Trade Sanctions*

(preliminary, please do not circulate)

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Abstract

How effective are trade sanctions? We examine the economic impact of unprecedented sanctions imposed on Russia following February 2022, when Western countries banned the exports of close to 40% of all country-product varieties Russia had been importing prior to the war. By combining data on the universe of international trade transactions, domestic railway shipments, firm balance sheets, and government procurement data before and after the sanctions' imposition, we provide the most comprehensive analysis of the economic impact of trade sanctions to date. Using a difference-in-differences approach, we find that the sanctioned country-product imports experienced a sharp 62% decline compared to non-sanctioned import flows following the war's onset. The total imports of sanctioned products into Russia fell by only a slightly smaller magnitude, suggesting that roundabout trade and substitution only partially compensated the decline in sanctioned imports. Notably, firms that relied on to-be-sanctioned imports saw a 15% reduction in output. This pattern is observed even for firms that are part of military-adjacent supply chains. Overall, our findings suggest that, despite widespread anecdotal evidence that sanctions' effectiveness was undermined by substitution and evasion, the sanctions on Russian imports had an adverse impact on the Russian economy.

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1 Introduction

International relations are challenging to govern. Economic sanctions have increasingly been used to discipline countries that violate international law and norms (Eaton and Engers, 1992). One prevalent type of sanctions, commonly employed both now and in the past, are trade sanctions where one country prohibits the export or import of certain products to or from another (*target*) country, or completely blocks off trade.

How effective are trade sanctions? And, in particular, are sanctions against the target country's imports (hereafter, *import sanctions*) effective at disrupting the target country's production? There is a significant debate on this topic in both policy circles and academia. On the one hand, economic theory would predict that, unless firms have access to readily available substitutes, import sanctions should be effective at reducing the country's production capabilities. On the other hand, considerable journalistic, anecdotal, and scholarly evidence suggests that import sanctions are counterproductive, as they might lead to a relatively quick reorganization of supply chains and ultimately hurt the country imposing the sanctions on par with the target country.

We study the effectiveness of import sanctions in the context of Russia following the 2022 Russian invasion of Ukraine. This context is uniquely suitable for our research for several reasons. First, it represents the most extensive sanctions campaign against one of the world's biggest economies. This case tests the limits of sanctions' effectiveness, as it involves a large economy with economically prosperous neighboring countries that remained neutral or even friendly to the target state after the start of the war. A major debate continues on the effectiveness of import sanctions against Russia and whether they were compromised by substitution, re-routing, and evasion.[1] Second, multiple countries impose sanctions at different points on different product codes, down to the ten-digit level, creating ample variation for empirical analysis using a differences-in-

[1] See journalist reports, e.g., https://news.sky.com/story/how-uk-made-cars-are-finding-their-way-to-russias-showrooms-13092809 and https://foreignpolicy.com/2024/02/22/russia-sanctions-weapons-ukraine-war-military-semiconductors/, as well as academic work by Tyazhelnikov and Romalis (2023), Chupilkin, Javorcik, and Plekhanov (2023a) and Babina, Hilgenstock, Itskhoki, Mironov, and Ribakova (2023a).

differences design. Finally, this case offers a data-rich environment, with available information on customs transactions, railway shipments, firm balance sheets, and government procurement contracts. This wealth of data allows us to analyze the economic effects of trade sanctions with a previously unattainable level of detail.

We begin by confirming that import sanctions indeed reduced the imports of the sanctioned country-product varieties. Specifically, we estimate a difference-in-differences specification comparing the import flows of sanctioned and non-sanctioned country-product combinations before and after the onset of the war. A rich set of fixed effects helps us rule out a number of explanations unrelated to trade sanctions themselves. For instance, granular ten-digit-product-by-time fixed effects account for any product-specific shocks, such as concurrent spikes in demand for military-related and dual-use products. In turn, country-by-time fixed effects account for any country-specific shocks, such as whether a country simultaneously imposed other types of sanctions, such as restrictions on financial operations, which could have decreased all imports from that country, not just those under import sanctions.

We find that the sanctioned country-product imports went down dramatically after the war's onset, decreasing by 62% relative to non-sanctioned imports. Dynamic estimates reveal that the decline was sharp and growing over time, reaching 78% by the end of 2023. Importantly, we observe no pretrends, which supports the parallel trends assumption underlying our difference-in-differences strategy. The estimates remain similar when we use a staggered difference-in-differences strategy that leverages the heterogeneous timing of the sanctions' imposition.

Next, we show that import sanctions caused a substantial and sharp differential increase in the imports of sanctioned products from countries that were relatively friendly to the Russian regime following the start of the war. These estimates are strongly suggestive of substitution toward or rerouting through these third countries.

However, we find that substitution and rerouting did not fully offset the decline in the sanctioned country-product import flows. First, excluding 'friendly' countries from the comparison

group in the exercise above does not substantially alleviate this decline. Second, the decline in sanctioned imports remains negative even when we limit our analysis to countries that have implemented the sanctions (about a 55% decline). Finally, in a more aggregate product-level specification, we find that the total imports of sanctioned products also substantially declined compared to the total imports of non-sanctioned products across all importing countries (about a 43% decline).

Finally, leveraging the richness of our data, we show that import sanctions had a negative impact on the performance of exposed Russian firms. Specifically, in a firm-year difference-in-differences specification, we find that firms that imported a greater share of the soon-to-be-sanctioned country-product flows prewar saw a sharp decline in revenues after war's onset. In terms of magnitude, moving a firm from zero to full exposure to sanctioned imports is associated with a 15% decline in firm revenue after the war's onset.

The downstream impact on firm revenue is present even after controlling for firms' industry, omitting wholesalers and transportation companies, and focusing exclusively on firms in manufacturing. Consistent with the revenue decline reflecting an actual decline in output as opposed to a decline in prices, we find similar negative effects on other firm-level outcomes, including material costs and the volume of incoming domestic railway shipments.

We contribute to the burgeoning literature on the economics of geopolitical threats and international trade, and specifically to a subset of this literature concerning trade sanctions.

Theoretically, researchers have explored the rationale behind imposing sanctions on other nations. Most existing frameworks consider trade policy and the threat of trade sanctions as a tool of coercion (Eaton and Engers, 1992; Thoenig, 2023; Becko, 2024; Clayton, Maggiori, and Schreger, 2024; Liu and Yang, 2024). In Becko and O'Connor (2024), sanctions may also take place on equilibrium path to preserve the countries' commitment power to make future threats more credible. Our paper contributes to this ongoing discussion by demonstrating empirically that trade sanctions fulfill a geopolitical purpose beyond mere coercion. Specifically, they can disrupt production within the target economy and, ultimately, serve to weaken its military capabilities.

On the empirical side, the literature primarily investigates two types of sanctions: trade sanctions, which involve restrictions on export or import transactions for an entire country (Haidar, 2017; Juhász, 2018; Hinz and Monastyrenko, 2022), and targeted sanctions, which restrict economic transactions for select firms (Ahn and Ludema, 2020; Nigmatulina, 2021; Draca, Garred, Stickland, and Warrinnier, 2023). In both cases, the evidence for sanctions' effectiveness is mixed. Targeted sanctions, when applied alone, have shown to be limited in impact. For example, the sanctions imposed on Russia following the 2014 Annexation of Crimea and the occupation of Donbas targeted specific firms as opposed to products. If anything, they had a *positive* impact on targeted Russian firms due to countering subsidies by the Russian government (Nigmatulina, 2021). Trade sanctions have also shown to be of mixed effectiveness. While Crozet and Hinz (2020) in pre-war Russia and Haidar (2017) in Iran find a small decline of sanctioned trade flows, Haidar (2017) observes significant diversion of sanctioned imports from sanctioning to non-sanctioning countries. Most closely related to ours is contemporaneous work by Chupilkin, Javorcik, and Plekhanov (2023b) and Chupilkin, Javorcik, Peeva, and Plekhanov (2024) who use UN COMTRADE and the Russian customs data, respectively, to document the importance of roundabout trade in circumventing the post-2022 trade sanctions against Russia.[2]

We contribute to the empirical literature on sanctions in four ways. Most importantly, this paper is the first to combine the transaction-level customs data and firms' balance sheets to trace the impact of import sanctions all the way down to firm output. Second, we are able to assess whether trade substitution or rerouting documented by journalists and academics alike was able to offset the negative downstream effects of sanctions on firms. We find that it was not. Third, we analyze an unprecedented set of sanctions imposed on one of the world's largest economies; as of 2022, Russia was the 8th largest by real GDP. Earlier research typically focused on smaller economies like Iran or Venezuela, or on the much more limited pre-2022 sanctions against Russia. Finally, by compiling a novel dataset of sanctions against Russia, we are able to analyze the impact

[2]Also see the research on the implications of trade sanctions on the exchange rate (Itskhoki and Mukhin, 2022) and the use of US dollar in trade invoicing (Berthou, 2022; Chupilkin, Javorcik, Peeva, and Plekhanov, 2023).

of trade sanctions by all major countries, not just the EU, and utilize a staggered rollout design in addition to a simple before-and-after difference-in-differences. Altogether, our paper provides the most comprehensive assessment of the economic impact of trade sanctions on Russia to date.[3]

The rest of the paper is organized as follows. Section 2 provides the background on the Russian invasion of Ukraine in February 2022 as well as the sanctions that followed. Section 3 describes the data. Section 4 presents the results for the evolution of sanctioned import flows. Section 5 presents the results for the impact on firms that were importing to-be-sanctioned country-product varieties prior to the war. Section 6 concludes.

