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Abstract

How effective are trade sanctions? We examine the economic impact of the unprecedented sanctions imposed on Russia following February 2022, when Western countries banned exports accounting for 36% of Russia's prewar import value. Combining novel, manually collected records of these sanctions with Russian customs data, firm balance sheets, domestic railway shipments, and government procurement contracts, we provide the most comprehensive analysis of the economic impact of trade sanctions on a target country to date. Using a difference-in-differences approach, we find that imports of sanctioned country-product varieties into Russia saw a sharp 62% decline following the war's onset. While we see substantial rerouting through third countries, it did not fully offset the direct import losses: total imports of sanctioned products fell by 27%. Firms that had relied on soon-to-be-sanctioned imports experienced a 14% decline in output, also observed in manufacturing, technology, and firms linked to military supply chains. Affected firms also saw reduced government procurement sales and incurred additional losses when their buyers or suppliers were exposed to sanctions. Overall, our findings suggest that, contrary to widespread claims of ineffectiveness, import sanctions on Russia had far-reaching adverse effects.

JEL: D22, D74, F14, F51, H56

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1 Introduction

After decades of globalization, the world is witnessing a renewed trend toward fragmentation of trade linkages (Gopinath, Gourinchas, Presbitero, and Topalova, 2025). A key manifestation of this shift is the growing use of *trade sanctions*—restrictions on cross-border trade imposed for geopolitical purposes (Morgan, Syropoulos, and Yotov, 2023).

Governments typically impose trade sanctions for at least two main reasons. One objective is to punish a target country and induce a change in the political behavior of that or other countries, immediately or over time. Yet, political concessions are often slow to materialize, making it difficult to assess the effectiveness of sanctions on these grounds. A second, more direct objective is to disrupt the target country's productive capacity—particularly by restricting access to high-tech inputs—and thereby erode its industrial base as well as technological and military capabilities. For instance, the EU officially justified the sanctions it imposed on Russia after February 2022 with *"the aim of weakening Russia's economic base, depriving it of critical technologies and markets, and significantly curtailing its ability to wage war"* (European Commission, 2022).

How effective are trade sanctions at achieving this second objective? And, in particular, do sanctions on the target country's imports—hereafter, *import sanctions*—disrupt its production and supply chains? On one hand, economic theory predicts that if firms cannot easily replace foreign inputs, import sanctions should impede output. This logic is especially compelling for high-tech or specialized goods that are difficult to substitute. On the other hand, a growing body of journalistic, anecdotal, and scholarly accounts questions this view, arguing that import sanctions often fail to bite due to rapid sourcing adjustments, enforcement difficulties, and limited downstream impact on production, ultimately causing less harm to the target economy than expected and raising doubts about whether the costs to sanctioning countries are justified.

Despite significant scholarly interest, causal evidence on the economic pass-through of import sanctions remains limited. Such estimates require detailed micro-level data linking firms in targeted countries to their import behavior and outcomes, along with variation in sanction timing and coverage. These conditions are rarely met in practice—either because data quality in sanctioned countries is poor or because sanctions are typically imposed all at once, often alongside other

measures, and tend to target only a narrow set of sectors or be issued by a small group of countries.

We overcome these challenges by studying the effectiveness of import sanctions in the context of Russia following its 2022 invasion of Ukraine. This context is uniquely suitable for our research question for several reasons. First, it represents one of the most extensive sanctions campaigns in history, imposed against one of the world's biggest economies.[1] It thus tests the limits of sanctions' effectiveness, particularly given Russia's proximity to large trading partners, many of which remained neutral or friendly after the war began and were well positioned to facilitate trade diversion.[2] Second, the sanctions were imposed by multiple countries at different times and on different product categories, down to the ten-digit level, generating rich variation for identification. Third, Russia offers an unusually data-rich environment, with available information on customs transactions, firm-level financials, domestic railway shipments, and government procurement contracts. We combine these sources with a novel, manually assembled dataset on import sanctions against Russia, covering 35 sanctioning countries and relating to around 6,000 ten-digit product codes observed in Russian customs data. Together, these data allow us to study the economic pass-through of import sanctions with a previously unattainable level of detail.

