BOFIT Discussion Papers
3 • 2024

Iikka Korhonen and Heli Simola

High-priority battlefield items and television sets – How sanctions reduced Russians' access to goods

SUOMEN PANKKI 18 11 FINLANDS BANK EUROSYSTEM
BOFIT
THE BANK OF FINLAND
INSTITUTE FOR
EMERGING ECONOMIES

BOFIT Discussion Papers
Editor-in-Chief Zuzana Fungáčová

BOFIT Discussion Papers 3/2024
27 February 2024

Iikka Korhonen and Heli Simola:
High-priority battlefield items and television sets – How sanctions reduced Russians' access to goods

ISSN 1456-5889, online

Bank of Finland
Helsinki 2024

Iikka Korhonen and Heli Simola

High-priority battlefield items and television sets – How sanctions reduced Russians' access to goods

Abstract

We examine Russian imports since a coalition of countries imposed sanctions on exports to Russia. As Russia no longer publishes detailed statistics on foreign trade, we rely on export data from its largest trading partners (mirror statistics). We are particularly interested in trade diversion, i.e. the extent to which Russian imports have shifted from sanctioning countries to other countries. Our analysis is based on monthly export data and focuses on technology goods (HS codes 84 and 85) utilizing a difference-in-difference approach. Our dataset covers exports to Russia at the HS6-level of disaggregation from 26 sanctioning and 14 non-sanctioning countries during 2018–2023. We find that the exports of sanctioning countries to Russia fell drastically overall, with exports of sanctioned goods declining more than average exports. On the other hand, the export of sanctioned goods to Russia by non-sanctioning countries have risen more than their overall exports, indicating that Russia has managed to replace some goods no longer available from sanctioning countries, but not all of them.

Keywords: Russia, sanctions, foreign trade
JEL: F12, F14, F51

Acknowledgements: We wish to thank Javier Quintana, Zuzana Fungáčová, Jan Fidrmuc and Laurent Weill, as well as the participants in the XX ESCB Emerging Markets Workshop and BOFIT seminar for constructive comments. Greg Moore provided excellent language advice. All remaining errors and omissions are naturally ours.

Iikka Korhonen, Bank of Finland Institute for Emerging Economies (BOFIT), orcid.org/0000-0002-9037-7797, iikka.korhonen@bof.fi.

Heli Simola, Bank of Finland Institute for Emerging Economies (BOFIT), orcid.org/0000-0002-8505-8708, heli.simola@bof.fi.

Non-technical summary

FOCUS

A wide coalition of countries has imposed extensive economic sanctions on Russia since Russia launched a full-scale war in Ukraine in February 2022. A key aim of the sanctions has been to curb Russia's ability to make war by restricting the availability of technology critical to Russia's military industry. The main mechanism is restriction of technology goods exports to Russia. We examine the effects of these restrictions on exports of sanctioning and non-sanctioning countries to Russia. We are particularly interested in trade diversion, i.e. the extent to which Russian imports have shifted from sanctioning countries to other countries.

CONTRIBUTION

We provide an analysis based on highly disaggregated data on how sanctions have changed Russia's import patterns of technology goods. We focus on the trade diversion aspect with an extensive country coverage, up-to date data and differentiation between categories of sanctioned goods. We also control for the variation in timing of the export restrictions.

FINDINGS

We find that the exports of sanctioning countries to Russia fell drastically overall, with exports of sanctioned goods declining more than exports of non-sanctioned goods. On the other hand, exports from non-sanctioning countries to Russia have generally recovered and now exceed pre-invasion levels. The level of exports of sanctioned goods from non-sanctioning countries has risen more than the level of exports of non-sanctioned goods since the invasion. The role of China is substantial, but exports of other non-sanctioning countries have also risen. Nevertheless, the exports of non-sanctioning countries to Russia have failed to completely make up for the loss of exports to Russia from sanctioning countries.

1 Introduction

Russia's war of aggression on Ukraine and robust international responses have renewed interest in the efficacy of economic, political and systemic sanctions. Sanctions imposed after the illegal annexation of Crimea, for example, had a clearly negative effect on the Russian economy (Korhonen, 2019). Sanctions not only affect the countries implementing them and the target country, they also impact third countries that are neither participants nor targets of the sanctions regime. While bystander countries can use the opportunity of sanctions to increase their market share in a targeted country, they can also face disruptions in supply networks that decrease their foreign trade.
In this paper, we concentrate on changes in Russia's foreign trade as result of Western sanctions, and more precisely, on the extent to which Russia's imports have shifted from sanctioning countries to non-sanctioning suppliers.

The initial rounds of sanctions against Russia and Russian entities related to the illegal annexation of Crimea and Sevastopol in 2014, as well as military operations in eastern Ukraine. They came in two waves from the European Union member states, the United States, Canada, Australia and other like-minded countries. The first wave of sanctions after the annexation of Crimea were quite limited. Following the shooting down of Malaysia Airlines flight MH17 by Russian troops, more substantial sanctions were introduced. Perhaps the most substantive sanctions related to long-term financing for several large Russian state-owned companies, including largest banks Sberbank and VTB. In the account of Korhonen (2019) on earlier sanctions, the negative effects of sanctions are shown to impact the Russian economy via diminished foreign trade, capital inflows and other channels.

Sanctions imposed in 2014 remained limited for years. Russia continued its illegal occupation of Crimea, while undermining the territorial integrity, sovereignty and independence of Ukraine. It was only after the full-scale invasion of Ukraine on February 24, 2022 that the number and scope of sanctions increased. The European Union, the United States, the United Kingdom, Japan, Canada and many other countries introduced multiple rounds of economic actions against Russia. Their stated purpose was to limit Russia's ability to wage its illegal war against Ukraine and international legal order. Sanctions ranged from finance (limiting Russia's access to foreign financing and immobilizing a large part of the Bank of Russia's international reserves) to trade (export to Russia of certain categories of goods, and even specific goods themselves, were forbidden by the EU, US, UK and others). Many Russian individuals have found their assets in the EU and elsewhere frozen. As sanctions regimes are constantly evolving almost daily, up-to-date listings can be found e.g. in S&P Global (2024).