2 Background

Following the Russian aggression against Ukraine in February 2022, Western countries imposed an unprecedented level of sanction measures against Russia—an embargo on high-tech imports and equipment, targeted sanctions against prominent firms, restrictions on Russian oil trade, and exit of large multinational companies, as a means of putting pressure on the Russian government to stop the war or at least limit its resources in waging it.

These were not the first international sanctions against Russia. Prior to 2022, some sanctions were imposed after the Russian annexation of Crimea in 2014 and the start of the Donbas war. However, these sanctions were much more limited in scope and primarily targeted the politically connected and state-owned firms. On the contrary, the 2022–2023 sanctions were much wider and comprehensive. They not only included a larger list of targeted firms and individuals, which is continuously being expanded, but sanctioning countries also fully banned shipment of an overwhelming number of products to and from all Russian firms.

The 2022–2023 trade sanctions against Russia were of two types: against Russian exports and

[3]We also add to the literature on wars and trade. This literature has documented the negative impact of wars on international trade as well as the peace-inducing effect of trade integration (Martin, Mayer, and Thoenig, 2008a,b; Thoenig, 2023). Closely related to our context, Korovkin and Makarin (2023) and Korovkin, Makarin, and Miyauchi (2024) examine the negative impact of the 2014 Russia-Ukraine conflict on Ukrainian firms' trade with Russia and the disruption and reorganization of production networks within Ukraine, respectively. We add by providing granular estimates for the passthrough of import sanctions imposed by third countries during the 2022 Russia-Ukraine war.

against Russian imports. Sanctions targeting Russian imports were implemented almost immediately after February 2022, while sanctions against Russian exports were introduced towards the end of 2022. Measures against Russian exports included a ban of maritime oil export from Russia to G7 countries and the EU, along with a price cap on exports to all other countries (Johnson, Rachel, and Wolfram, 2023). Eventually, similar restrictions were applied to other raw materials. In this project, however, we focus exclusively on the impact of sanctions against Russian imports, with the goal of understanding whether restricted access to banned inputs disrupted the production processes of Russian firms.

Sanctions on the Russian imports, the focus of this paper, included bans on the Western exports of "cutting-edge technology (e.g. quantum computers and advanced semiconductors, electronic components and software), certain types of machinery and transportation equipment, specific goods and technology needed for oil refining, energy industry equipment, technology and services, aviation and space industry goods and technology (e.g. aircraft, aircraft engines, spare parts or any kind of equipment for planes and helicopters, jet fuel), maritime navigation goods and radio communication technology, a number of dual-use goods (goods that could be used for both civil and military purposes), such as drones and software for drones or encryption devices, luxury goods (e.g. luxury cars, watches, jewellery), civilian firearms, their parts and other army materials, chemicals, lithium batteries and thermostats, and other goods which could enhance Russian industrial capacities."[4] We present more details on the scope of these import sanctions and our data collection process below.

The impact of these trade sanctions on the Russian economy remains highly debated. Surveying over 1,800 Russian firms, Simachev et al. (2023) found that nearly two-thirds of the firms surveyed experienced negative effects from sanctions. The adverse impacts of sanctions were more pronounced among importing firms, with 30% of the surveyed firms reporting difficulties with importing necessary goods and services, and 17% facing issues with importing and servicing essential

[4] https://www.consilium.europa.eu/en/policies/sanctions/restrictive-measures-against-russia-over-ukraine/sanctions-against-russia-explained/

machinery. Nevertheless, there remains a lack of direct evidence on whether and by how much the affected firms reduced output.

3 Data and Descriptive Statistics

3.1 Customs Data

One of the key datasets we rely on in this project is a transaction-level dataset of international shipments as recorded by the Federal Customs Service of Russia.[5] For each transaction, the dataset contains the country of shipment, the 10-digit product code (where the first six digits match the Harmonized product classification), the product description, information on the sending and buying firms (including the tax ID for the firms located in Russia), unit value, total weight of each shipment, and its total contract value.

To investigate the completeness of this dataset, Figure 1 presents the total value of all imports recorded in these data (in dark orange) benchmarked against the mirror data from UN Comtrade reported by other countries (purple), data from UN Comtrade reported by Russia (blue, stopped reporting in February 2022), World Trade Organization (WTO, dark green), and the official data from the Russian Statistics Service (dark blue, stopped reporting in January 2022). When aggregated, our data matches almost exactly the Russian official export and import statistics and closely matches the UN Comtrade mirror exports to Russia, Trade Data Monitor mirror exports to Russia, and the WTO Russian imports. While there is a difference in levels between the mirror trade data and our dataset, this difference most likely stems from the cost of transportation and insurance. Overall, these estimates suggest that our data correctly reflects the volume and evolution of Russian imports. This is in line with Babina, Hilgenstock, Itskhoki, Mironov, and Ribakova (2023b) and Chupilkin et al. (2023), who also find that the quality of the Russian customs data available was not severely affected by the start of the war.

[5]The data was acquired by HEC Lausanne for the purpose of this research. The purchase has been cleared by the ethics committee and law specialists at HEC Lausanne. MIT Sloan School of Management signed a data transfer agreement with HEC Lausanne to make this data available to one of our team members affiliated with MIT Sloan.

3.2 Domestic Railway Shipments

We also use transaction-level data on domestic and international firm-to-firm railway shipments. For each transaction, the dataset records its weight, product code and description, buyer and seller information, and the nature of the shipment (import, export, or a domestic shipment). The detailed product code can be matched with the HS customs codes and therefore sanctions. In our context, railway shipments data are useful as they offer granular proxy measures for the quantity of firms' domestic outgoing and incoming shipments and provide insight into the structure of the firm-to-firm production network.

3.3 Firm Accounting Data

Further, we use the universe of reporting firm balance sheets and financial statements from 2016 through 2022. These data are collected and made available by the Federal Tax Authority. Firm balance sheets record the firm yearly revenues, material expenditures, labor expenditures, and costs along with other firm variables. We merge this dataset with the import transactions using buyer firm tax ID ("INN") to assess the impact of sanctions on firms.

3.4 Government Procurement

We extract the data on military procurement purchases from the Goszakupki database for the years 2012–2024 using the keywords related to military procurement. We then also apply filters to restrict our search to government procurement only. In total, we have identified 10,588 firms that engaged in military procurement as buyers and 24,240 firms that engaged in military procurement as suppliers at any point in this dataset.

3.5 Data on the Import Sanctions Against Russia

Finally, we manually compile a dataset on import sanctions imposed by eight major trading partners on Russia after February 2022. The list of sanctioning partners includes the EU, US, UK, Switzerland, Australia, Canada, South Korea and Japan. We based our dataset on the records available on the online platform Alta.ru (accessed in August 2023), which provides comprehensive

information on the sanctioned products and their description, the sanctioning countries, and the type of trade flow being sanctioned (Russian exports, Russian imports, re-exports to Russia, or transit through Russia).[6] This dataset was methodically cross-referenced with the enforcement dates extracted from official legal documents, notably the EU's Council Regulation 2022/263, the US's Supplements No. 2, 4, and 5 to Part 746, Title 15, and the UK's SI 2022/850, SI 2022/792, and SI 2022/1110. Through this process, we have identified 9,267 distinct country-product sanctioned varieties, highlighting specific dates of sanction imposition for 2,936 pairs, which are primarily associated with sanctions from the US, the UK, and the EU. Due to the challenges of identifying precise sanction dates, for most of our analysis, we will rely on a difference-in-differences strategy comparing country-product trade flows before and after the start of the war. We also include a staggered difference-in-differences approach to validate our findings.

3.6 Descriptive Statistics

Using our comprehensive data, we establish several descriptive facts about the sanctions against Russian imports after February 2022.

First, combining the data on sanctions with the customs transactions, we examine the size of imposed sanctions as well as how it evolves with the timeline of the sanctions' introduction. Specifically, Figures 2 and 3 depict the evolution of cumulative shares of all sanctioned country-product and product imports over time. Since we do not know the exact dates of sanctions' imposition for many country-product pairs, we impute March 1, 2022 as a default date for those pairs.

According to our calculations, close to 40% of all country-product imports to Russia, weighted by prewar trade value, had been sanctioned by July 2023. Furthermore, more than 80% of all product codes, again weighted by prewar trade value, were sanctioned by at least one country by July 2023. In terms of timing, most country-product varieties by volume were sanctioned in the first few months of the war, while the most voluminous products overall were sanctioned closer to May 2023. Based on this difference in timing, it appears that the sanctioning countries initially

[6] Available at https://www.alta.ru/tnved/forbidden_codes/.

targeted products on which Russia was heavily dependent for imports from those countries. Closer to July 2023, they began to impose sanctions on ten-digit products for which their share in Russian imports was relatively small.