We begin by documenting several stylized facts. First, trade sanctions banned 36% of the value of all country-product varieties that Russia imported before the war, constituting one of the largest trade shocks in recent history.[3] Second, while a large share of sanctioned imports concentrated in a few high-tech product codes and a few sanctioning countries, a nontrivial portion of imports within these categories remained unsanctioned. Third, despite coordination within the Western coalition, the specific lists of banned products varied substantially across sanctioning countries. Collectively, these facts underscore the richness of the setting and motivate our granular empirical analysis.

Our analysis proceeds in two main steps. We begin by assessing whether sanctions have effectively restricted imports to the target country—Russia. We then examine the extent to which these

[1] As of 2021, Russia ranked as the fourth-largest economy globally in terms of PPP-based GDP and tenth-largest in terms of nominal GDP, according to World Bank (2023).

[2] There is an active policy and academic debate about the extent to which import sanctions on Russia were undermined by rerouting and substitution via third countries. E.g., see Conway (2023) and Mackinnon (2024), as well as work by Chupilkin, Javorcik, and Plekhanov (2023), Babina et al. (2023), and Tyazhelnikov and Romalis (2024).

[3] For comparison, during the 2018–2021 U.S.–China trade war, the U.S. increased tariffs of up to 25.8% on 18% of its imports (Fajgelbaum and Khandelwal, 2022).

import sanctions have disrupted production and supply chains within the Russian economy.

As a first stage in the import analysis, we explore whether sanctions effectively reduced imports of the sanctioned country-product varieties. To this end, we pursue two complementary empirical strategies. The first is a simple pre-post difference-in-differences (DiD) approach that compares import flows of sanctioned and non-sanctioned country-product varieties before and after the war's onset. The second is a staggered DiD strategy that compares newly sanctioned imports with those not (or not yet) subject to sanctions. While the former approach is simple, transparent, and well-suited to our context—given that most sanctions were imposed in the early months of the war—the latter allows us to focus on the period just around the imposition of sanctions, helping us to further disentangle the effects of trade sanctions from broader wartime disruptions.[4]

Both specifications include a rich set of fixed effects to address a number of competing explanations. Granular ten-digit-product-by-time fixed effects account for product-specific shocks, such as surges in demand for military-related or dual-use goods. Country-time fixed effects control for country-specific shocks, such as whether a country simultaneously imposes other types of restrictions on doing business with Russia.

Using these strategies, we find a massive reduction in the sanctioned country-product imports. The pre-post DiD strategy suggests that the imports of sanctioned country-product varieties went down dramatically after the war's onset, decreasing by 62% relative to non-sanctioned flows. Dynamic estimates reveal that the decline was sharp and growing over time, reaching nearly 80% by the end of our study period in December 2023. The staggered DiD strategy shows similar estimates. Importantly, we observe no pretrends for either strategy, lending support to the parallel trends assumption underlying our identification argument.

Such large negative estimates are perhaps not surprising: a full and immediate ban placed on a given country-product variety would, in principle, be expected to halt its imports entirely. That the estimated decline is somewhat smaller likely reflects a combination of factors, including imperfect enforcement, the presence of exemptions, or potential measurement limitations. Nevertheless, the

[4]Recent research highlights potential biases in staggered DiD designs when treatment effects vary substantially across units and over time (see Arkhangelsky and Imbens, 2024 for a review). Following the guidance of Rios-Avila, Nagengast, and Yotov (2024), we address these concerns by employing the ETWFE estimator from Wooldridge (2021), which is particularly well-suited for estimating large-scale gravity models.

sharp reduction in sanctioned imports—observed without pretrends despite a multitude of concurrent shocks—constitutes a strong first stage and supports the validity of our empirical strategy.

