.003*** (0.294)	-1.993*** (0.293)	-1.922*** (0.292)	-1.917*** (0.285)
Real effective exchange rate	-0.012 (0.012)		-0.000 (0.012)	
Harmonised index of consumer prices	0.007 (0.007)	0.006 (0.006)		
Marginal lending key interest rate	-0.071* (0.037)	-0.046 (0.036)	-0.080** (0.040)	-0.069* (0.040)
Labour productivity	0.013*** (0.004)	0.009** (0.004)	0.011** (0.005)	0.010** (0.005)
Exchange rate against the Russian rouble		0.019*** (0.006)		0.014 (0.021)
Producer prices in industry			0.010 (0.009)	0.002 (0.016)
Sanction time (Dummy)	0.241*** (0.083)	0.075 (0.066)	0.193*** (0.063)	0.128 (0.090)
_cons	-0.063 (2.662)	0.100 (3.127)	2.912 (2.651)	2.013 (2.831)
Number of observations	1904	1904	1888	1888
R-squared	0.889	0.889	0.873	0.878

Robust standard errors clustered at country level in parentheses; ln: natural logarithm; In model (2.3) and (2.4), 16 observations are excluded due to the missing data in producer prices in industry (the total observations decrease from 1904 to 1888); *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$



Appendix F: Impact of EU countries' sanctions on export to Russia: the logarithm of the raw values

	Export of European countries to Russia			
	Model (3.1)	Model (3.2)	Model (3.3)	Model (3.4)
European sanctions index	-0.007 (0.005)	0.005 (0.005)	-0.000 (0.007)	0.003 (0.006)
GDP of the RF (ln)	1.860*** (0.227)	1.631*** (0.268)	1.433*** (0.247)	1.452*** (0.233)
GDP of the EU countries (ln)	0.873*** (0.072)	0.873*** (0.075)	0.893*** (0.085)	0.892*** (0.083)
Distance between capitals (ln)	-2.003*** (0.294)	-1.993*** (0.293)	-1.922*** (0.292)	-1.916*** (0.285)
Real effective exchange rate	-0.011 (0.012)		-0.000 (0.012)	
Harmonised index of consumer prices	0.007 (0.007)	0.006 (0.006)		
Marginal lending key interest rate	-0.072* (0.037)	-0.045 (0.037)	-0.080** (0.040)	-0.068* (0.041)
Labour productivity	0.013*** (0.004)	0.009* (0.004)	0.011** (0.005)	0.010** (0.005)
Exchange rate against the Russian rouble		0.019*** (0.006)		0.014 (0.021)
Producer prices in industry			0.010 (0.010)	0.002 (0.016)
Sanction time (Dummy)	0.309*** (0.095)	0.022 (0.099)	0.198 (0.122)	0.101 (0.139)
_cons	-0.260 (2.682)	0.239 (3.201)	2.928 (2.695)	2.124 (2.874)
Number of observations	1904	1904	1888	1888
R-squared	0.889	0.890	0.873	0.878

Robust standard errors clustered at country level in parentheses; ln: natural logarithm; In model (3.3) and (3.4), 16 observations are excluded due to the missing data in producer prices in industry (the total observations decrease from 1904 to 1888); *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$



Appendix G: Impact of EU countries' sanctions on export to Russia: the logarithm of the lagged values

	Export of European countries to Russia			
	Model (4.1)	Model (4.2)	Model (4.3)	Model (4.4)
European sanctions index	0.005 (0.006)	0.010*** (0.003)	0.011** (0.004)	0.012*** (0.002)
GDP of the RF (ln)	1.877*** (0.212)	1.689*** (0.255)	1.488*** (0.226)	1.515*** (0.231)
GDP of the EU countries (ln)	0.873*** (0.072)	0.873*** (0.075)	0.893*** (0.085)	0.892*** (0.083)
Distance between capitals (ln)	-2.003*** (0.294)	-1.992*** (0.293)	-1.922*** (0.292)	-1.917*** (0.285)
Real effective exchange rate	-0.011 (0.012)		0.000 (0.013)	
Harmonised index of consumer prices	0.007 (0.007)	0.006 (0.006)		
Marginal lending key interest rate	-0.072* (0.038)	-0.046 (0.036)	-0.080** (0.040)	-0.069* (0.040)
Labour productivity	0.013*** (0.004)	0.009* (0.004)	0.011** (0.005)	0.010** (0.005)
Exchange rate against the Russian rouble		0.019*** (0.006)		0.014 (0.021)
Producer prices in industry			0.010 (0.009)	0.002 (0.016)
Sanction time (Dummy)	0.204*** (0.053)	0.007 (0.064)	0.114 (0.077)	0.048 (0.091)
_cons	-0.454 (2.604)	-0.448 (3.024)	2.236 (2.647)	1.371 (2.809)
Number of observations	1904	1904	1888	1888
R-squared	0.888	0.890	0.873	0.878