Figures 4 and 5 display the total monthly imports into Russia by whether the country-exporter ever imposed sanctions and by whether a product has been sanctioned. Figure 4 shows that imports from countries that have imposed sanctions saw a significant reduction, plummeting by approximately two-thirds from over $15 billion to just above $5 billion in March 2022. Conversely, imports from countries without sanctions also declined, albeit less drastically, by about one-third from $14 billion to $10 billion, and then rose to an even higher level of around $16 billion.

In turn, Figure 5 shows that total imports of products sanctioned by at least one country have halved, declining from a peak of $30 billion to $15 billion in March 2022. By 2023, the overall value partially rebounded to around $20 billion, which remains slightly lower than the average monthly import value in 2021. Meanwhile, the value of products not sanctioned by any country remained stable throughout the period from 2019 to 2023. Therefore, at least in terms of overall value, the compensation was mostly taking place through rerouting or substitution between sanctioning and non-sanctioning countries rather than through relabeling or substitution between sanctioned and non-sanctioned products.

Figure 6 lists the most sanctioned product category codes. Specifically, within each HS2 code, we calculate the total share of country-HS10-product flows (based on 2021 data) that were ultimately sanctioned. This list is in line with the aims of sanctions specified by the Western states and listed in 2, which was to starve the Russian economy and, ultimately, Russian military of frontier technologies and critical inputs. The most sanctioned HS2 category, 84, for example, includes microchips, engines, and manufacturing machinery.

4 Results: Impact on Trade

We start by estimating the impact of import sanctions on Russian trade patterns. Our analysis proceeds in three steps. First, we identify the relative impact of import sanctions on the sanctioned country-product import flows into Russia. Second, we evaluate the extent to which there has been substitution to, and rerouting through, countries that remained neutral or friendly to the Russian regime following the onset of the war. Finally, we examine whether the volumes of substitution and rerouting were sufficient to compensate for the loss of sanctioned imports.

4.1 Impact on Sanctioned Country-Product Imports

To estimate the impact of import sanctions on the sanctioned imports, we compare the import flows of sanctioned and non-sanctioned country-product varieties before and after the onset of the war. Specifically, we estimate the following difference-in-differences equation:

$$y_{gct} = \tau_{gc} + \eta_{gt} + \omega_{ct} + \theta_t \times Sanctioned_{gc} + \zeta_{gct}. \tag{1}$$

Here, y_{gct} are (log-)trade flows from country c to Russia of a 10-digit product code g at quarter t, measured either by total value or by total weight shipped;[7] $Sanctioned_{gc}$ is an indicator that takes a value of 1 if a country-c-product-g trade flow has been sanctioned at any point, and 0 otherwise; τ_{gc} are the product-country fixed effects; η_{gt} are the product-quarter fixed effects; and ω_{ct} are the country-quarter fixed effects, netting out country boycotts and other country-level shocks as well as any changes in trade routing that do not depend on product type. The standard errors are two-way-clustered at the product and country level.

The event-study results are displayed in Figure 7. We observe no differential trends prior to the war and then a sharp drop in trade volume of the sanctioned country-product import flows compared to non-sanctioned imports after the war started. The negative impact is of considerable

[7] We transform the outcome variables using a logarithm with 1 inside to avoid omitting country-product-quarter cells with zero trade while keeping the estimation procedure computationally feasible.

magnitude and grows over time, reaching -1.5 log points in value by the first quarter of 2023, equivalent to a 78% decline. In Table 1, we estimate a nondynamic version of Equation (1), interacting $Sanctioned_{gc}$ with a simple post-February-2022 indicator instead of the yearly indicators and gradually adding the various fixed effects. Column (7) suggests a 62% relative decline for sanctioned imports after the war's onset.

To further demonstrate that the observed declining patterns are attributable to sanctions rather than other country-product shocks caused by the war, we employ a staggered difference-in-differences specification that leverages variation in the heterogeneous timing of sanctions. This approach compares country-product import flows that were recently sanctioned to those that had not yet been sanctioned at a given moment in time.[8] Figure 8 presents the resulting estimates, produced at the monthly level to closely examine the timing of the sanctions' introduction. We obtain similar findings with this alternative identification strategy. The estimates indicate that sanctions have an immediate adverse impact on the sanctioned import flows, which intensifies over time, eventually reaching a relative plateau around the fourth or fifth month after the introduction of sanctions.

4.2 Substitution and Rerouting Effects

One major concern with the estimates in Section 4.1 is that the war and sanctions can also affect the non-sanctioned trade flows. If the effects are positive, for instance, due to substitution or rerouting, the estimates in Figure 7 would be artificially inflated.

We quantitatively investigate the presence of such substitution and rerouting patterns. To this

[8] Following Fajgelbaum, Goldberg, Kennedy, and Khandelwal (2019), we estimate the following equation:

$$y_{gct} = \tau_{gc} + \eta_{gt} + \omega_{ct} + \sum_{\tau} \beta_{0\tau} \mathbb{1}(event_{gct} = \tau) + \sum_{\tau} \beta_{1\tau} \mathbb{1}(event_{gct} = \tau) \times Sanctioned_{gc} + \zeta_{gct} \quad (2)$$

where $\mathbb{1}(event_{gct} = \tau)$ is an indicator variable that takes the value 1 when the event for country c and product g was τ months away at period t. For the sanctioned imports, the event occurs precisely in the month when the sanctions were imposed. For the nonsanctioned imports, we define the event as occurring at the earliest date of sanctions imposed on the same 10-digit product by any country. If a given 10-digit product was not sanctioned by any country, we then consider the earliest date of sanctions imposed on the same 8-digit product by any country. If there are still no sanctions at this level, we proceed to the earliest date of sanctions on the same 6-digit product by any country, and so on, until the event is defined for all products. The coefficients of interest are $\beta_{1\tau}$.

end, we first identify a set of countries that we classify as relatively friendly to the Russian regime.[9] We also define a group of countries that ever sanctioned any exports to Russia in our sample as "enemy" countries. We then estimate a version of Equation (1) but with additional interaction terms between an indicator for whether a product g was ever sanctioned, an indicator for whether country c was antagonistic or friendly to the Russian regime, and the quarterly indicators.

Figure 9 presents the results. The estimates show an increase in Russian imports of sanctioned products from friendly countries, indicating substantial substitution to or rerouting through these countries. Nevertheless, the impact on sanctioned trade flows remains negative and of similar magnitude to Figure 7, i.e., after the friendly countries were removed from the comparison group. We note, however, that although the estimates for friendly and enemy countries are similar in magnitude, the total volume of prewar imports was much larger for latter than for the former. As such, the increase in imports from the friendly countries due to substitution and rerouting was unlikely to fully compensate for the decline in imports (directly) from the enemy countries.

We further investigate whether these substitution and rerouting patterns were sufficient to offset the negative impact of sanctions by estimating Equation (1) only within a group of enemy countries. This exercise is likely overly conservative because Russia saw a decline even of non-sanctioned imports from those countries, e.g., due to the general disruption of trade and financial ties. Nevertheless, the results plotted in Figure 10 and displayed in columns (1)–(2) of Table 2 also show negative effects of import sanctions on the sanctioned country-product trade flows.[10] These estimates strongly suggest that the results in Figure 7 are not due to rerouting and substitution towards other countries.

[9] We consider Armenia, Kazakhstan, Kyrgyzstan, Georgia, Turkey, Belarus, Serbia, China, Hong Kong, and UAE to be such countries. We based this list on the journalist accounts of the countries used for rerouting. However, our results are robust to excluding some of these countries and including others.

[10] Since the types of product sanctioned are highly correlated within this group of countries, we omit the product-quarter fixed effects from this particular specification.

4.3 Impact of Import Sanctions on Total Trade of Sanctioned Products

Next, we quantify whether sanctions led to a decline in the total imports of sanctioned products, independent of country-importer, by estimating a product-level version of Equation (1):

$$y_{gt} = \tau_g + \eta_t + \theta_t \times Sanctioned_g + \zeta_{gt}. \tag{3}$$

where y_{gct} are the total (log-)import flows of a ten-digit product code g into Russia at quarter t; $Sanctioned_g$ is an indicator that takes a value of 1 if the ten-digit-product code g has been sanctioned by *any* country and at any point, and 0 otherwise; and the τ_g and η_t are the ten-digit-product-code and quarter fixed effects. The standard errors are clustered at the product level.

Figure 11 presents the results. The total imports of sanctioned products to Russia went down dramatically, albeit by a smaller magnitude relative to the decline in the country-product-level specification (Figure 7). Table 3 displays the nondynamic estimates, showing a decline in sanctioned imports of 43% across postwar periods. Overall, these patterns imply that import sanctions were effective in driving down the total imports of the sanctioned product categories. Interestingly, we do not see evidence of increased unit prices.

5 Results: Impact on Firms

While the results in Section 4 suggest that import sanctions were effective in reducing imports of targeted products, it remains unclear whether they were also effective in disrupting production in the target economy. In this section, we leverage the richness of our data and assess the downstream implications of import sanctions for the performance of firms that were affected by their inability to import certain critical inputs.