Second, we document substantial rerouting and substitution of sanctioned products through third countries. Specifically, we observe a sharp and sustained spike in the imports of sanctioned products from countries that remained relatively friendly to the Russian regime following the war's onset, such as China and Turkey. According to the pre-post DiD results, such imports have increased sharply by close to 150% following the war's onset. These estimates again exhibit no pretrends, are growing over time, and are confirmed in the staggered DiD design. Leveraging shipment-level information on the country of origin, we find that this increase was almost entirely driven by rerouting—that is, imports of sanctioned products originally produced elsewhere, and particularly in sanctioning countries. In contrast, substitution toward goods made in those same friendly countries has been much more muted.

Third, we show that such rerouting and substitution did not fully offset the decline in sanctioned imports. Specifically, estimating our DiD specifications at the product level, we find that the total imports of sanctioned products declined substantially relative to non-sanctioned products across all source countries. For instance, in a pre-post DiD specification with three-digit-product-by-time fixed effects—to account for time-varying shocks, such as surges in demand, within broader product categories—the decline in overall imports of sanctioned products is estimated at 27%. The effect again comes with no pretrends, persists over time, and is similar in magnitude under the staggered DiD design. These results suggest that rerouting and substitution, on average, only partially mitigated the impact of sanctions, offsetting the total decline in sanctioned imports only by about a half.[5,6]

Although the sanctions were moderately successful in reducing the imports of sanctioned products into Russia despite substantial rerouting through third countries, they may still have been ineffective in disrupting production due to domestic substitution and compensatory government

[5]It is important to note that this average effect masks some important heterogeneity across product categories. While sanctions were largely effective at restricting import flows, we find that they did not reduce imports of critical components directly used in weapons production. In fact, we observe a relative increase in friendly-country imports of critical components identified based on data from the Main Directorate of Intelligence of Ukraine (2025).

[6]Firm-product-level estimates controlling for firm-by-year fixed effects confirm a significant average decline in imports of sanctioned products, reinforcing our main findings.

transfers, e.g., in the form of procurement contracts (Nigmatulina, 2021). We now merge in the comprehensive data on the balance sheets of more than two million Russian firms to explore the impact of import sanctions on firms and supply chains in the target economy.

First, we investigate whether import sanctions had a negative impact on the performance of Russian firms that were exposed to these restrictions. To this end, we estimate a set of DiD specifications comparing firms that imported the sanctioned country-product varieties prior to the war with those that did not, before and after the war's onset. Our specifications include firm fixed effects to account for time-invariant firm attributes, as well as a range of firm-level characteristics interacted with year fixed effects. In particular, we include industry-year fixed effects to control for time-varying shocks that may have differentially affected industries—such as labor supply disruptions due to mobilization, which could have had a greater impact on more labor-intensive sectors.

We find that firms that imported sanctioned country-product varieties prewar experienced a sharp 14% decline in revenues following the war's onset. This negative effect persisted with a similar magnitude throughout both 2022 and 2023, indicating that any adaptation strategies that firms may have employed did not result in a successful recovery, nor was the effect substantially delayed due to firms' preexisting inventories. Besides providing strong evidence for the disruptive effects of import sanctions on firm production, these findings further support our results of an overall decline in sanctioned product imports, alleviating concerns that Russian customs data might be missing significant volumes of unregistered transactions.

Consistent with the revenue decline reflecting an actual contraction in output, we find negative effects of similar magnitudes on other firm-level outcomes, including total cost of goods sold, gross profits, value added, as well as disaggregated measures of capital, material, and labor expenditures. We also see a 1.3 percentage point higher probability that firm sales become missing in the data, which can be interpreted as increased firm exit.

The downstream impact on firm output is present even when focusing exclusively on firms in manufacturing or science and technology sectors. In fact, the effect on firms in the science and technology sector is significantly larger than in any other broad industry group, reaching approximately 20%. The decline is also present among firms that at any point engaged in military-related government procurement. These findings are consistent with one of the key stated objectives of

these import sanctions—namely, to target high-tech and military-adjacent industrial capabilities—and with the fact that high-tech and manufacturing inputs are among the most heavily sanctioned product categories in our dataset.