To assess how Western trade-related sanctions have affected international trade in the sanctioned goods, we ask whether Russia's imports of sanctioned goods have shifted to countries not participating in sanctions against Russia. We use monthly export data and focus on technology goods with HS code 84 ("Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof") and HS code 85 ("Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles"). We concentrate on these HS codes as they contain the majority of sanctioned goods that might be used to increase Russia's military capabilities in its war against Ukraine. Our dataset covers exports to Russia at the HS6-level of disaggregation from 26 sanctioning and 14 non-sanctioning countries during the period 2018–2023.

To our best knowledge, nobody has yet assessed how exports of sanctioned goods have developed in a large sample of countries that includes Russia's top trading partners (China, Türkiye, India and Kazakhstan). Our research is related to Chupilkin et al. (2023), but our contribution includes more countries that export to Russia and a substantially longer data sample.

We find that overall technology exports to Russia by sanctioning countries have declined drastically since the start of Russia's full-on invasion of Ukraine. Moreover, exports of sanctioned goods have declined substantially more than those of the non-sanctioned goods. Exports of sanctioned goods continued the decline throughout 2023, while technology export of non-sanctioning countries to Russia recovered after a sizeable dip immediately after the February 2022 invasion to pre-invasion levels and above. Exports of sanctioned technology goods also recovered after the immediate post-invasion decline. Russia has thus managed to replace at least some of its lost technology imports by turning to other supplier countries.

Our results show that sanctions have been effective in their stated aims when it comes to sanctioning countries. However, this effect has been partly offset by Russia's ability to find alternative suppliers for sanctioned goods. While China is now Russia's most important trading partner, other countries have become significant suppliers of sanctioned goods to Russia. These results may indicate that officials overseeing sanctions regimes for the European Union and United States need to expand the scope of their efforts in curbing Russia's access to critical goods.

The rest of the paper is structured as follows. In the next section, we discuss some of the previous literature on the effects of trade sanctions against Russia. The third section presents our data and its main features, and the fourth section discusses our main empirical results. The fifth section concludes.

2 Literature on the effects of trade sanctions on Russia

The literature on the many-faceted economic effects of sanctions has a long tradition. Mulder (2022) convincingly documents the use of economic sanctions and coercion throughout history, including the increase in their use since the early 20th century. The recent sanctions rounds against Russia are just the latest installments in a long continuum.

While Russia's full-on invasion of Ukraine is still a fresh event, the effects of earlier sanctions on trade between Russia and other countries are well-studied.

Crozet and Hinz (2020) look at the effect of sanctions on foreign trade between Russia and other countries within a traditional gravity model. Look first at Russia's exports to its major trading partners, they determine that Russia lost some $54 billion in exports (roughly 7% of total predicted exports) between the beginning of sanctions to the end of 2015. Western countries imposing sanctions lost approximately $42 billion in exports to Russia, with more than 90% of the loss borne by the countries in the European Union. This $42 billion, in turn, was 0.3% of sanctioning countries' total exports. Interestingly, most of this reduction in trade affected goods neither side had banned. Trade declined perhaps because of reduced availability of finance or greater risk aversion. It should be noted that Russia also introduced counter-sanctions against imports from Western countries in such categories as foodstuffs.

Belin and Hanousek (2021) compare effects of trade sanctions from both sides – an export ban on hydrocarbon extraction technology from the West and an import ban on foodstuffs from Russia. They find that the latter approach was much more effective in lowering the value of trade. The authors conclude that this is most likely because Western sanctions were not introduced retroactively, so agreements made prior to 2014 were honored and the purchased equipment sent to Russia.

Cheptea and Gaigné (2018) find that less than half of the drop in the EU exports to Russia in goods that Russia sanctioned was due to sanctions per se. The larger share of export decline came from the weak ruble and the decrease in Russian purchasing power. Moreover, EU exports of agricultural goods are now higher than before sanctions, indicating that the EU producers have been able to re-orient their exports to circumvent sanctions.

Fritz et al. (2017) apply a counterfactual analysis based on an econometric model to assess the effect of sanctions on EU exports to Russia. They find that EU exports to Russia between 2014 and 2016 fell by $35 billion (11% below baseline) more than they would have without sanctions. In this analysis, the export drop was largest in agricultural goods targeted by Russia's counter-

sanctions. However, exports declined in many other categories, hinting at the importance of trade finance and its availability. This finding is common for papers on this topic.

It should be noted that the aforementioned papers analyze a period when sanctions on Russia were far looser than the sanctions packages introduced after February 2022. We would expect, therefore, that the effects from the most recent batch of sanctions have likely been larger. For example, Dai et al. (2021) find that the most extensive trade sanctions have reduced bilateral trade by as much as 90%. By this measure Russia has not been sanctioned to the same extent.

Looking at more recent sanctions, Simola (2023a) provides an update on the most recent empirical papers related to sanctions and their effects, including effects of Russia sanctions. The most important contributions for our discussion are the works of Borin et al. (2022) and Chupilkin et al. (2023). Borin et al. (2022), who examine the development of Russian imports with a synthetic control method, find that in the fourth quarter of 2022 the value of Russian imports from sanctioning countries was about 50% lower and from non-sanctioning countries about 30% higher compared to their estimated "no-war" scenario. Chupilkin et al. (2023) focus on disaggregated EU exports to Russia and circumvention of sanctions through Central Asian countries. Employing a difference-in-difference approach, they conclude that EU exports of sanctioned products to Russia have declined substantially since the introduction of sanctions. However, they also find evidence of sanction circumvention through rerouting of banned exports via third countries.

In addition, Simola (2023b) provides a descriptive analysis and documents how the aggregate value of Russia's imports of sanctioned technology goods has decreased, even when taking into account possible sanctions evasion via third countries. Moreover, as unit prices have increased, the volume of imports has declined even more than in value terms. On the other hand, there are certain products and product categories where Russia has been able to increase its total imports since the imposition of sanctions. Examples include machines for the manufacture of semiconductor devices, electrical signal generators and lathes for removing metal.