To this end, we estimate a firm-year differences-in-differences regression, comparing firms before and after the war's onset by the degree to which a given firm has been importing sanctioned products prewar from countries that eventually sanctioned them. First, we construct an annual

panel of firms from 2016 through 2022 and merge it with the customs data for 2019–2022 to calculate a firm-specific prewar sanctions exposure. That is, for a given firm f, we combine all of its imports from January 2019 to February 2022 and identify the imports of the products that would later be sanctioned. We then divide the latter by the former:

$$Exposure_f = \frac{\sum_c \sum_g Sanctioned\,Value_{fcg}}{\sum_c \sum_g Value_{fcg}}.$$

where f stands for a firm, g stands for a ten-digit-product code, and c stands for the country-importer. We set $Exposure_f$ to 0 for firms that were never importers.

We then estimate the following difference-in-differences specification:

$$y_{ft} = \mu_f + \beta_t \times Exposure_f + \alpha_{it} + \delta_t \times \mathbb{1}\{f \text{ ever imported}\} + \epsilon_{ft} \tag{4}$$

Here, y_{ft} are firm yearly revenues or other firm-year outcomes, μ_f are the firm fixed effects, α_{it} are the fixed effects for industry i of firm f interacted with the year dummies, and $\delta_t \times \mathbb{1}\{f \text{ ever imported}\}$ flexibly controls for firm f's prewar importer status. The coefficients of primary interest are β_t's. We cluster the standard errors at the firm level.

Figures 12 presents the estimates for firm revenues as an outcome. Firms with a higher sanction exposure saw a sharp decline in their revenues after the war's onset, after having their revenues evolve in parallel with less-exposed firms before the war. The magnitude is also sizeable: increasing a firm's exposure to sanctions (i.e., the share of its prewar country-product imports that would later be sanctioned) from 0% to 100% is associated with a decline in firm's sales by approximately 15%. Figure 13 further displays a negative impact on material expenditures, suggesting that the decline in sales likely reflects the overall drop in production rather than reduced prices.

Table 4 confirms these estimates in a table form. Additionally, it shows that, firms in military supply chain see a similar reduction in sales and, while noisier, also profits, material costs, and labor costs.

6 Conclusion

In an era of nuclear weapons and the general hesitancy to engage in large-scale international conflicts, countries often resort to sanctions as a tool of foreign policy and influence. Import sanctions serve as a strategic tool to deprive the targeted country of essential inputs, thereby disrupting its production capabilities. But how effective are import sanctions in achieving these objectives?

We study this question in the context of the 2022 Russian invasion of Ukraine and the subsequent import sanctions imposed on Russia, which were unparalleled in their scope. Combining Russian data on the universe of international trade transactions, domestic railway shipments, accounting data for a near-universe of Russian firms, and government procurement data, we provide the most granular and comprehensive evidence on the impact of import sanctions to date.

Our findings indicate that import sanctions had a large negative impact on the sanctioned country-product trade flows. Despite observing some degree of substitution and rerouting, these measures were insufficient to offset the negative effects of import sanctions on trade. Finally, we document the negative impact of import sanctions on the affected Russian firms. These findings suggest that, contrary to claims that import sanctions were undermined by trade substitution and evasion, these measures hurt Russian firms.

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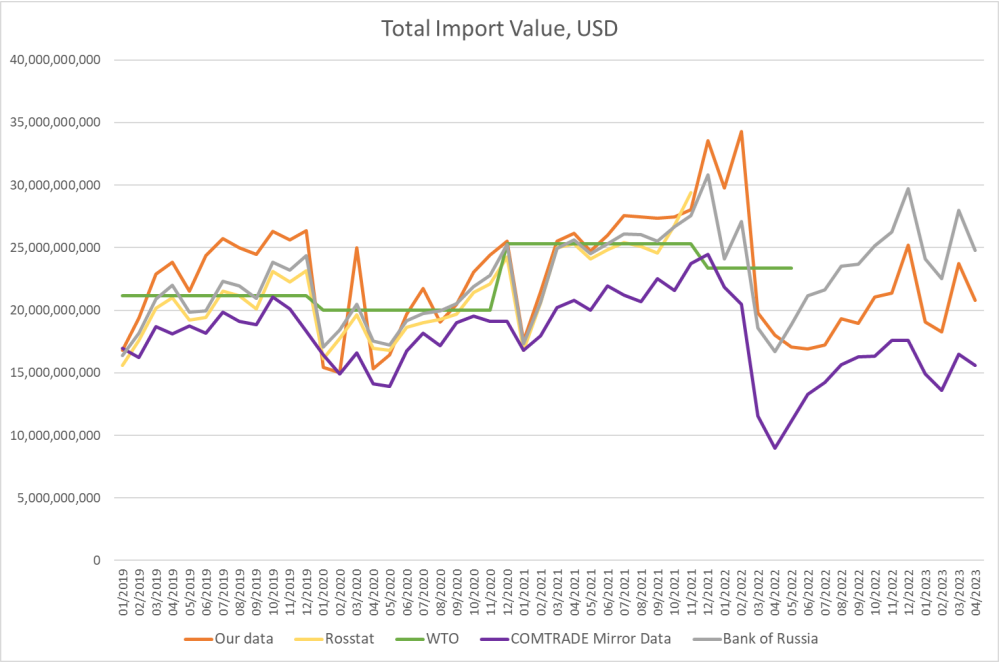
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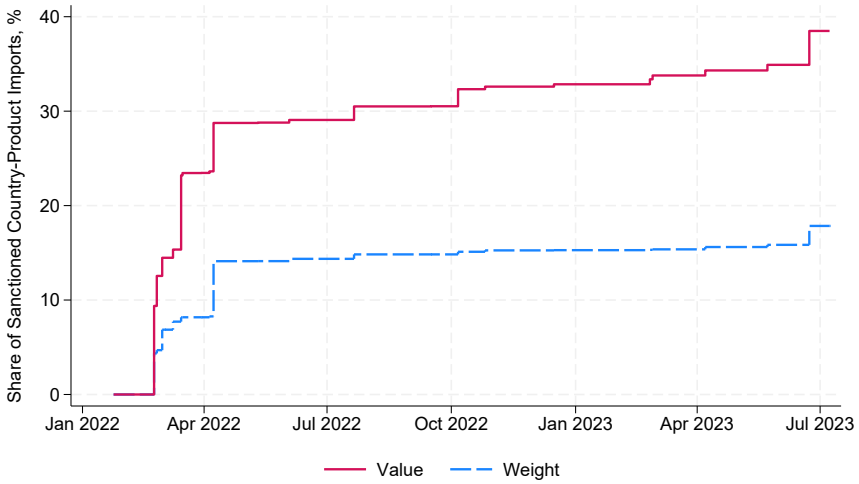
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Figure 1: Data Validation



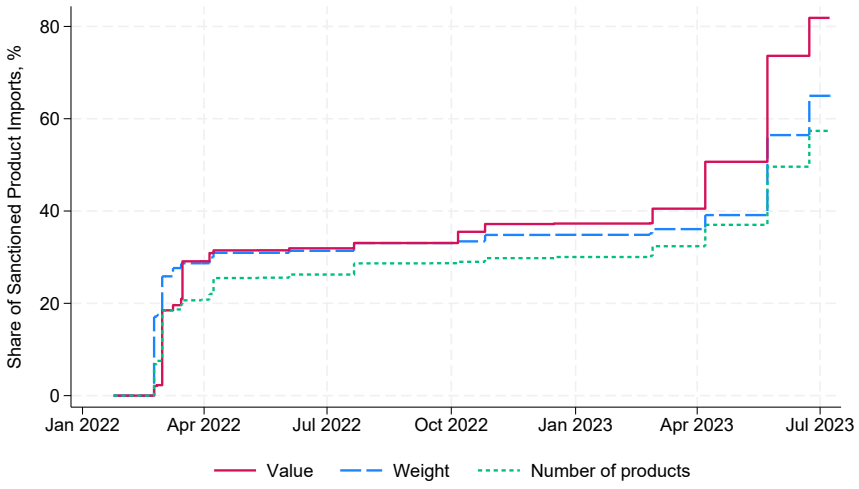
Notes: This figure depicts the total value of goods imported by Russia from 2019 to 2023 (in USD), as specified by various data sources: (i) our data, aggregated to the monthly level, shown in orange; (ii) UN Comtrade mirror data, reported by other countries, displayed in purple; (iii) official data from the Russian Statistical Service, in yellow; (iv) official data from the Bank of Russia, in gray; and (v) data from the WTO, in green.

Figure 2: Share of Sanctioned Imports



Notes: This figure displays the timeline of sanctions imposed on Russian country-product imports following the Russian invasion of Ukraine in February 2022, based on their prewar trade volume. Specifically, for each date from February 2022 to July 2023, we calculate the share of sanctioned country-ten-digit-product import flows based on the data from 2021. These shares are calculated both by value (in red) and by weight (in blue, long-dashed).