We also do not observe any relative increase in firms' government procurement sales, which might have indicated compensatory efforts by the government to support firms adversely affected by import sanctions. On the contrary, we find that exposed firms became 2.4 percentage points less likely to win a government procurement contract in a given year and experienced a 31% decline in the total annual value of contracts secured following the war's onset.

Finally, we leverage firm-to-firm railway shipment data to examine the broader impact of import sanctions on domestic supply chains. We find that firms directly exposed to import sanctions experienced a decline in their in-shipments, further indicating output shrinkage and lack of compensating domestic substitution. Moreover, firms with suppliers or buyers exposed to import sanctions also experienced a decline in their own sales, even after controlling for their direct exposure. These findings suggest that the effects of import sanctions propagated through supply chains, amplifying their overall impact.

Taken together, our results suggest that, contrary to claims that import sanctions against Russia were ineffective due to roundabout trade, these measures resulted in significant disruptions to Russia's production processes, especially in technologically advanced sectors.

We contribute to the burgeoning literature on the economics of geopolitical threats and international trade—or *geoeconomics* (see Mohr and Trebesch, 2025 and Clayton, Maggiori, and Schreger, 2025 for recent overviews). 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; Clayton, Maggiori, and Schreger, 2023, 2024; Thoenig, 2023; Alekseev and Lin, 2024; Becko, 2024; Becko and O'Connor, 2024; Bianchi and Sosa-Padilla, 2024; Broner, Martin, Meyer, and Trebesch, 2024; Kooi, 2024; Liu and Yang, 2024; Mayer, Mejean, and Thoenig, 2024). Our paper contributes to this ongoing discussion by demonstrating empirically that trade sanctions fulfill another key geopolitical purpose. Specifically, they can disrupt production and supply chains within the target economy and, ultimately, serve to weaken its technological and military capabilities—key determinants of future

geopolitical power. So far, this channel has only been explored theoretically in Kooi (2024) and is an underlying premise in Alekseev and Lin (2024). More broadly, we provide an empirical assessment of the credibility and limits of geoeconomic power: how effective is the threat of the U.S. and its allies in constraining a targeted country's industrial base, and to what extent is that power diluted by rerouting through and substitution to third countries? The empirical moments we document—such as the degree of substitution between Western and non-Western inputs, and the pass-through of import sanctions to firm-level outcomes—can inform calibration exercises and future theoretical work on the mechanisms and scope of geoeconomic influence.

On the empirical side, the literature primarily investigates two types of sanctions: trade sanctions, which restrict export or import transactions for entire countries (Haidar, 2017; Juhász, 2018; Hinz and Monastyrenko, 2022; Aytun, Hinz, and Özgüzel, 2025), and targeted sanctions, which limit economic activity for select firms (Ahn and Ludema, 2020; Nigmatulina, 2021; Draca, Garred, Stickland, and Warrinnier, 2023).[7] In both cases, the evidence on effectiveness is mixed. Targeted sanctions, when implemented in isolation, have generally shown limited impact. For example, sanctions imposed on Russia after the 2014 annexation of Crimea targeted specific firms rather than products and, somewhat paradoxically, had a *positive* average impact on the targeted Russian firms due to compensatory subsidies from the Russian government (Nigmatulina, 2021). Evidence on trade sanctions is also mixed, with the effectiveness of post-2022 sanctions on Russia particularly contested. For instance, several recent studies document extensive rerouting of sanctioned shipments through third countries, casting doubt on whether these sanctions had any meaningful economic pass-through effects (Chupilkin et al., 2023; Chupilkin, Javorcik, Peeva, and Plekhanov, 2024; Scheckenhofer, Teti, and Wanner, 2025).[8]

[7] See also Morgan, Syropoulos, and Yotov (2023) and Itskhoki and Ribakova (2024) for the comprehensive reviews on the recent literature on sanctions.