3 Data

We use monthly data on the value of exports to Russia by country and product. The data are expressed in US dollars, cover the period January 2018 to June 2023 and are sourced from the Global Trade Tracker database.[1] We focus on technology products, comprising chapters 84 and 85 of the

[1] https://www.globaltradetracker.com/.

HS nomenclature,[2] as the export restrictions imposed by the sanctioning coalition on technology products. We use the HS6-digit level disaggregation because it is the finest internationally comparable level of disaggregation available. We categorize the data according to sanctioning and non-sanctioning countries, and estimate empirical specifications separately for each set of countries. The country group lists are provided in the Appendix.

The dataset on sanctioning countries consists of 26 countries that have imposed at least some sanctions on Russia. It covers most EU countries and other developed economies participating in the sanctions regime, and focuses on the most important trading partners of Russia. The export restrictions are not identical to EU restrictions across all countries, but we assume that participating countries generally strive for compliance with EU restrictions.

The dataset on non-sanctioning countries includes 14 countries that have imposed no sanctions on Russia. It covers all major emerging economies and countries close to Russia in Central Asia and South-Eastern Europe. Most Middle East countries and Belarus are excluded due to lack of data.

Our dataset covers 772 individual product lines at the HS6 level of disaggregation. There were some notable changes in the HS nomenclature applied in 2017–2021 and from 2022 onwards. To maximize the comparability of the data, we have made some modifications to certain product lines in different time periods. We exclude product lines with major changes as comparisons have little meaning.

We include for all countries products with a positive export flow during at least one month of the sample period. Thus, accounting for zero export flows, we have a balanced panel of 66 months for all countries. The number of goods exported varies across countries, as we exclude such products, for which a country has no non-zero export flows during the sample period.

We construct an aggregate dummy variable that takes the value 1 if any export restrictions are imposed on the product by the EU and zero otherwise. We also divide sanctioned products into the following sub-groups: *high-priority battlefield items*, *other dual-use goods* (than high-priority battlefield items), *luxury goods* and *other sanctioned technology goods* to better reflect the types of products subject to export restrictions.

[2] Chapter 84 covers “nuclear reactors, boilers, machinery and mechanical appliances and parts thereof.” Chapter 85 covers "electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles.”

In total, our sample contains 443 products subject to EU export restrictions. Of those, 33 are high-priority battlefield items, 152 other dual-use goods, 45 luxury goods[3] and 213 other sanctioned technology goods. The different types of sanctioned goods partially overlap in some cases, but we have defined the dummies so that all sanctioned goods only belong to a single product group.[4]

In addition to a product-level sanction dummy, we also construct a time dummy for sanctions. For simplicity, we impose the sanctions on all products immediately after Russia's invasion of Ukraine in the baseline regression (they were actually extended gradually to a wide set of goods). Thus, our time dummy for sanctions takes a value of zero in 1M2018-2M2022 and a value of 1 in 3M2022-6M2023. In the robustness checks, we also control for temporal variation in the imposition of sanctions.

The countries in our sample cover 93% of the total value of Russian imports in 2021 for goods included in our sample as sanctioned goods. We cannot make detailed comparisons with Russian trade statistics for later periods as Russia ceased publication of most foreign trade statistics after it invaded Ukraine. Russian import data published by the Central Bank of Russia tend to co-move quite closely at the aggregate level with the summed exports of trading partners. Notably, this correlation has declined slightly since Russia's invasion of Ukraine (Simola, 2023b). Borin et al. (2023a), who compare unpublished highly disaggregated Russian customs data with mirror statistics, conclude that for goods trends in trade flows (with the exception of semiconductors) are quite similar.

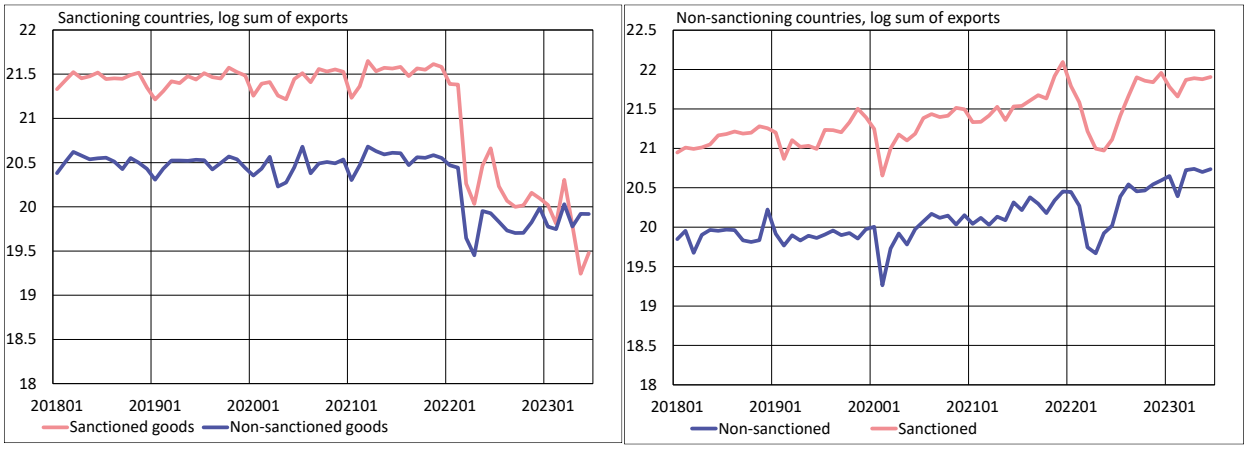
Taking a preliminary look at the data shows that at the aggregate level technology exports (HS codes 84 and 85) of sanctioning countries contracted sharply after Russia's invasion in Ukraine in February 2022 (Figure 1). The drop is more pronounced for sanctioned goods, but exports of non-sanctioned goods have also substantially declined. There has been practically no subsequent recovery in exports. The average value of monthly exports of sanctioned goods was about $2.2 billion in 2021, but only $0.4 billion in 1H23. For non-sanctioned goods, the corresponding values were about $0.8 billion in 2021 and $0.4 billion in 1H23.