Robust standard errors clustered at country level in parentheses; ln: natural logarithm; In model (4.3) and (4.4), 16 observations are excluded due to the missing data in producer prices in industry (the total observations decrease from 1904 to 1888); *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$



Appendix H: Impact of EU countries' sanctions on export to Russia: the first difference of raw sanction values

	Export of European countries to Russia			
	Model (5.1)	Model (5.2)	Model (5.3)	Model (5.4)
European sanctions index (first difference of sanction values)	−0.000 (0.000)	0.000 (0.000)	−0.000* (0.000)	−0.000 (0.000)
GDP of the RF (ln)	1.865*** (0.212)	1.639*** (0.260)	1.459*** (0.243)	1.474*** (0.236)
GDP of the EU countries (ln)	0.873*** (0.072)	0.873*** (0.075)	0.893*** (0.085)	0.892*** (0.083)
Distance between capitals (ln)	−2.003*** (0.294)	−1.993*** (0.293)	−1.922*** (0.292)	−1.917*** (0.285)
Real effective exchange rate	−0.011 (0.012)		−0.000 (0.012)	
Harmonised index of consumer prices	0.007 (0.007)	0.006 (0.006)		
Marginal lending key interest rate	−0.072* (0.038)	−0.046 (0.036)	−0.081** (0.040)	−0.069* (0.041)
Labour productivity	0.013*** (0.004)	0.009* (0.004)	0.011** (0.005)	0.010** (0.005)
Exchange rate against the Russian rouble		0.019*** (0.006)		0.014 (0.020)
Producer prices in industry			0.010 (0.009)	0.002 (0.016)
Sanction time (Dummy)	0.240** (0.097)	0.079 (0.069)	0.207*** (0.063)	0.140 (0.092)
_cons	−0.302 (2.572)	0.148 (3.079)	2.600 (2.720)	1.864 (2.905)
Number of observations	1904	1904	1888	1888
R-squared	0.888	0.890	0.873	0.878

Robust standard errors clustered at country level in parentheses; ln: natural logarithm; In model (5.3) and (5.4), 16 observations are excluded due to the missing data in producer prices in industry (the total observations decrease from 1904 to 1888); *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$



Appendix I: Variance inflation factor (VIF) values for the estimation models with the logarithms of the raw values and lagged sanction values

	The case of logarithm of the raw values				The case of logarithm of the lagged values			
	Model (3.1)	Model (3.2)	Model (3.3)	Model (3.4)	Model (4.1)	Model (4.2)	Model (4.3)	Model (4.4)
European sanctions index	10.51	10.73	10.62	10.69	8.42	8.37	8.38	8.35
GDP of the RF (ln)	3.78	4.15	4.37	4.37	4.11	4.48	4.71	4.71
GDP of the EU countries (ln)	1.17	1.14	1.16	1.15	1.17	1.14	1.16	1.15
Distance between capitals (ln)	1.27	1.25	1.13	1.12	1.27	1.25	1.13	1.12
Real effective exchange rate	1.29		1.13		1.30		1.13	
Harmonised index of consumer prices	1.84	1.59			1.84	1.59		
Marginal lending key interest rate	1.56	2.17	1.89	2.14	1.56	2.15	1.87	2.11
Labour productivity	1.60	1.73	1.70	1.74	1.57	1.71	1.68	1.72
Exchange rate against the Russian rouble		3.44		7.10		3.37		7.05
Producer prices in industry			2.03	4.18			2.01	4.17
Sanction time (Dummy)	14.53	17.05	15.90	16.95	9.00	10.29	9.67	10.24
Mean VIF	4.17	4.80	4.44	5.49	3.36	3.82	3.53	4.51



Appendix J: Variance inflation factor (VIF) values for the estimation models with the first difference of sanction values and the first difference of the logarithms of sanction values