[8] Also see the research on the implications of trade sanctions for the exchange rate (Itskhoki and Mukhin, 2022) and the use of the US dollar in trade invoicing (Berthou, 2022; Chupilkin, Javorcik, Peeva, and Plekhanov, 2023), the effects of oil embargo and price cap policy (Hilgenstock, Ribakova, Shapoval, Babina, Itskhoki, and Mironov, 2023; Johnson, Rachel, and Wolfram, 2023a,b; Monastyrenko and Picard, 2023; Kilian, Rapson, and Schipper, 2024; Spiro, Wachtmeister, and Gars, 2024; Bai, Fernández-Villaverde, Li, Xu, and Zanetti, 2025; Cardoso, Salant, and Daubanes, 2025), the exit of multinational enterprises (Wellhausen and Zhu, 2024), the effects on exporters (Aytun et al., 2025), the consequences for sanctioning countries (Görg, Jacobs, and Meuchelböck, 2024) and countries-intermediaries (Corsetti, Demir, and Javorcik, 2024; Li, Li, Park, Wang, and Wu, 2024), and financial sanctions (Efing, Goldbach, and Nitsch, 2023; Huang, Jiao, and Wei, 2025).

We contribute to the empirical literature on sanctions in four main ways. Most important, this paper is the first to combine the transaction-level customs data with firm-level information to trace the full causal chain from import sanctions to import flows, and ultimately to firm output, supply chains, and government procurement. Second, we compile a novel dataset of import sanctions against Russia at the ten-digit product-by-country-by-month level, which allows us to isolate the causal impact of sanctions net of concurrent macroeconomic shocks, policy changes, or other country- or product-specific demand and supply shifters. Third, we assess whether trade rerouting and substitution documented by journalists and academics were sufficient to offset the downstream effects on firms. Using significantly more detailed data than previously available, we confirm substantial rerouting but find limited substitution. However, we show that these channels were, on average, insufficient to fully mitigate the adverse effects. Finally, we study an unprecedented set of sanctions imposed on one of the world's largest economies. Prior work has focused primarily on smaller economies such as Iran or Venezuela, or on the more limited pre-2022 sanctions against Russia. Altogether, our paper offers one of the most comprehensive assessments of the economic impact of trade sanctions on a target country to date.[9]

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 stylized facts. Section 5 analyzes the sanctions' impact on import flows. Section 6 examines the sanctions' impact on firms that imported soon-to-be-sanctioned varieties before the war as well as broader supply chains. Section 7 explores the impact on military-related imports and production. Section 8 concludes.

2 Background

Following the Russian aggression against Ukraine in February 2022, Western countries imposed an unprecedented level of sanction measures against Russia. The total number of sanctions imposed on Russia—exceeding 19,000—made Russia one of the most sanctioned countries in

[9]We also add to the literature on wars and trade. This literature has documented the negative impact of conflicts on international trade as well as the peace-inducing effects of trade integration (Martin, Mayer, and Thoenig, 2008a,b; Thoenig, 2023; see also Kleinman, Liu, and Redding, 2024). 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 their bilateral trade and the disruption and reorganization of production networks within Ukraine, respectively.

world history (Trefanenko, 2025). In fact, this figure is greater than the combined number of sanctions imposed on Iran, Venezuela, Myanmar, and Cuba as of the time of writing (Forbes, 2025).

These were not the first international sanctions against Russia. Prior to 2022, sanctions were imposed after the 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 post-2022 sanctions were much more comprehensive.

Post-2022 sanctions included measures that targeted Russia's financial system, such as the freezing of more than $300 billion of the Russian Central Bank's reserves and the exclusion of key Russian banks from the SWIFT international payment system. Sanctions have also been levied against individuals, freezing assets and imposing travel bans on Russian elites and government officials. Additionally, Western companies have been barred from providing Russia with services in IT, consulting, and legal fields, with many large multinational companies exiting Russia voluntarily. Furthermore, Russian airlines and shipping companies have faced transportation bans, further isolating the country from global supply chains.