For non-sanctioning countries, the trends are very different. Exports of both sanctioned and non-sanctioned goods declined initially sharply. After that, they recovered rapidly and reached the

[3] Sanctions on luxury goods typically concern only goods where the price exceeds a certain threshold. They thus apply only to a subset of expensive goods within a particular product line that is hard to separate out.
[4] Luxury goods are defined as a residual category because such sanctions typically cover only a subset of goods as noted above. Thus, we first check to see whether the sanctioned good falls under any other sanction category. If not, it is defined as a sanctioned luxury good.

pre-war level by 2022. In 2023, the level of exports appears to have stabilized. In terms of US dollars, the average monthly value of exports of sanctioned goods was $2.4 billion in 2021 and $3.0 billion in 1H23, while the average value of non-sanctioned goods was $0.6 billion in 2021 and $0.9 billion in 1H23.

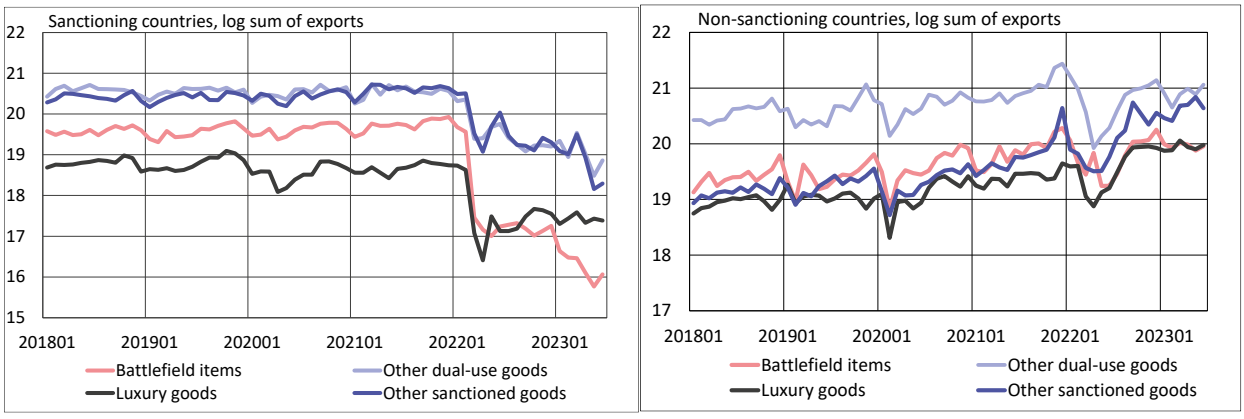
Figure 1. Development of technology exports to Russia in 2018-2023 for A) sanctioning countries and B) non-sanctioning countries.



Source: Authors' calculations on data sourced from Global Trade Tracker database.

Developments across sanctioned product groups also differ slightly. Exports of sanctioning countries have declined in all sanctioned product groups. High-priority battlefield items have seen the deepest decline, with exports falling by 97% from 2M22 to 6M23. The mildest drop of 71% was recorded for luxury goods. In contrast, the exports of non-sanctioning countries have recovered from the initial drop in spring 2022 and eventually attained pre-war levels. Highest growth has been recorded for other sanctioned goods and luxury goods, while the growth has been more moderate for high-priority battlefield items and other dual-use goods.

Figure 2. Development of exports to Russia of various products subject to sanctions in 2018-2023 for A) sanctioning countries and B) non-sanctioning countries.



Source: Authors' calculations on data sourced from Global Trade Tracker database.

4 Empirical results

In line with previous studies (Cigna et al., 2022; Chupilkin et al., 2023), we apply a difference-in-difference setup to investigate the effect of sanctions on exports of sanctioning and non-sanctioning countries to Russia. We estimate the following specification separately for sanctioning and non-sanctioning countries:

$$Log(Export_{ijt}) = SanctionTime*SanctionProduct + FE_{iit} + e_{ijt} \quad (1)$$

The dependent variable is the log of exports of product j from country i to Russia at time t. To capture the effect of the sanctions, we use an interaction term of the time dummy for sanctions and the product dummy for sanctions. We also add country-time fixed effects and country-product effects to control for such effects as the exporter's exchange rate fluctuations. As we have monthly data, we also account for seasonal variation by month-specific fixed effects in certain specifications.

4.1 Baseline regressions

For background, we first estimate the effect of the sanctions (and the war itself) on the exports of all products to Russia. We apply only the time dummy for sanctions, which takes a value of 1 beginning from March 2022. Our results suggest that the value of exports of technology goods from the sanctioning countries to Russia declined on average by about 40 % (Table 1[5]) after Russia's invasion and resulting sanctions. Technology exports from non-sanctioning countries, in contrast, increased by about 90% on average.

[5] Note that the percentage change is calculated as [exp (coefficient)-1]*100.

Table 1. Effect of war and sanctions on exports to Russia.

Dependent variable: log ($Export_{ijt}$)		
	Sanctioning countries	*Non-sanctioning countries*
All goods	-0.5195*** (0.1511)	0.6387*** (0.0355)
Country-product fixed effects	x	x
Control for seasonality (month)	x	x
N	1,023,546	390,852
R^2	0.64	0.72

Focusing particularly on sanctioned products, our results suggest that sanctions have had a substantial effect on the exports of sanctioning countries to Russia. As depicted in Figure 1, all exports from sanctioning countries to Russia declined after Russia's invasion of Ukraine in February 2022. Exports of sanctioned products have declined substantially more than exports of non-sanctioned products, reflecting the effect of sanctions. The coefficient of the interaction term of the time-sanction and product-sanction dummy suggests that exports of sanctioned products declined on average by 70% more than products not subject to sanctions.