Figure 3: Share of Sanctioned Products in Russian Imports



Notes: This figure displays the timeline of sanctions imposed on products imported by Russia following the Russian invasion of Ukraine in February 2022, based on their prewar trade volume. Specifically, for each date from February 2022 to July 2023, we calculate the share of ten-digit-product import flows sanctioned by any country based on the data from 2021. These shares are calculated by value (in red), by weight (in blue, long-dashed), and by the number of products (in green, short-dashed).

Figure 4: Total Value of Russian Imports by Whether a Country Imposed Sanctions

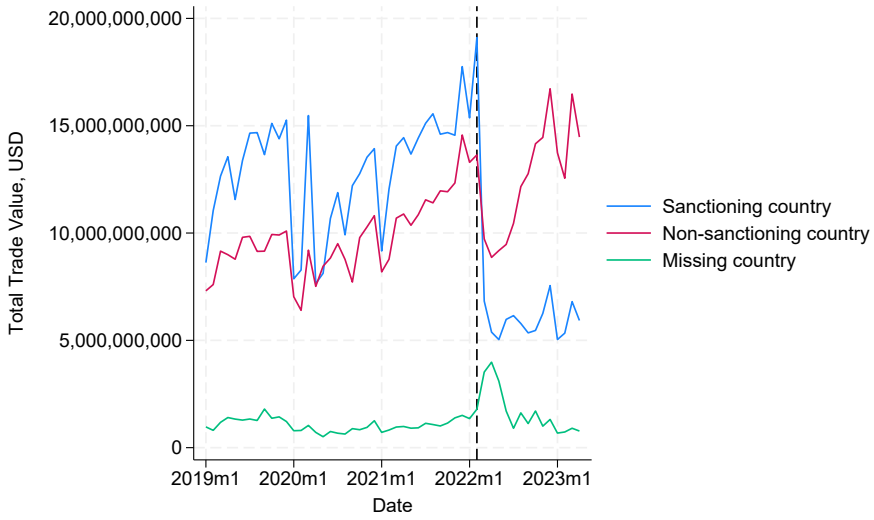


Figure 5: Total Value of Russian Imports by Whether a Ten-Digit-Product Was Ever Sanctioned

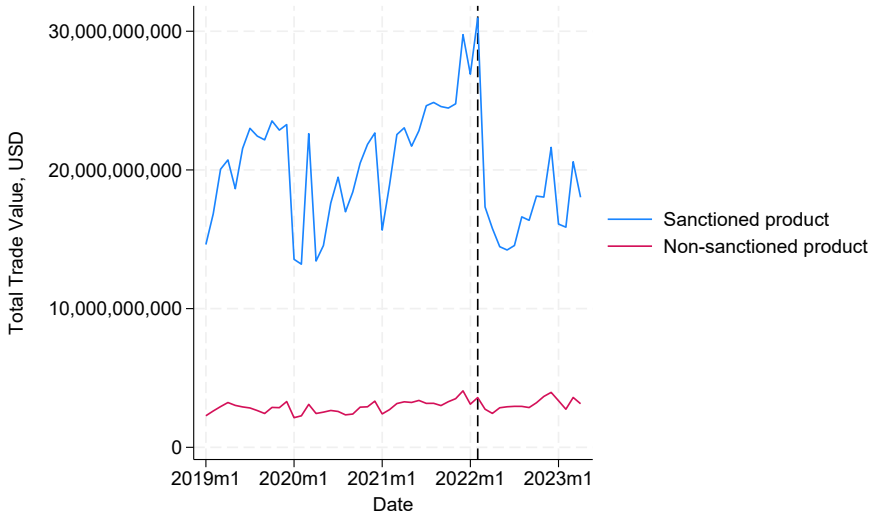
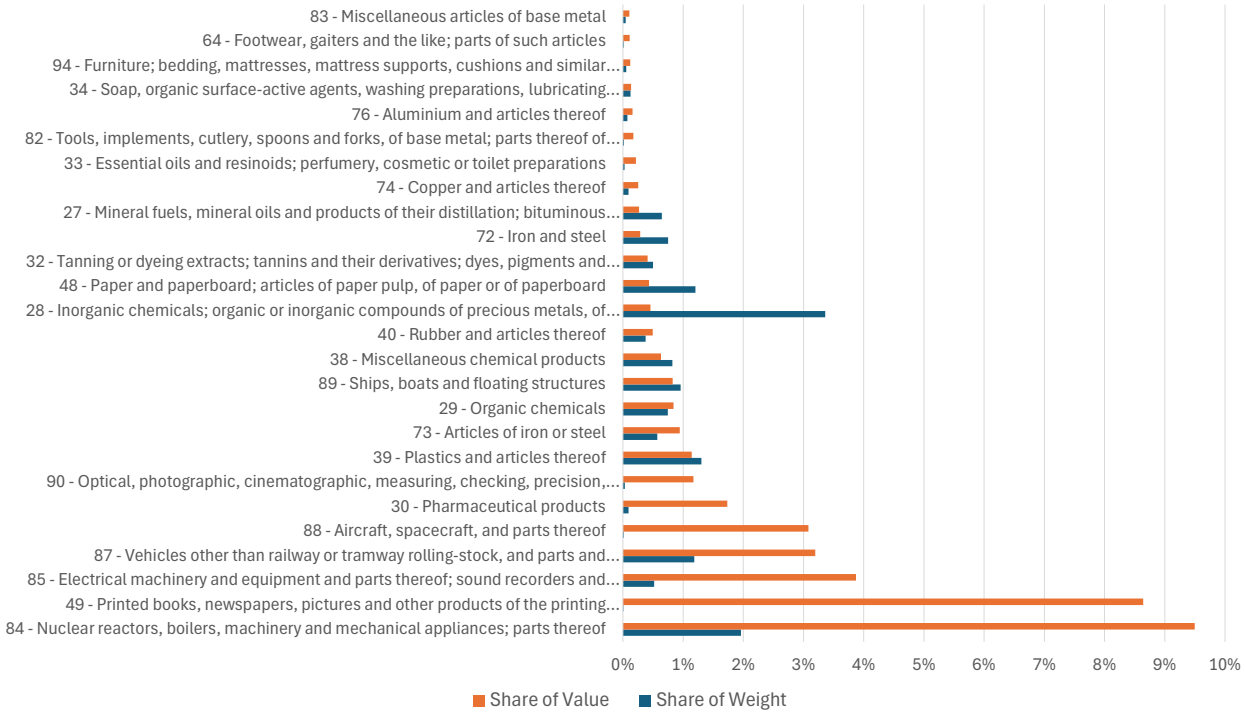
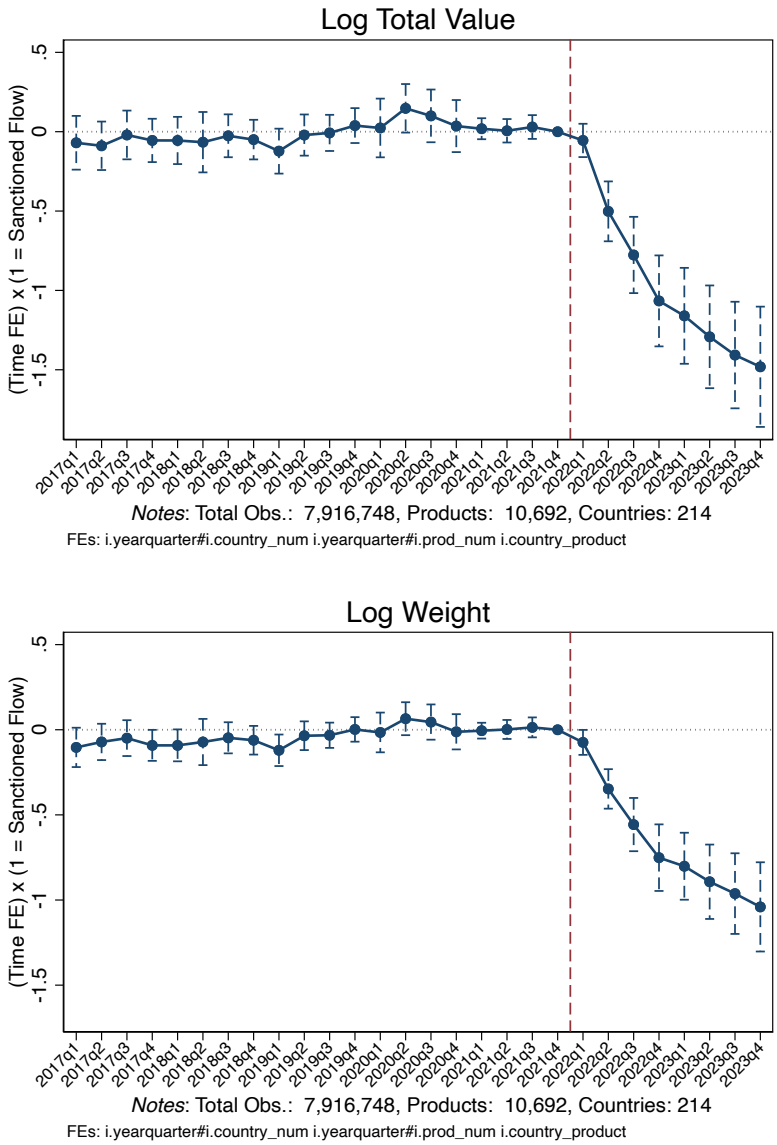