	The first difference of sanction values				The first difference of the logarithms of sanction values			
	Model (1)	Model (2)	Model (3)	Model (4)	Model (1)	Model (2)	Model (3)	Model (4)
European sanctions index	1.09	1.10	1.09	1.10	1.63	1.72	1.69	1.72
GDP of the RF (ln)	4.06	4.50	4.71	4.72	5.61	6.66	6.95	7.06
GDP of the EU countries (ln)	1.17	1.14	1.16	1.15	1.17	1.14	1.16	1.15
Distance between capitals (ln)	1.27	1.25	1.13	1.12	1.27	1.25	1.13	1.12
Real effective exchange rate	1.30		1.13		1.31		1.13	
Harmonised index of consumer prices	1.84	1.59			1.86	1.60		
Marginal lending key interest rate	1.56	2.15	1.87	2.12	1.56	2.22	1.91	2.18
Labour productivity	1.58	1.71	1.68	1.72	1.73	1.78	1.78	1.79
Exchange rate against the Russian rouble		3.39		7.09		3.60		7.21
Producer prices in industry			2.01	4.18			2.10	4.18
Sanction time (Dummy)	4.62	5.91	5.30	5.90	6.54	8.73	7.75	8.69
Mean VIF	2.05	2.53	2.23	3.23	2.52	3.19	2.84	3.90



Appendix K: Additional models

Different Options Explored to Cast the Sanction Index

We tried different options to select which form of the sanction index we will use: (i) raw values (i.e. untransformed) ; (ii) lagged values (t-1); (iii) logarithms of raw values; (iv) logarithms of lagged values (t-1); (v) the first difference of raw values; (vi) first difference of the logarithm of the sanction index. Forms (i-v) are not used in our analysis as they either lead to statistically insignificant results (Appendixes D-H) or suffer from multicollinearity (Appendixes I and J). Given that form (vi) is the only one that does not suffer from multicollinearity, we use it for the remainder of our analysis. Additionally, form (vi) is highly relevant for this analysis as there is often a delay in the coming into force of sanctions.

Models with Different Variable Combinations

In set (7), $HICP_{t,i}$ and $ER_{t,i}$ are removed, in set (8), $REER_{t,i}$ and $PPI_{t,i}$ are excluded, in set (9), $PPI_{t,i}$ and $ER_{t,i}$ are removed, and in set (10), $REER_{t,i}$ and $HICP_{t,i}$ are removed.

$$\begin{aligned} XRU_{t,i} = & \alpha_{c1} + \beta_{c1}FD(\ln_S_t) + \gamma_{c1} \ln_GDP_{t,r} + \delta_{c1} \ln_GDP_{t,i} + \theta_{c1} \ln_dist_{r,i} \\ & + \vartheta_{c1}REER_{t,i} + \lambda_{c1}PPI_{t,i} + \zeta_{c1}ML_{t,i} + \phi_{c1}LP_{t,i} + \psi_{c1}time_t + \varepsilon_{t,r,i}^{c1} \end{aligned} \quad (7)$$

$$\begin{aligned} XRU_{t,i} = & \alpha_{b1} + \beta_{b1}S_t + \gamma_{b1} \ln_GDP_{t,r} + \delta_{b1} \ln_GDP_{t,i} + \theta_{b1} \ln_dist_{r,i} \\ & + \rho_{b1}HICP_{t,i} + \varphi_{b1}ER_{t,i} + \zeta_{b1}ML_{t,i} + \phi_{b1}LP_{t,i} + \psi_{b1}time_t + \varepsilon_{t,r,i}^{b1} \end{aligned} \quad (8)$$

$$\begin{aligned} XRU_{t,i} = & \alpha_{a1} + \beta_{a1}S_t + \gamma_{a1} \ln_GDP_{t,r} + \delta_{a1} \ln_GDP_{t,i} + \theta_{a1} \ln_dist_{r,i} \\ & + \vartheta_{a1}REER_{t,i} + \rho_{a1}HICP_{t,i} + \zeta_{a1}ML_{t,i} + \phi_{a1}LP_{t,i} + \psi_{a1}time_t + \varepsilon_{t,r,i}^{a1} \end{aligned} \quad (9)$$

$$\begin{aligned} XRU_{t,i} = & \alpha_{d1} + \beta_{d1}S_t + \gamma_{d1} \ln_GDP_{t,r} + \delta_{d1} \ln_GDP_{t,i} + \theta_{d1} \ln_dist_{r,i} \\ & + \varphi_{d1}ER_{t,i} + \lambda_{d1}PPI_{t,i} + \zeta_{d1}ML_{t,i} + \phi_{d1}LP_{t,i} + \psi_{d1}time_t + \varepsilon_{t,r,i}^{d1} \end{aligned} \quad (10)$$