Our result, which is similar to that of Chupilkin et al. (2023), shows a coefficient of about 0.8 for the EU and US exports to Russia for sanctioned goods. Our result is bit larger, which may reflect our sole focus on technology goods. Borio et al. (2022) find that the effects of sanctions were particularly strong for high-technology products in 2022.

The estimations for non-sanctioning countries imply trade diversion, i.e. non-sanctioning countries providing Russia with substitutes to make up for Russia's lost imports from sanctioning countries. As shown in Figure 1, exports of all products from non-sanctioning countries to Russia grew after a short initial drop. Exports of sanctioned products, however, grew faster than exports of non-sanctioned products. The coefficient of the interaction term of the time-sanction and product-sanction dummy suggests that on average, exports of sanctioned products increased by at least 25% more compared to products not subject to sanctions. This reflects Russia's heightened need for trade diversion of sanctioned products, since exports to Russia from sanctioning countries declined so sharply. Our results are largely in line with the findings of Chupilkin et al. (2023), with their coefficients varying in different specifications between 0.15 and 0.40.

Table 2. Regressions on effects of sanctions.

Dependent variable: log ($Export_{ijt}$)						
	Sanctioning countries			Non-sanctioning countries		
All sanctioned goods	-1.2244*** (0.1235)	-1.2353*** (0.0184)	-1.2352*** (0.1279)	0.6916*** (0.0476)	0.2195*** (0.0691)	0.2195*** (0.0691)
Country-product fixed effects	x	x	x	x	x	x
Country-time fixed effects		x	x		x	x
Control for seasonality (month)	x		x	x		x
N	1,023,546	1,023,546	1,023,546	390,852	390,852	390,852
R2	0.64	0.65	0.65	0.72	0.74	0.74

Note: Standard errors are clustered by HS6 product. *, ** and *** denote statistical significance at the 10%, 5% and 1% leve, respectively.

We now examine in detail the effect of sanctions on various product groups. Again, we can see mirror effects for sanctioning and non-sanctioning countries. For sanctioning countries, the contraction in exports was by far sharpest for high-priority battlefield items (Table 3). Exports of these items in most of our specifications decline on average by about 97% than products not subject to sanctions. The exports of other dual-use goods and other goods declined by about 70% more than non-sanctioned products. For luxury goods, the effect is in most specifications much smaller and not statistically significant. This probably reflects the fact that our data poorly capture actual products subject to luxury good sanctions as we were unable to differentiate them by price.

Table 3. Regressions for sanction product groups and sanctioning countries.

Dependent variable: log ($Export_{ijt}$) sanctioning countries		
High-priority Battlefield Items	-3.2878*** (0.2896)	-3.3686*** (0.2943)
Other dual-use goods	-1.1671*** (0.1812)	-1.1987*** (0.1872)
Luxury goods	-0.1012 (0.2048)	-0.0755 (0.2140)
Other sanctioned goods	-1.1042*** (0.1490)	-1.0966*** (0.1545)
Country-product fixed effects	x	x
Country-time fixed effects		x
Control for seasonality (month)	x	x
N	1,023,546	1,023,546
R2	0.64	0.65

Shifting to the non-sanctioning countries, our results suggest that trade diversion has been particularly strong in high-priority battlefield items. For these goods, the exports of non-sanctioning countries have in most specifications increased on average by about 100–120% than products not subject to sanctions (Table 4). The result is statistically highly significant and quite robust across various specifications.

Our results also point to trade diversion for other dual-use goods and other goods. The results are highly statistically significant, but the size of the coefficients varies somewhat across specifications. The trade diversion effect is smaller and not always statistically significant for luxury products subject to sanctions. The results remain quite similar after we exclude China and Hong Kong from the sample.

Table 4. Regressions for sanction product groups and non-sanctioning countries.

Dependent variable: log ($Export_{ijt}$), non-sanctioning countries		
High-priority Battlefield Items	0.7924*** (0.1897)	0.6952*** (0.1829)
Other dual-use goods	0.6071*** (0.7970)	0.2090*** (0.0909)
Luxury goods	0.4063*** (0.1479)	-0.0168 (0.1500)
Other sanctioned goods	0.7463*** (0.0648)	0.1731*** (0.0817)
Country-product fixed effects	x	x
Country-time fixed effects		x
Control for seasonality (month)	x	x
N	390,852	390,852
R2	0.72	0.74

Note**:** Standard errors are clustered by HS6 product. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively

We now further narrow our focus of trade diversion to products in the HS 85 category for electrical equipment. Most high-priority battlefield items such as integrated circuits and semiconductors belong to this category. As Table 3 shows, exports of non-sanctioning countries to Russia increased sharply for electrical equipment classed as high-priority battlefield items or other dual-use goods. For other products, the results are less clear-cut. As the results remain quite similar after excluding China and Hong Kong, it is hard to argue that the results are driven solely by China and Hong Kong. Even so, the increase in China's exports of sanctioned goods to Russia is especially strong.

4.2 Robustness checks

We first examine whether the results are dominated by certain geographic regions. For sanctioning countries, we evaluate the role of EU as our data sample takes an EU perspective both country-wise and regarding sanctions definitions. Excluding EU countries from the estimations suggests that the results are qualitatively similar and highly statistically significant for other countries with respect to high-priority battlefield items and other dual-use goods (Table 5). For other goods, the result is statistically significant only at the 10% level. It is not significant for luxury goods. This apparently

reflects the high coordination of sanctions between coalition countries particularly on goods that are most important for military purposes, while there is more variation regarding export restrictions on other products.

Table 5. Regressions on sanctioning countries excluding EU.