Figure 6: Most Sanctioned Products (HS2) in Terms of Prewar Shares



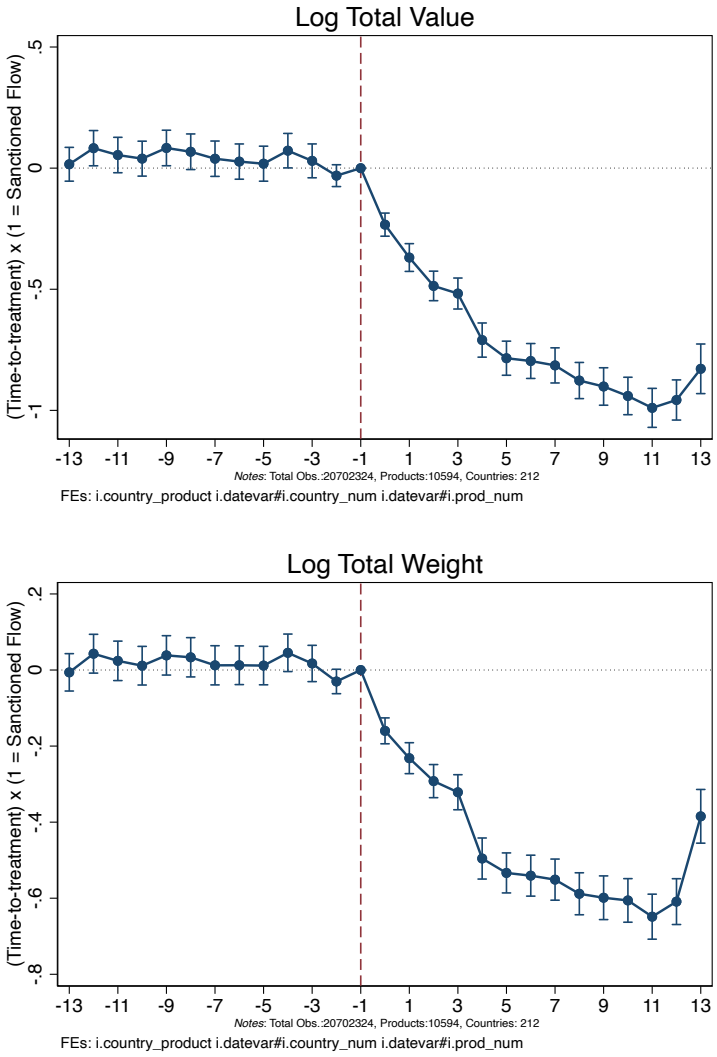
Notes: The list is capped at top 27 in terms of value share.

Figure 7: The Impact of Sanctions on Russian Imports, Country-Product-Level



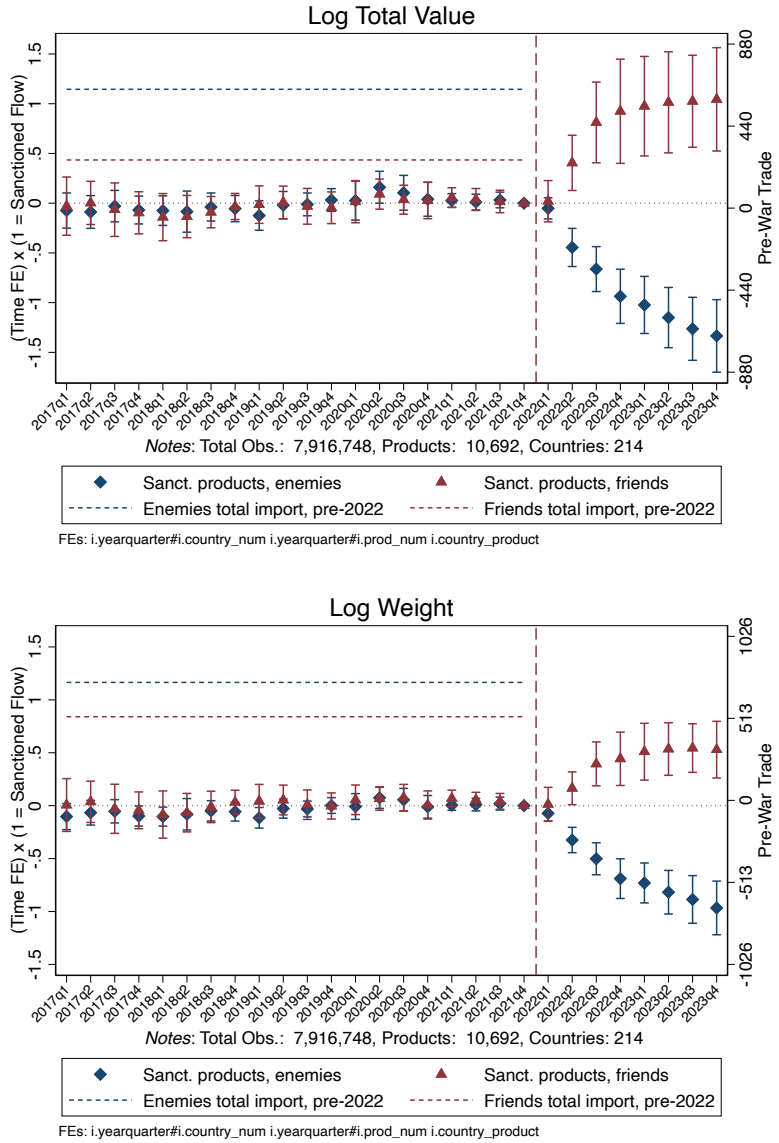
Notes: These figures present the dynamic difference-in-differences estimates of Equation (1), which assess the impact of sanctions on Russian imports by comparing the volume of sanctioned country-product imports to that of non-sanctioned imports before and after the war's onset. The data is aggregated quarterly, with 2021Q4 serving as the baseline period. The top (bottom) figure uses the total import value (net weight) of a given product from a given country in a given quarter as an outcome. The logarithms of outcome variables are calculated by transforming the initial variable X with $L(X) = \log(X + 1)$. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure 8: The Impact of Sanctions on Russian Imports, Country-Product-Level, Staggered Design



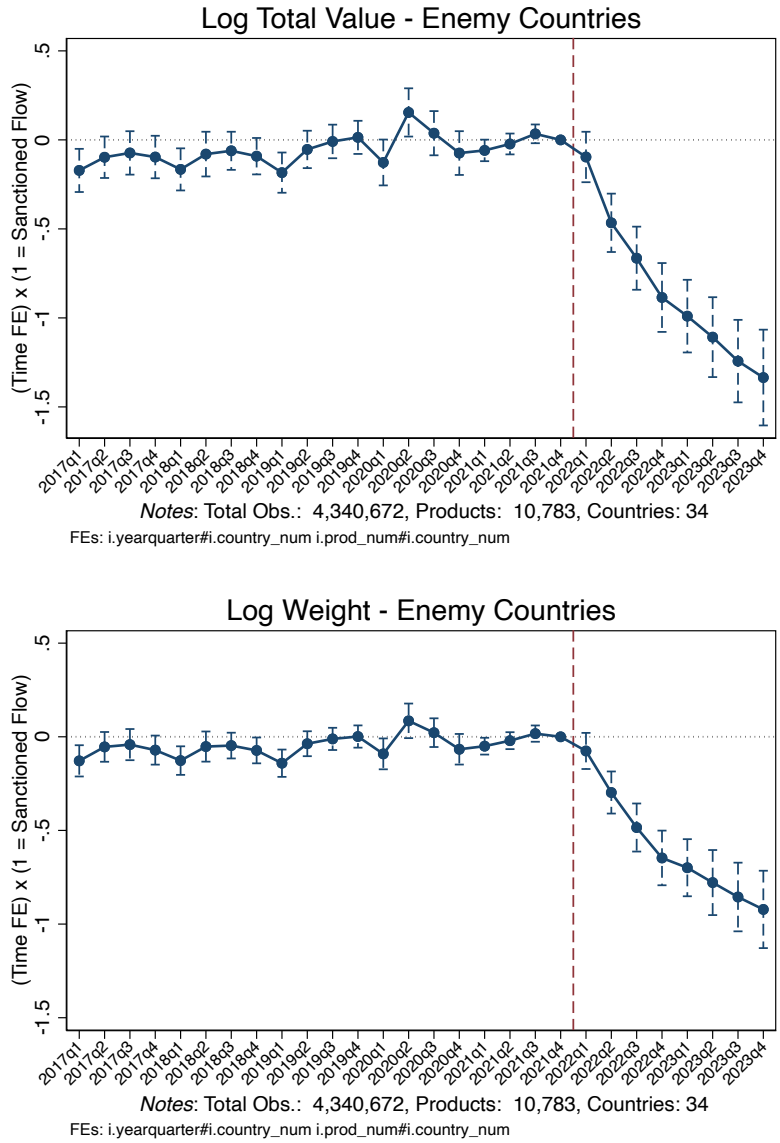
Notes: These figures present the staggered difference-in-differences estimates of Equation (8), which assess the impact of sanctions on Russian imports by comparing the volume of sanctioned country-product imports to that of non-sanctioned imports before and after the imposition of sanctions on the former. The data is aggregated at the monthly level, with the month before the imposition of sanctions on a given country-product import flow serving as the baseline period. The top (bottom) figure uses the total import value (net weight) of a given product from a given country in a given quarter as an outcome. The logarithms of outcome variables are calculated by transforming the initial variable X with $L(X) = \log(X + 1)$. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure 9: The Impact of Sanctions on Russian Imports, Country-Product-Level, With Estimates of Substitution and Rerouting