Sensitivity Tests

Models that use (S_t^a) instead of (S_t) :

$$\begin{aligned} XRU_{t,i} = & \alpha_{c3} + \beta_{c3}FD(\ln_S_t^a) + \gamma_{c3} \ln_GDP_{t,r} + \delta_{c3} \ln_GDP_{t,i} + \theta_{c3} \ln_dist_{r,i} \\ & + \vartheta_{c3}REER_{t,i} + \lambda_{c3}PPI_{t,i} + \zeta_{c3}ML_{t,i} + \phi_{c3}LP_{t,i} + \psi_{c3}time_t + \varepsilon_{t,r,i}^{c3} \end{aligned} \quad (11)$$

$$\begin{aligned} XRU_{t,i} = & \alpha_{b3} + \beta_{b3}FD(\ln_S_t^a) + \gamma_{b3} \ln_GDP_{t,r} + \delta_{b3} \ln_GDP_{t,i} + \theta_{b3} \ln_dist_{r,i} \\ & + \rho_{b3}HICP_{t,i} + \varphi_{b3}ER_{t,i} + \zeta_{b3}ML_{t,i} + \phi_{b3}LP_{t,i} + \psi_{b3}time_t + \varepsilon_{t,r,i}^{b3} \end{aligned} \quad (12)$$

$$\begin{aligned} XRU_{t,i} = & \alpha_{a3} + \beta_{a3}FD(\ln_S_t^a) + \gamma_{a3} \ln_GDP_{t,r} + \delta_{a3} \ln_GDP_{t,i} + \theta_{a3} \ln_dist_{r,i} \\ & + \vartheta_{a3}REER_{t,i} + \rho_{a3}HICP_{t,i} + \zeta_{a3}ML_{t,i} + \phi_{a3}LP_{t,i} + \psi_{a3}time_t + \varepsilon_{t,r,i}^{a3} \end{aligned} \quad (13)$$



$$\begin{aligned} XRU_{t,i} = & \alpha_{d3} + \beta_{d3} \text{FD}(\ln S_t^a) + \gamma_{d3} \ln_GDP_{t,r} + \delta_{d3} \ln_GDP_{t,i} + \theta_{d3} \ln_dist_{r,i} \\ & + \varphi_{d3} \text{ER}_{t,i} + \lambda_{d3} \text{PPI}_{t,i} + \zeta_{d3} \text{ML}_{t,i} + \phi_{d3} \text{LP}_{t,i} + \psi_{d3} \text{time}_t + \varepsilon_{t,r,i}^{d3} \end{aligned} \quad (14)$$

Models that use (S_t^b) instead of (S_t):

$$\begin{aligned} XRU_{t,i} = & \alpha_{c4} + \beta_{c4} \text{FD}(\ln S_t^b) + \gamma_{c4} \ln_GDP_{t,r} + \delta_{c4} \ln_GDP_{t,i} + \theta_{c4} \ln_dist_{r,i} \\ & + \vartheta_{c4} \text{REER}_{t,i} + \lambda_{c4} \text{PPI}_{t,i} + \zeta_{c4} \text{ML}_{t,i} + \phi_{c4} \text{LP}_{t,i} + \psi_{c4} \text{time}_t + \varepsilon_{t,r,i}^{c4} \end{aligned} \quad (15)$$

$$\begin{aligned} XRU_{t,i} = & \alpha_{b4} + \beta_{b4} \text{FD}(\ln S_t^b) + \gamma_{b4} \ln_GDP_{t,r} + \delta_{b4} \ln_GDP_{t,i} + \theta_{b4} \ln_dist_{r,i} \\ & + \rho_{b4} \text{HICP}_{t,i} + \varphi_{b4} \text{ER}_{t,i} + \zeta_{b4} \text{ML}_{t,i} + \phi_{b4} \text{LP}_{t,i} + \psi_{b4} \text{time}_t + \varepsilon_{t,r,i}^{b4} \end{aligned} \quad (16)$$

$$\begin{aligned} XRU_{t,i} = & \alpha_{a4} + \beta_{a4} \text{FD}(\ln S_t^b) + \gamma_{a4} \ln_GDP_{t,r} + \delta_{a4} \ln_GDP_{t,i} + \theta_{a4} \ln_dist_{r,i} \\ & + \vartheta_{a4} \text{REER}_{t,i} + \rho_{a4} \text{HICP}_{t,i} + \zeta_{a4} \text{ML}_{t,i} + \phi_{a4} \text{LP}_{t,i} + \psi_{a4} \text{time}_t + \varepsilon_{t,r,i}^{a4} \end{aligned} \quad (17)$$

$$\begin{aligned} XRU_{t,i} = & \alpha_{d4} + \beta_{d4} \text{FD}(\ln S_t^b) + \gamma_{d4} \ln_GDP_{t,r} + \delta_{d4} \ln_GDP_{t,i} + \theta_{d4} \ln_dist_{r,i} \\ & + \varphi_{d4} \text{ER}_{t,i} + \lambda_{d4} \text{PPI}_{t,i} + \zeta_{d4} \text{ML}_{t,i} + \phi_{d4} \text{LP}_{t,i} + \psi_{d4} \text{time}_t + \varepsilon_{t,r,i}^{d4} \end{aligned} \quad (18)$$