Dependent variable: log ($Export_{ijt}$), sanctioning countries with and without EU				
	All countries	Ex. EU	All countries	Ex. EU
All sanction products	-1.2352*** (0.1279)	-0.7186*** (0.1424)		
High-priority Battlefield Items			-3.3686*** (0.2943)	-3.1756*** (0.3867)
Other dual-use goods			-1.1987*** (0.1872)	-0.8554*** (0.1976)
Luxury goods			-0.0755 (0.2140)	0.2547 (0.2587)
Other sanctioned goods			-1.0966*** (0.1545)	-0.3074* (0.1647)
N	1,023,546	265,197	1,023,546	265,197
R^2	0.65	0.62	0.65	0.62

For non-sanctioning countries, we check whether our results are driven by China and Hong Kong. The analysis in Simola (2023b) suggests that China and Hong Kong have played a key role in providing Russia alternative imports for many sanctioned products. We conduct similar regressions as above for a sample of non-sanctioning countries where China and Hong Kong are excluded. For all sanctioned products, the average effect is of similar magnitude at about 20%, and the result is statistically significant at the 5% level (Table 6). Estimations by sanctioned product group bring more heterogeneous results. While the results for high-priority battlefield items are quite similar even when China and Hong Kong are excluded, the results for other sanctioned products seem to be driven mainly by China and Hong Kong.

Table 6. Regressions on non-sanctioning countries excluding China and Hong Kong.

Dependent variable: log ($Export_{ijt}$), non-sanctioning countries with and without China and Hong Kong				
	All countries	Ex. China and Hong Kong	All countries	Ex. China and Hong Kong
All sanction products	0.2195*** (0.0691)	0.1822** (0.0776)		
High-priority Battlefield Items			0.6952*** (0.1829)	0.6771*** (0.2028)
Other dual-use goods			0.2090*** (0.0909)	0.1582 (0.1030)
Luxury goods			-0.0168 (0.1500)	0.1728 (0.1650)
Other sanctioned goods			0.1731*** (0.0817)	0.0855 (0.0941)
N	390,852	321,522	390,852	321,522
R^2	0.74	0.61	0.74	0.61

Note: All estimations include country-time and product-time fixed effects and controls for seasonality. Standard errors are clustered by HS6 product. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

We perform a placebo test similar to Cigna et al. (2023) that assumes sanctions are imposed in March 2021 and estimate the model up to February 2022 (the last period before sanctions actually entered into force). In most cases, the coefficients are close to zero and not statistically significant (Table 7). The exports of high-priority battlefield items from both sanctioning and non-sanctioning countries to Russia appear to have increased more than other exports during the year preceding Russia's invasion. This may suggest Russia was preparing for war and further sanctions, but recovery from the Covid-19 pandemic may also factor in here.

Table 7. Regressions on placebo test for imposing sanctions already in 3M21.

Dependent variable: log ($Export_{ijt}$), sanctions imposed on 3M21 and model estimated for 1M18-2M22				
	Sanctioning countries		Non-sanctioning countries	
All sanction products	-0.0031 (0.0333)		0.0935** (0.0424)	
High-priority Battlefield Items		0.2120*** (0.0682)		0.2765** (0.0976)
Other dual-use goods		-0.0234 (0.0439)		0.1449** (0.0602)
Luxury goods		-0.0389 (0.062825)		-0.1567 (0.0999)
Other sanctioned goods		-0.0219 (0.0393)		0.0697 (0.0477)
N	775,550	775,550	296,100	296,100
R^2	0.70	0.71	0.77	0.77

Note. All estimations include country-time and product-time fixed effects and controls for seasonality. Standard errors are clustered by HS6 product. *, ** and *** denote statistical significance at the 10%, 5% and 1% level, respectively.

We examine the importance of timing on the impact of sanctions. A large number of export restrictions were imposed immediately after Russia's invasion of Ukraine or very soon thereafter. The restrictions were, however, further extended in consecutive sanction packages on multiple occasions. To control this on-going tightening of sanctions, we apply the staggered difference-in-difference framework proposed by Callaway and Sant'Anna (2021) which allows varying treatment timing and heterogeneous treatment effects. We focus on the high-priority battlefield items and other dual-use items as the information on the imposition of sanctions on these goods is readily available,[6] and compare them against non-sanctioned products.

Our results for sanctioning countries confirm the previous findings with a sizable negative and statistically highly significant effect of sanctions on the exports of sanctioned goods (Table 8). The results are similar if we use as a control group only the non-treated goods, or if we include those products that have yet to be treated. A more detailed temporal examination of the sanction effects shows that the results are similar and statistically highly significant throughout the sample period. The effect becomes even larger towards the latter part of the observation period, which may reflect the gradual implementation of measures to deal with sanctions evasion.

[6] As most EU export restrictions are defined at the CN8 disaggregation level, there can be multiple implementation dates for more aggregated HS6 level product lines. In such cases, we define the implementation date as the date that applies to the largest number of products covered by that particular product line.

Results are mixed for non-sanctioning countries. The average effect is positive, but much smaller than in the baseline regressions and not statistically significant. Closer examination of the temporal evolution of the sanction effect shows mixed effects for the first months after the imposition of sanctions. This could reflect the overall negative demand shock and uncertainty that affected exports of all goods to Russia in the early months after Russia's invasion. In the period 10M22-4M23 in particular, the coefficient tends to be larger and for some months also statistically significant at the 5% level. This could reflect the adjustment period needed for trade diversion channels to activate.

Table 8. Regressions on time variable imposition of sanctions.

Dependent variable: log ($Export_{ijt}$), time-varying sanctions				
	Sanctioning countries		*Non-sanctioning countries*	
	Never treated	Never treated and not yet treated	Never treated	Never treated and not yet treated
Average	-1.4505*** (0.0785)	-1.3528*** (0.0783)	0.0982 (0.1073)	0.1275 (0.1071)
3M22	-1.3896*** (0.1713)	-1.2303*** (0.1680)	-0.0492 (0.2184)	0.0241 (0.2147)
4M22	**-1.0674***** **(0.1196)**	**-0.9003***** **(0.1171)**	**0.0294** **(0.1667)**	**0.0871** **(0.1644)**
5M22	-1.0332*** (0.1214)	-0.8831*** (0.1189)	-0.1344 (0.1727)	-0.0404 (0.1697)
6M22	-1.1508*** (0.1230)	-1.0124*** (0.1205)	0.1714 (0.1911)	0.2384 (0.1879)
7M22	-0.9967*** (0.1000)	-0.8509*** (0.0986)	-0.0702 (0.1484))	-0.0468 (0.1462)
8M22	-1.1919*** (0.1017)	-1.0552*** (0.1003)	-0.0718 (0.1481)	-0.0814 (0.1460)
9M22	-1.2686*** (0.1022)	-1.1276*** (0.1009)	0.0446 (0.1511)	0.0346 (0.1489)
10M22	-1.2644*** (0.0975)	-1.1640*** (0.0964)	0.2466* (0.1458)	0.2444* (0.1439)
11M22	-1.5068*** (0.0983)	-1.3819*** (0.0971)	0.0253 (0.1502)	0.0869 (0.1480)
12M22	-1.1975*** (0.0903)	-1.1493*** (0.0898)	0.2744** (0.1321)	0.2880** (0.1312)
1M23	-1.3610*** (0.0907)	-1.3161*** (0.0902)	0.1503 (0.1299)	0.1740 (0.1291)
2M23	-1.5012*** (0.0902)	-1.4583*** (0.0897)	0.2964** (0.1315)	0.3175** (0.1306)