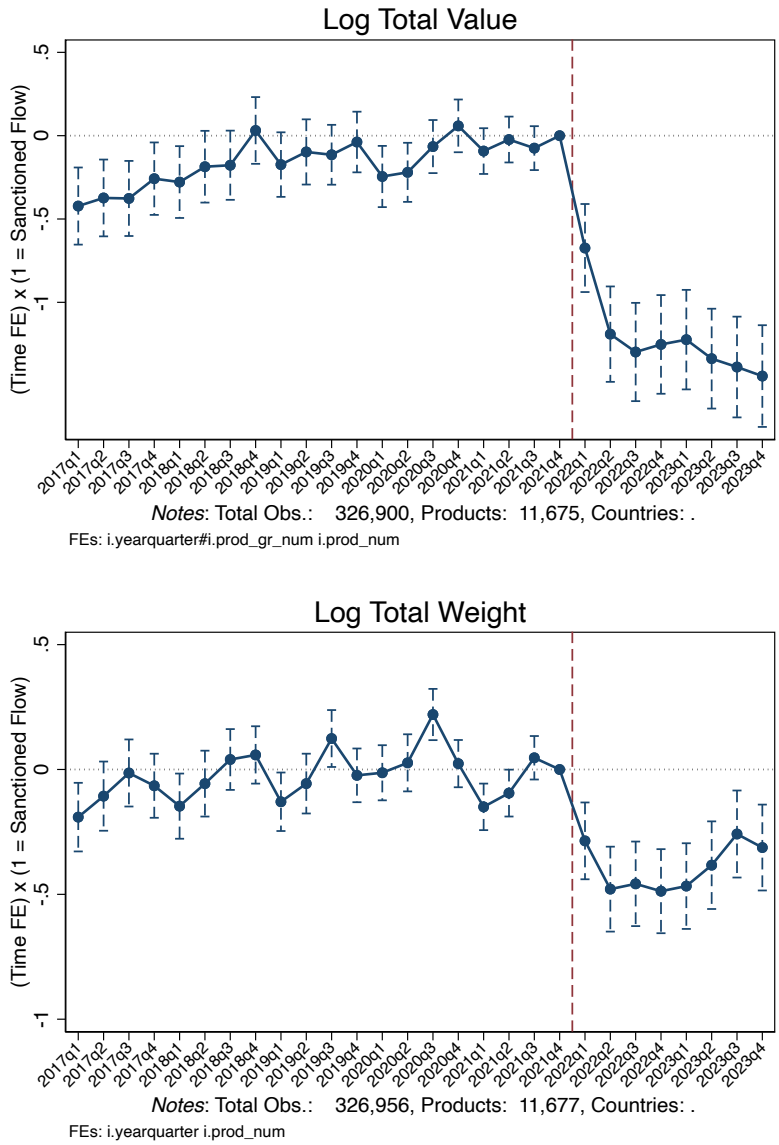
Notes: These figures investigate the presence of substitution to and rerouting through third countries by estimating a version of Equation (1), which compares the volume of sanctioned country-product imports to that of non-sanctioned imports, before and after the war's onset, but separating out the imports of ever-sanctioned products from the 'friendly' countries. 'Friends' are the countries that remained relatively friendly to the Russian regime after the war's onset: Armenia, Kazakhstan, Kyrgyzstan, Georgia, Turkey, Belarus, Serbia, China, Hong Kong, and the UAE. 'Enemy' countries include countries that have ever imposed trade sanctions on Russia. The data is aggregated at the quarterly level, with 2021Q4 serving as the baseline period. The top (bottom) figure uses the total import value (net weight) of a given product from a given country in a given quarter as an outcome. The logarithms of outcome variables are calculated by transforming the initial variable X with $L(X) = \log(X + 1)$. The short-dashed lines represent the total volume of prewar trade with friendly and enemy countries. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure 10: The Impact of Sanctions on Russian Imports, Country-Product-Level, 'Enemy' Countries Only



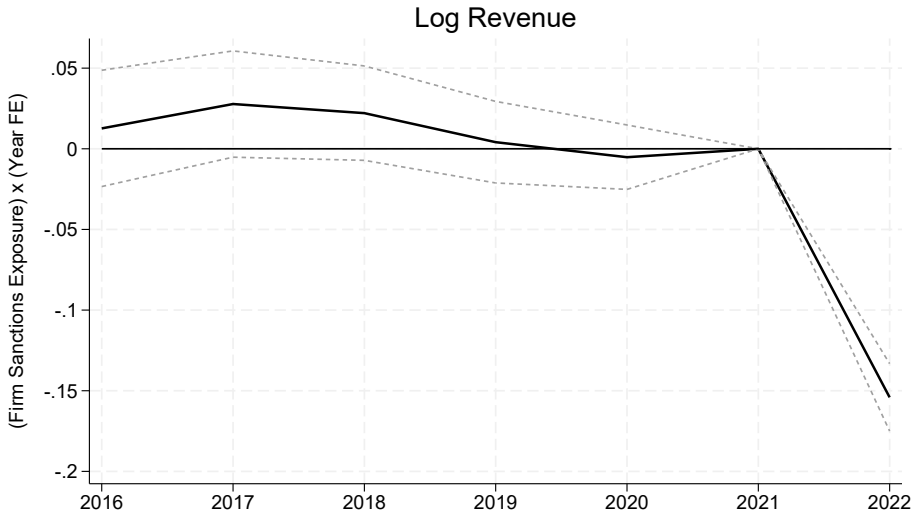
Notes: These figures explore whether the decline in sanctioned imports is present even within a subsample of 'enemy' countries, i.e., those that ever imposed trade sanctions on Russia. Specifically, they present the dynamic difference-in-differences estimates of Equation (1) comparing the volume of sanctioned country-product imports to that of non-sanctioned imports before and after the war's onset, but on a subsample of 'enemy' countries. The data is aggregated at the quarterly level, with 2021Q4 serving as the baseline period. The top (bottom) figure uses the total import value (net weight) of a given product from a given country in a given quarter as an outcome. The logarithms of outcome variables are calculated by transforming the initial variable X with $L(X) = \log(X + 1)$. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure 11: The Impact of Sanctions on Russian Imports, Product-Level



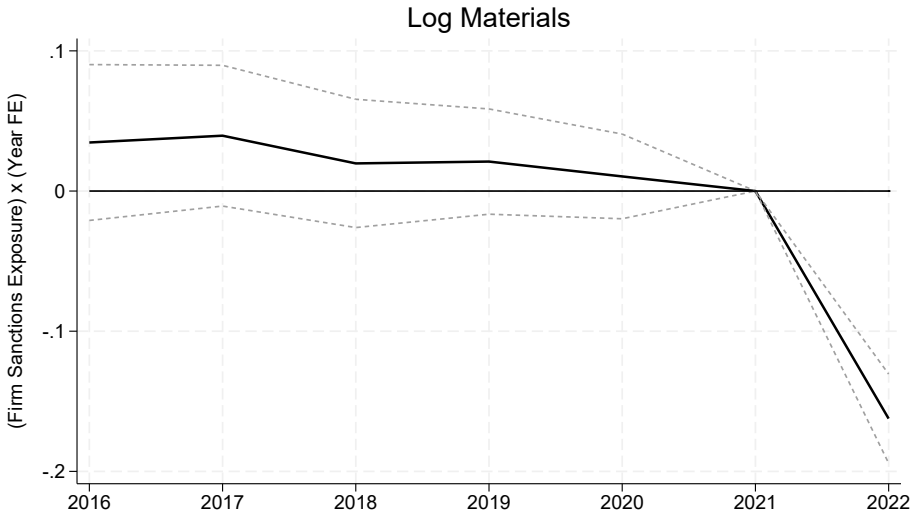
Notes: These figures assess the impact of sanctions on the total imports of sanctioned products, independent of the identity of countries-importers. Specifically, they present the dynamic difference-in-differences estimates of Equation (3), which compares the volume of sanctioned product imports to that of non-sanctioned imports before and after the war's onset. The data is aggregated at the quarterly level, with 2021Q4 serving as the baseline period. The top (bottom) figure uses the total import value (net weight) of a given product in a given quarter as an outcome. The logarithms of outcome variables are calculated by transforming the initial variable X with $L(X) = \log(X + 1)$. The bars represent 95% confidence intervals. Standard errors are clustered at the product level.