Appendix N: Values of alpha and KHI

α	$o_{k,i}$	Description
0	0	Absence of sanctions
1	100	Sanction against an individual
10	50	Official announcement of sanctions
100	1	Sanction against a company
1,000	5	Sanction against an economic sector
3,000	15	Embargo

Because of their size, values of $\chi_{k,i,u}$ cannot be displayed as they are relative to the implementation date of each sanction (68 sanctions in total). We thus provide the value of $o_{k,i}$ as it defines the slope of $\chi_{k,i,u}$. As stated in Bali and Rapelanoro (2021, p. 29): “The lower $o_{k,i}$ is, the more horizontal the slope will be, and the less the time factor will negatively impact the sanction’s ability to apply economic pressure [...] In other words, $o_{k,i}$ is allowing us to calibrate the time factor intensity and behaviour.” The complete data base is available upon request at morad.bali@irnc.org.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1057/s41302-024-00266-5>.



Funding This work was supported in part by U.S. Department of Defense Minerva Program Grant No. FA9550-21-1-0156. The funding source is not involved in study design, collection, analysis and interpretation of the data, writing report and decision to submit the article for publication.

Data availability We thank Manh Hung Do for his support in processing the data. We are also grateful to Professor Nicole B. Simpson and the two anonymous reviewers of our paper for their constructive feedback and valuable suggestions.

Declarations

Conflict of interest The authors declared that they have no conflict of interest.

References

- Aalto, P., and T. Forsberg. 2016. The structuration of Russia's geo-economy under economic sanctions. *Asia Europe Journal* 14(2): 221–237.
- Afesorgbor, S.K. 2019. The impact of economic sanctions on international trade : How do threatened sanctions compare with imposed sanctions? *European Journal of Political Economy* 56: 11–26.
- Ahmed, R. R., Ghauri, S. P., Vveinhardt, J., and Streimikiene, D. 2018. An empirical analysis of export, import, and inflation : A case of Pakistan. *ESPERA*, 21(3).
- Bali, M., and N. Rapelanoro. 2021. How to simulate international economic sanctions: a multipurpose index modelling illustrated with EU sanctions against Russia. *International Economics* 168: 25–39. <https://doi.org/10.1016/j.inteco.2021.06.004>.
- Bali, M. 2018. The impact of economic sanctions on Russia and its six greatest european trade partners : A Country Svar Analysis. *Финансы и бизнес*, 14(2), Article 2.
- Bali, M. 2020. Methodological Limitations of the Literature in the Study of Economic Sanctions, the Ukrainian Crisis Case. *DATA SCIENCE International Scientific and Practice Conference Contribution papers*, pp. 55–54.
- Bali, M. 2022. L'UE peut-elle intensifier sa réponse avec les sanctions économiques ? *Cahiers de la sécurité et de la justice*, 55(2), 35–42. Cairn.info.
- Bělin, M., and J. Hanousek. 2021. Which sanctions matter ? Analysis of the EU/Russian sanctions of 2014. *Journal of Comparative Economics* 49(1): 244–257.
- Biersteker, T. J., Eckert, S. E., Tourinho, M., and Hudáková, Z. 2018. UN targeted sanctions datasets (1991–2013). *Journal of peace research*, 55(3)
- Bournakis, I. 2012. The determinants of exports in the Greek manufacturing sector. *Global Business and Economics Review* 14(4): 362–380.
- Calvo, G.A., and C.M. Reinhart. 2002. Fear of floating. *The Quarterly Journal of Economics* 117(2): 379–408.
- Chaudhry, A., and S.K.H. Bukhari. 2013. A structural VAR analysis of the impact of macroeconomic shocks on Pakistan's textile exports. *Economic Modelling* 32: 302–315.
- Cheptea, A., and Gaigné, C. 2020. Russian food embargo and the lost trade. *European Review of Agricultural Economics*, 47(2), Article 2.
- Christiano, L. J., and Eichenbaum, M. 1992. *Liquidity effects and the monetary transmission mechanism*. National Bureau of Economic Research.
- Conway, P. 1998. Macroeconomic variability in New Zealand: An SVAR study. *New Zealand Economic Papers* 32(2): 161–186.
- Crozet, M., and J. Hinz. 2020. Friendly fire: The trade impact of the Russia sanctions and counter-sanctions. *Economic Policy* 35(101): 97–146.
- Davis, C.M. 2016. The Ukraine conflict, economic–military power balances and economic sanctions. *Post-Communist Economies* 28(2): 167–198.
- Deshmukh, J., and Pyne, P. K. 2013. *Labour productivity and export performance : Firm-level evidence from Indian manufacturing industries since 1991*. ARTNeT Working Paper Series.
- Dong, Y., and C. Li. 2018. Economic sanction games among the US, the EU and Russia: Payoffs and potential effects. *Economic Modelling* 73: 117–128.