3M23	-1.7188*** (0.0925)	-1.6572*** (0.0921)	0.1096 (0.1358)	0.1202 (0.1322)
4M23	-2.1769*** (0.0954)	-2.1259*** (0.0950)	0.2733** (0.1331)	0.3047** (0.1322)
5M23	-2.2867*** (0.0945)	-2.2366*** (0.0940)	0.1363 (0.1350)	0.1483 (0.1340)
6M23	-2.0957*** (0.0907)	-2.0957*** (0.0907)	0.1399 (0.1295)	0.1399 (0.1295)

5 Concluding remarks

Utilizing highly disaggregated data, we showed that trade sanctions imposed by the European Union and its allies have been successful in limiting sanctioning countries' exports to Russia. In the sector of technological goods, exports of high-priority battlefield items have collapsed almost completely. It is noteworthy that exports of non-sanctioned technological goods to Russia have also strongly declined.

On the other hand, overall technology exports from non-sanctioning countries to Russia have generally recovered and now exceed pre-invasion levels. The level of exports of sanctioned goods has risen more than the level of exports of non-sanctioned goods since the invasion. This effect is particularly pronounced for high-priority battlefield items. Especially in this subcategory of sanctioned goods, the role of China (and Hong Kong to a lesser extent) is substantial, but exports of other non-sanctioning countries have also risen in comparison to non-sanctioned goods. In sub-categories such as dual use and luxury goods it is hard to establish China's role. Nevertheless, the exports of non-sanctioning countries to Russia have failed to completely make up for the loss of exports to Russian from sanctioning countries. In this sense, sanctions have worked – even with room for tighter enforcement. These observations may also guide efforts of officials in the EU, US and elsewhere seeking to stem the flow of sanctioned goods to Russia.

References

Bělin, Matěj and Jan Hanousek (2021) Which sanctions matter? Analysis of the EU/Russian sanctions of 2014. *Journal of Comparative Economics*, 49(1): 244-257.

Borin, Alessandro, Gabriele Cappadona, Francesco Paolo Conteduca, Benjamin Hilgenstock, Oleg Itskhoki, Michele Mancini, Maxim Mironov and Elina Ribakova (2023). The impact of EU sanctions on Russian imports. VoxEU Column, 29 May 2023.

Callaway, Brantly and Pedro H.C. Sant'Anna (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225(2): 200-230.

Cheptea, Angela and Carl Gaigné (2018). Russian food embargo and the lost trade, SMART-LERECO Working Paper 18-05.

Chupilkin, Maxim, Beata Javorcik and Alexander Plekhanov (2023) The Eurasian roundabout: Trade flows into Russia through the Caucasus and Central Asia. EBRD Working Paper No. 276.

Cigna, Simone, Philipp Meinen, Patrick Schulte and Nils Steinhoff (2022). The impact of US tariffs against China on US imports: evidence for trade diversion? *Economic Inquiry*, 60(1): 162-173.

Crozet, Matthieu and Julian Hinz (2020). Friendly fire: the trade impact of the Russia sanctions and counter-sanctions. *Economic Policy*, 35(101): 97-146.

Dai, Mian, Gabriel J. Felbermayr, Aleksandra Kirilakha, Constantinos Syropoulos, Erdai Yalcon and Yoto V. Yotov (2021). Timing the impact of sanctions on trade. In Peter A.G. van Bergeijk (ed.), *Research Handbook on Economic Sanctions*, Edgar Elgar Publishing.

Frazer, Garth and Johannes Van Biesebroeck (2010). Trade growth under the African growth and opportunity act. *Review of Economics and Statistics*, 92(1): 128-144.

Fritz, Oliver, Elisabeth Christen, Franz Sinabell and Julian Hinz (2017). "Russia's and the EU's Sanctions – Economic and Trade Effects, Compliance and the Way Forward," European Parliament, Policy Department, Directorate-General for External Policies, http://www.europarl.europa.eu/RegData/etudes/STUD/2017/603847/EXPO_STU(2017)603847_EN.pdf.

Korhonen, Iikka (2019). Sanctions and counter-sanctions – What are their economic effects in Russia and elsewhere? BOFIT Policy Brief 2/2019.

Mulder, Nicholas (2022). *The Economic Weapon: The Rise of Sanctions as a Tool of Modern War*. Yale University Press.

Simola, Heli (2023a). What the literature says about the effects of sanctions on Russia. BOFIT Policy Brief 8/2023.

Simola, Heli (2023b). Latest developments in Russian imports of sanctioned technology products. BOFIT Policy Brief 15/2023.

S&P Global (2024) Sanctions against Russia – a timeline. https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/sanctions-against-russia-8211-a-timeline-69602559.