Figure 12: The Impact of Sanctions on Firm Sales



Notes: This figure examines the impact of sanctions on the revenues of firms that, prior to the war, imported a greater share of their country-product varieties that were later sanctioned. Specifically, it presents the dynamic difference-in-differences estimates of Equation 4, which compares firm revenues with a higher versus lower prewar exposure to future import sanctions, before and after the war's onset. The revenue data come at the yearly level, and 2021 serves as the baseline period. The logarithm of outcome variable is calculated by transforming the initial variable X with $L(X) = \log(X+1)$. The bandwidths represent 95% confidence intervals. Standard errors are clustered at the product level.

Figure 13: The Impact of Sanctions on Firms' Material Expenditures



Notes: This figure examines the impact of sanctions on the material costs of firms that, prior to the war, imported a greater share of their country-product varieties that were later sanctioned. Specifically, it presents the dynamic difference-in-differences estimates of Equation 4, which compares firm revenues with a higher versus lower prewar exposure to future import sanctions, before and after the war's onset. The revenue data come at the yearly level, and 2021 serves as the baseline period. The logarithm of outcome variable is calculated by transforming the initial variable X with $L(X) = \log(X + 1)$. The bandwidths represent 95% confidence intervals. Standard errors are clustered at the product level.

Table 1: The Impact of Sanctions on Russian Imports, Country-Product-Level, Quarterly

	(1) Log Total Value	(2) Log Total Weight	(3) Log Total Value	(4) Log Total Weight	(5) Log Total Value	(6) Log Total Weight	(7) Log Total Value	(8) Log Total Weight
	Panel A: Baseline Estimation							
Post-War × Sanctioned Flow	-2.163***	-1.559***	-2.445***	-1.632***	-0.792***	-0.551***	-0.958***	-0.644***
	(0.157)	(0.109)	(0.304)	(0.221)	(0.091)	(0.068)	(0.129)	(0.087)
Product-Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Product-Quarter FE			✓	✓			✓	✓
Country-Quarter FE					✓	✓	✓	✓
	Panel B: Splitting the Country Groups							
Post-War × Sanctioned Flow	-2.163***	-1.559***	-1.876***	-1.273***	-1.876***	-1.273***	-0.846***	-0.591***
	(0.157)	(0.109)	(0.275)	(0.203)	(0.275)	(0.203)	(0.117)	(0.082)
Post-War × Ever-Sanctioned Product × Friend	1.838***	1.065***	2.093***	1.322***	2.093***	1.322***	0.797***	0.376***
	(0.341)	(0.230)	(0.400)	(0.271)	(0.400)	(0.271)	(0.160)	(0.077)
Product-Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Product-Quarter FE			✓	✓			✓	✓
Country-Quarter FE					✓	✓	✓	✓
Mean Dep. Var.	3.51	2.42	3.52	2.43	3.52	2.43	3.52	2.43
SD Dep. Ver.	5.04	3.92	5.04	3.92	5.04	3.92	5.04	3.92
R^2	0.61	0.65	0.67	0.70	0.67	0.70	0.69	0.71
Observations	7,944,524	7,944,524	7,916,944	7,916,944	7,916,944	7,916,944	7,916,748	7,916,748
Number of Countries	221	221	221	221	221	221	214	214
Number of Products	11,677	11,677	10,692	10,692	10,692	10,692	10,692	10,692

Notes: This table presents the estimates of equation (1) studying whether imports on the product-country-quarter level declined after the start of the Russian invasion of Ukraine in 2022 depending on sanctioned status. The outcome in even columns is log-value traded, and in the odd columns—log-weight traded. To avoid missing values, the logarithms add 1 to the argument's value. Standard errors in parentheses are clustered twoway at the country and product level. Panel A shows baseline results; Panel B splits flows into three country groups, comparing the changes in flows between Russia and "enemies", "friends", and natural countries. Friendly countries are Armenia, Kazakhstan, Kyrgyzstan, Georgia, Turkey, Belarus, Serbia, China, Hong Kong, and UAE. * p<0.1, ** p<0.05, *** p<0.01.

Table 2: Friends and Enemies Separately, Country-Product-Level, Quarterly

	(1) Log Total Value	(2) Log Total Weight	(3) Log Total Value	(4) Log Total Weight
	Enemy Countries		*Friendly Countries*	
Post-War × Sanctioned Flow	-0.792***	-0.551***		
	(0.092)	(0.069)		
Post-War × Ever-Sanctioned Product			0.766***	0.410***
			(0.167)	(0.074)
Country-Quarter FE	✓	✓	✓	✓
Product-Country FE	✓	✓	✓	✓
Mean Dep. Var.	4.20	2.84	3.99	3.01
SD Dep. Ver.	5.21	4.01	5.52	4.57
R^2	0.63	0.66	0.69	0.73
Observations	4,340,672	4,340,672	1,046,388	1,046,388
Number of Countries	34	34	10	10
Number of Products	10,783	10,783	9,855	9,855

Notes: This table presents the estimates of equation (1) studying whether imports on the product-country-quarter level declined after the start of the Russian invasion of Ukraine in 2022 depending on sanctioned status. The outcome in even columns is log-value traded, and in the odd columns—log-weight traded. To avoid missing values, the logarithms add 1 to the argument's value. Standard errors in parentheses are clustered twoway at the country and product level. Friendly countries are Armenia, Kazakhstan, Kyrgyzstan, Georgia, Turkey, Belarus, Serbia, China, Hong Kong, and UAE. * p<0.1, ** p<0.05, *** p<0.01.

Table 3: The Impact of Sanctions on Russian Imports, Product-Level, Quarterly

	(1) Log Total Value	(2) Log Total Weight	(3) Log Unit Price	(4) Log Total Value	(5) Log Total Weight	(6) Log Unit Price
Post-War × Sanctioned Product	-0.561***	-0.366***	-0.027**	-1.070***	-0.784***	0.050**
	(0.092)	(0.077)	(0.014)	(0.134)	(0.111)	(0.021)
Quarter FE	✓	✓	✓			
Product FE	✓	✓	✓	✓	✓	✓
3-Digit Product-Quarter FE				✓	✓	✓
Mean	9.60	7.93	3.59	9.60	7.93	3.59
SD	6.31	5.68	2.55	6.31	5.68	2.55
R^2	0.74	0.77	0.89	0.74	0.78	0.90
Observations	326,956	326,956	239,074	326,900	326,900	239,054
Number of Products	11,677	11,677	11,010	11,675	11,675	11,007

Notes: This table presents the estimates of equation (3). It explores if imports on the *product-quarter* level declined after the start of the Russian invasion of Ukraine in 2022, depending on sanctioned status. The outcome in columns (1) and (4) is log-value traded; in columns (2) and (5)—log-weight traded, columns (3) and (6) show the results for the log-unit price. The logarithms add 1 to the argument's value to avoid missing values. Standard errors in parentheses are clustered at the product level. * p<0.1, ** p<0.05, *** p<0.01.

Table 4: The Impact of Trade Sanctions on Russian Firms

	(1) Log Revenue	(2) Log Profit	(3) Log Capital	(4) Log Materials	(5) Log Labor
Panel A: Difference-in-Differences Estimation: Ever Sanctioned					
Post-2022 × Firm Imported Sanctioned Flows	-0.155***	-0.119***	-0.077***	-0.153***	-0.059***
	(0.015)	(0.023)	(0.019)	(0.021)	(0.016)
Firm FE	✓	✓	✓	✓	✓
Year-Industry FE	✓	✓	✓	✓	✓
Year-Importer Status FE	✓	✓	✓	✓	✓
Mean Dep. Var.	16.73	14.04	14.62	17.55	16.11
SD Dep. Var.	2.26	2.46	2.65	2.70	2.26
R^2	0.86	0.75	0.89	0.88	0.91
Observations	3,742,883	2,785,871	4,171,987	1,000,517	979,764
Number of Firms	606,255	527,155	670,024	192,372	187,237
Panel B: Only Military-Related Firms					
Post-2022 × Firm Imported Sanctioned Flows	-0.135**	-0.112	-0.089	-0.102	-0.044
	(0.059)	(0.092)	(0.083)	(0.070)	(0.056)
Firm FE	✓	✓	✓	✓	✓
Year-Industry FE	✓	✓	✓	✓	✓
Year-Importer Status FE	✓	✓	✓	✓	✓
Mean Dep. Var.	18.69	15.28	15.75	19.71	17.94
SD Dep. Var.	2.31	2.56	3.04	2.29	2.15
R^2	0.89	0.78	0.91	0.89	0.93
Observations	117,340	97,147	118,370	51,974	51,918
Number of Firms	16,224	15,295	16,358	8,506	8,491

Notes: This table presents the estimates of equation (4). All dependent variables are denominated in the logarithm of Russian rubles. The Ever Sanctioned dummy variable indicates whether any sanctions were imposed on goods traded by the firm pre-2022. The military dummy variable indicates if the firm is classified as a military buyer or military supplier according to our classification. Spark Interfax data spanning 2014 to 2022 are used for this analysis. Standard errors in parentheses are clustered at the firm level. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.