- Doornich, J.B., and A. Raspotnik. 2020. Economic sanctions disruption on international trade patterns and global trade dynamics: analyzing the effects of the European union's sanctions on Russia. *Journal of East-West Business* 26(4): 344–364.
- Doxey, M.P. 1980. *Economic sanctions and international enforcement*. Springer.
- Dragoi, A.-E., and A.-C. Balgar. 2016. Economic sanctions against Russia. *A Critical Evaluation. Knowledge Horizons. Economics* 8(1): 63.
- Dreger, C., Kholodilin, K. A., Ulbricht, D., and 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*, 44(2), Article 2.
- Early, B.R., and K.A. Preble. 2020. Going fishing versus hunting whales: Explaining changes in how the US enforces economic sanctions. *Security Studies* 29(2): 231–267.
- Edwards, S. 1992. Trade orientation, distortions and growth in developing countries. *Journal of Development Economics* 39(1): 31–57.
- Edwards, S. 1993. Openness, trade liberalization, and growth in developing countries. *Journal of Economic Literature* 31(3): 1358–1393.
- Eichengreen, B. 2022. Sanctions, SWIFT, and China's Cross-Border Interbank Payments System. *CSIS Brief*. Washington, DC: Center for Strategic and International Studies.
- Fedoseeva, S., and R. Herrmann. 2019. The price of sanctions: An empirical analysis of German export losses due to the Russian agricultural ban. *Canadian Journal of Agricultural Economics/revue Canadienne D'agroeconomie* 67(4): 417–431.
- Felbermayr, G., Syropoulos, C., Yalcin, E., and Yotov, Y. V. 2020. *On the Heterogeneous Effects of Sanctions on Trade and Welfare : Evidence from the Sanctions on Iran and a New Database*.
- Fountas, S., and D. Bredin. 1998. Exchange rate volatility and exports: The case of Ireland. *Applied Economics Letters* 5(5): 301–304.
- Fritz, O., Christen, E., Sinabell, F., Hinz, J., and others. 2017. Russia's and the EU's sanctions. Economic and trade effects, compliance and the way forward. *WIFO Studies*.
- George, A. L., Simons, W. E., Hall, D. K., Jentleson, B. W., Sagan, S. D., Herrmann, R., Lauren, P. G., and Zimmermann, T. 1994. *The limits of coercive diplomacy* (Vol. 296). Westview Press Boulder, CO.
- Giumelli, F. 2017. The redistributive impact of restrictive measures on EU members : Winners and losers from imposing sanctions on Russia. *JCMS: journal of common market studies*, 55(5), Article 5.
- Gros, D., and Mustilli, F. 2016. *The Effects of Sanctions and Counter-Sanctions on EU-Russian Trade Flows. CEPS Commentary*, 5 July 2016.
- Guillaumont, P., and Guillaumont, S. 1990. *Why and how to stabilize producer prices for export crops in developing countries*. The World Bank.
- Gylfason, T. 1999. Exports, inflation and growth. *World Development* 27(6): 1031–1057.
- Harrell, P. E., and Rosenberg, E. 2016. *The next generation of sanctions*.
- Hastings, J.V. 2022. North Korean trade network adaptation strategies under sanctions: implications for denuclearization. *Asia and the Global Economy* 2(1): 100031.
- Havlik, P. 2014. *Economic consequences of the Ukraine conflict*. Policy Notes and Reports.
- Hayek, F. A. 1978. *Law, legislation and liberty, volume 1 : Rules and order* (Vol. 1). University of Chicago Press.
- Heckscher, E. F. 1919. *The effect of foreign trade on the distribution of income*.
- Hellquist, E. 2016. Either with us or against us ? Third-country alignment with EU sanctions against Russia/Ukraine. *Cambridge Review of International Affairs*, 29(3), Article 3.
- Herbert, G. 2022. *The Unintended Consequences of Economic Sanctions*.
- Hufbauer, G. C., Oegg, B., and others. 2003. *The impact of economic sanctions on US trade : Andrew Rose's gravity model*.
- Hufbauer, G. C., Schott, J. J., and Elliott, K. A. 1990a. *Economic sanctions reconsidered : History and current policy* (Vol. 1). Peterson Institute.
- Hufbauer, G. C., Schott, J. J., and Elliott, K. A. 1990b. *Economic sanctions reconsidered : Supplemental case histories* (Vol. 2). Institute for International Economics.
- Hufbauer, G. C., Schott, J. J., and Elliott, K. A. 2007. *Economic sanctions reconsidered : History and current policy* (Vol. 3). Peterson Institute for International Economics.
- Jeanne, O., and A.K. Rose. 2002. Noise trading and exchange rate regimes. *The Quarterly Journal of Economics* 117(2): 537–569.
- Jones, E., and Whitworth, A. 2014. The unintended consequences of European sanctions on Russia. *Survival*, 56(5), Article 5.