Appendix

Table 1. Sanctioning countries

Austria	Latvia
Belgium	Lithuania
Bulgaria	Netherlands
Czech Republic	Poland
Denmark	Romania
Estonia	Singapore
Finland	Slovakia
France	Spain
Germany	Sweden
Hungary	Switzerland
Italy	Taiwan
Japan	UK
Korea	US

Table 2. Non-sanctioning countries

Azerbaijan	Kazakhstan
Brazil	Malaysia
China	Serbia
Georgia	South Africa
Hong Kong	Thailand
Indonesia	Turkey
India	Vietnam

BOFIT Discussion Papers

A series devoted to academic studies by BOFIT economists and guest researchers. The focus is on works relevant for economic policy and economic developments in transition / emerging economies.

2021	No 1	Eeva Kerola and Benoît Mojon: What 31 provinces reveal about growth in China
	No 2	Ekaterina Paustyan: Politically motivated intergovernmental transfers in Russia: The case of the 2018 FIFA World Cup
	No 3	Zuzana Fungáčová, Eeva Kerola and Laurent Weill: Does bank efficiency affect the bank lending channel in China?
	No 4	Shulong Kang, Jianfeng Dong, Haiyue Yu, Jin Cao and Valeriya Dinger: City commercial banks and credit allocation: Firm-level evidence
	No 5	Denis Davydov, Jukka Sihvonen and Laura Solanko: Who cares about sanctions? Observations from annual reports of European firms
	No 6	Ralph De Haas, Ralf Martin, Mirabelle Muûls and Helena Schweiger: Managerial and financial barriers to the net-zero transition
	No 7	Haiyue Yu, Jin Cao and Shulong Kang: Who cares: Deciphering China's female employment paradox
	No 8	Mikko Mäkinen: Does a financial crisis change a bank's exposure to risk? A difference-in-differences approach
	No 9	Ekaterina Borisova and Denis Ivanov: Covid-19 vaccine efficacy and Russian public support for anti-pandemic measures
	No 10	Orkun Saka, Yuemei Ji and Paul De Grauwe: Financial policymaking after crises: Public vs. private interests
	No 11	Joscha Beckmann and Mariarosaria Comunale: Exchange rate fluctuations and the financial channel in emerging economies
	No 12	Heli Simola: Trade collapse during the covid-19 crisis and the role of demand composition
	No 13	Orkun Saka, Barry Eichengreen and Cevat Giray Aksoy: Epidemic exposure, financial technology, and the digital divide
	No 14	Claire Yurong Hong, Xiaomeng Lu and Jun Pan: FinTech adoption and household risk-taking
	No 15	Xiaoming Li, Zheng Liu, Yuchao Peng and Zhiwei Xu: Bank risk-taking and monetary policy transmission: Evidence from China
2022	No 1	Michael Funke and Adrian Wende: The US–China phase one trade deal: An economic analysis of the managed trade agreement
	No 2	Michael Alexeev and Nikita Zakharov: Who profits from windfalls in oil tax revenue? Inequality, protests, and the role of corruption
	No 3	Florian Léon and Laurent Weill: Elections hinder firms' access to credit
	No 4	Alistair Dieppe and Hideaki Matsuoka: Sectoral decomposition of convergence in labor productivity: A re-examination from a new dataset
	No 5	David P. Newton, Steven Ongena, Ru Xie and Binru Zhao: Banks vs. markets: Are banks more effective in facilitating sustainability?
	No 6	Tat-kei Lai and Luhang Wang: Spatial disparity of skill premium in China: The role of financial intermediation development
	No 7	Zuzana Fungáčová, Alexei Karas, Laura Solanko and Laurent Weill: The politics of bank failures in Russia
	No 8	Jin Cao, Valeriya Dinger, Ragnar E. Juelsrud and Karolis Liaudinskas: Trade conflicts and credit supply spillovers: Evidence from the Nobel Peace Prize trade shock
	No 9	Nils Steiner, Ruxanda Berlinschi, Etienne Farvaque, Jan Fidrmuc, Philipp Harms, Alexander Mihailov, Michael Neugart and Piotr Stanek: Rallying around the EU flag: Russia's invasion of Ukraine and attitudes toward European integration
	No 10	Andrey Tkachenko: State-business relations and access to external financing
	No 11	Denis Davydov, Tatiana Garanina and Laurent Weill: Managing bank liquidity hoarding during uncertain times: The role of board gender diversity
	No 12	Timur Natkhov and William Pyle: Revealed in transition: The political effect of planning's legacy
	No 13	Michael Funke and Adrian Wende: Modeling semiconductor export restrictions and the US-China trade conflict
	No 14	David Finck and Peter Tillmann: The macroeconomic effects of global supply chain disruptions
2023	No 1	Francis Osei and Laurent Weill: Regional favoritism in access to credit: just believe it
	No 2	Yiping Huang, Xiang Li, Han Qiu and Changhua Yu: BigTech Credit and Monetary Policy Transmission: Micro-Level Evidence from China
	No 3	Günther G. Schulze and Nikita Zakharov: Political cycles of media repression
	No 4	Anna Di Gong, Jin Wu and Jigao Zhu: When banks' shadow fades and shadow banking rises: Securitization and loan performance in China
	No 5	Julia Niemeläinen: China's macroeconomic policies and spillover effects
	No 6	Loren Brandt, Johannes Van Biesebroeck, Luhang Wang and Yifan Zhang: Where has all the dynamism gone? Productivity growth in China's manufacturing sector, 1998-2013
	No 7	Xiaoshan Hu, Guanghua Wan and Congmin Zuo: Education expansion and income inequality:Empirical evidence from China
	No 8	Tuuli McCully: Drivers of portfolio flows into Chinese debt securities amidst China's bond market development
	No 9	Iftekhar Hasan, Xiang Li and Tuomas Takalo: Technological innovation and the bank lending channel of monetary policy transmission
2024	No 1	David Lodge, Ana-Simona Manu and Ine Van Robays: China's footprint in global financial markets
	No 2	Mustafa Özer, Jan Fidrmuc, Emmanouil Mentzakis and Özcan Özkan: Does education affect religiosity? Causal evidence from a conservative emerging economy
	No 3	Iikka Korhonen and Heli Simola: High-priority battlefield items and television sets – How sanctions reduced Russians' access to goods

ISSN 1456-5889 (online)