- Kauffmann, M., R. Janzen, and M. Bali. 2023. Quelles bases de données pour les recherches sur la non-violence? *Recherches Internationales* 126(1): 91–106.
- Kholodilin, K. A., and Neţşunajev, A. 2019. Crimea and punishment : The impact of sanctions on Russian economy and economies of the euro area. *Baltic Journal of Economics*, 19(1), Article 1.
- Klinova, M., and E. Sidorova. 2019. Economic sanctions of the West against Russia : Development of the situation. *Studies on Russian Economic Development* 30(3): 355–364.
- Lahiri, A., and Végh, C. A. 2002. Living with the fear of floating : An optimal policy perspective. In *Preventing Currency Crises in Emerging Markets* (p. 663-704). University of Chicago Press.
- Lapp, S., Scheide, J., Solveen, R., and others. 1995. *Determinants of Exports in the G7-Countries*. Kiel Working Paper.
- Larch, M., S. Shikher, C. Syropoulos, and Y.V. Yotov. 2022. Quantifying the impact of economic sanctions on international trade in the energy and mining sectors. *Economic Inquiry* 60(3): 1038–1063.
- Le, H.T., D.P. Hoang, T.N. Doan, C.H. Pham, and T.T. To. 2022. Global economic sanctions, global value chains and institutional quality : Empirical evidence from cross-country data. *The Journal of International Trade and Economic Development* 31(3): 427–449.
- Lerner, A.P. 1952. Factor prices and international trade. *Economica* 19(73): 1–15.
- Lovasy, G. 1962. Inflation and Exports in Primary Producing Countries. *Staff Papers* 9(1): 37–69.
- Mikhaylov, A. 2019. *Oil and gas budget revenues in Russia after crisis in 2015*.
- Morgan, T.C., and V.L. Schwebach. 1995. Economic sanctions as an instrument of foreign policy : The role of domestic politics. *International Interactions* 21(3): 247–263.
- Morgan, T.C., and V.L. Schwebach. 1997b. Fools suffer gladly : The use of economic sanctions in international crises. *International Studies Quarterly* 41(1): 27–50.
- Morgan, T.C., N. Bapat, and V. Krustev. 2009. The threat and imposition of economic sanctions, 1971–2000. *Conflict Management and Peace Science* 26(1): 92–110.
- Morgan, T. C., and Schwebach, V. L. 1997a. Fools suffer gladly : The use of economic sanctions in international crises. *International Studies Quarterly*, 41(1), Article 1.
- Morgan, T. C., Bapat, N., and Kobayashi, Y. 2014. Threat and imposition of economic sanctions 1945–2005 : Updating the TIES dataset. *Conflict Management and Peace Science*, 31(5), Article 5.
- Naghavi, A., and G. Pignataro. 2015. Theocracy and resilience against economic sanctions. *Journal of Economic Behavior and Organization* 111: 1–12.
- Neuenkirch, M., and F. Neumeier. 2015. The impact of UN and US economic sanctions on GDP growth. *European Journal of Political Economy* 40: 110–125.
- Nguyen, T.T., and M.H. Do. 2021. Impact of economic sanctions and counter-sanctions on the Russian Federation's trade. *Economic Analysis and Policy* 71: 267–278.
- Nureev, R., and P. Petrakov. 2016. Economic sanctions against Russia : Expectations and reality. *The Business and Management Review* 7(5): 165.
- Orlova, N.V. 2016. Financial sanctions : Consequences for Russia's economy and economic policy. *Problems of Economic Transition* 58(3): 203–217.
- Pak, O., and G.L. Kretzschmar. 2016. Western sanctions—Only half the challenge to Russia's economic union. *Research in International Business and Finance* 38: 577–592.
- Pape, R.A. 1997. Why economic sanctions do not work. *International Security* 22(2): 90–136.
- Pape, R.A. 1998. Why economic sanctions still do not work. *International Security* 23(1): 66–77.
- Peksen, D. 2019. When do imposed economic sanctions work ? A critical review of the sanctions effectiveness literature. *Defence and Peace Economics* 30(6): 635–647.
- Rasoulinezhad, E. 2019. The sanctions and geographical shift in trading partners : Evidence from Iran and Russia through a gravity model. *Iranian Economic Review* 23(3): 593–610.
- Ricardo, D. 1817. *On the Principles of Political Economy and Taxation : London*.
- Rodman, K.A. 1995. Sanctions at bay ? Hegemonic decline, multinational corporations, and US economic sanctions since the pipeline case. *International Organization* 49(1): 105–137.
- Secrieru, S. and others. 2015. *Russia under sanctions : Assessing the damage, scrutinising adaptation and evasion*.
- Shagina, M. 2018. *RUSSIA'S ENERGY SECTOR: Evaluating progress on import substitution and technological sovereignty*. Global Risk Insights. <https://44s2n02i19u61od84f3rzjqx-wpengine.netdna-ssl.com/wp-content/uploads/2018/04/GRI-Russian-Energy-Sector-Import-Substitution.pdf>
- Shane, M., Roe, T. L., and Somwaru, A. 2008. Exchange rates, foreign income, and US agricultural exports. *Agricultural and Resource Economics Review*, 37(1203-2016-95246), 160-175.
- Shepherd, B. and others. 2013. *The gravity model of international trade : A user guide*.



- Silva, J.S., and S. Tenreiro. 2006. The log of gravity. *The Review of Economics and Statistics* 88(4): 641–658.
- Soest, C., and Portela, C. 2012. *GIGA Sanctions Dataset Codebook*.
- Sonaglio, C.M., A.C. Campos, and M.J. Braga. 2016. Effects of interest and exchange rate policies on Brazilian exports. *Economia* 17(1): 77–95.
- Stash, S. 2019. Prospects of aviation industry in the adaptation to sanctions against Russian economy. *Управление в Экономических и Социальных Системах* 1: 61–66.
- Szczepański, M. 2015. *Economic impact on the EU of sanctions over Ukraine conflict*. European Parliamentary Research Service.
- Timofeev, I.N. 2019. Rethinking sanctions efficiency. *Russia in Global Affairs* 17(3): 86.
- Tinbergen, J. 1962. *Shaping the world economy; suggestions for an international economic policy*.
- van Bergeijk, P. A., Demena, B. A., Reta, A., Jativa, G. B., and Kimararungu, P. 2019. Could the literature on the economic determinants of sanctions be biased? *Peace Economics, Peace Science and Public Policy*, 25(4).
- Vernon, R. 1979. Unintended consequences. *Political theory*, 7(1), Article 1.
- Vorotnikov, I.L., I.F. Sukhanova, M.Y. Lyavina, M.I. Glukhova, and K.A. Petrov. 2019. Economic sanctions and import substitution. *Entrepreneurship and Sustainability Issues* 6(4): 1872.
- Wagner, J. 2007. Exports and productivity: A survey of the evidence from firm-level data. *World Economy* 30(1): 60–82.
- Weber, P. M., and Schneider, G. 2022. Post-Cold War Sanctioning by the EU, the UN, and the US: Introducing the EUSANCT Dataset. *Conflict management and peace science*, 39(1), Article 1.
- Weber, P.M., and G. Schneider. 2020. How many hands to make sanctions work ? Comparing EU and US sanctioning efforts. *European Economic Review* 130: 103595.
- Whang, T. 2010. Structural estimation of economic sanctions : From initiation to outcomes. *Journal of Peace Research* 47(5): 561–573.
- Yotov, Y. V., Piermartini, R., Monteiro, J.-A., and Larch, M. 2016. *An advanced guide to trade policy analysis : The structural gravity model*. World Trade Organization Geneva.
- Zwick, T. 2004. Employee participation and productivity. *Labour Economics* 11(6): 715–740.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.