While the above sanctions are important and deserve to be studied separately, in this paper, we will focus on the post-2022 *trade* sanctions. Trade sanctions against Russia were of two types: against Russian exports and against Russian imports. Sanctions targeting Russian imports started being implemented almost immediately after February 2022, while sanctions against Russian exports started being introduced only 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 et al., 2023b). 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 and supply chains of Russian firms.

Sanctions on Russian imports have significantly restricted Russia's access to high-tech imports, particularly in sectors such as semiconductors, aerospace, and energy, but have also targeted a broader range of industries. In the words of the EU official sources, they included bans on the Western exports of:

> "cutting-edge technology (e.g. quantum computers and advanced semiconductors,

electronic components and software); 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); arms and related materiel of all types, including civilian firearms and their parts; chemicals, generators and thermostats; IT, electronic and optical components; cameras, lenses, toy drones, laptops and hard drives; and other goods which could enhance Russian industrial capacities" (Council of the European Union, 2024).

We provide additional details on the scope of these import sanctions and the products targeted in Section 4, following the discussion of our data sources in Section 3.

The impact of these import sanctions on the Russian economy remains highly debated. Some observers argue that they have inflicted long-term damage by restricting access to crucial technologies and foreign capital, forcing Russia to pay higher prices for components and depend on a narrower set of trading partners (Luck, 2025). Meanwhile, others note that the country has proven more resilient than anticipated, with redirected trade routes through Turkey, China, and other neutral states fully mitigating some of the initial supply shocks (Krueger, 2024). The resulting landscape has led to a complex "cat-and-mouse" dynamic, where sanctions pressure is met by increasingly inventive evasion tactics, from parallel imports to disguised rerouted shipments.

While rigorous causal estimates of the pass-through of import sanctions on Russia remain scarce, important descriptive evidence comes from Simachev et al. (2023), who surveyed over 1,800 Russian firms and found that nearly two-thirds reported negative effects from sanctions in the first year of the war. Their analysis documents substantial challenges faced by 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 machinery. Yet it remains unclear whether these self-reported effects align with objective measures from customs data, and to what extent such disruptions translated into measurable declines in firm output—questions that

this paper seeks to address.

3 Data

Data on the Sanctions Against Russia's Imports. One of the key challenges we face in our analysis is the absence of readily available data detailing which countries imposed trade sanctions on what specific product codes and when these sanctions were enacted. To address this gap, we manually compile a novel dataset on import sanctions imposed by nine major trading partners of Russia following February 2022: Australia, Canada, the EU, Japan, South Korea, Switzerland, Taiwan, the UK, and the US.

As a starting point for our dataset, we used the records available on the online platform Alta.ru, which provides detailed 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 (Alta, 2025). This dataset was methodically cross-referenced and supplemented with the information extracted from official legal documents from the sanctioning countries. Through this process, we have identified around 72,000 distinct country-product sanctioned varieties with 50 unique dates of sanction imposition. Partly to minimize the noise introduced by the challenging process of pinpointing precise sanction dates, in addition to a staggered difference-in-differences approach, we will also rely on a simple pre-post difference-in-differences comparing country-product imports before and after the start of the war.

Customs Data. To study the impact of sanctions on trade flows, we rely on a transaction-level dataset of international shipments as recorded by the Federal Customs Service of Russia. For each transaction, the dataset contains the country of shipment, the country of origin, the ten-digit product code (where the first six digits match the Harmonized System (HS) product classification), the product description, information on the sending and buying firms (including the tax ID for the firms located in Russia), total weight of each shipment and its total contract value.

To assess the completeness of this dataset, Figure A.1 compares the total value of all imports recorded in these data (in dark orange)[10] to several benchmarks: mirror exports data from UN

[10]Throughout the paper, including this figure, we exclude imports of physical cash.

Comtrade reported by other countries (purple), data from the World Trade Organization (WTO; green), and the official records from the Russian Statistics Service (yellow), which ceased publication in January 2022. When aggregated, our data matches almost exactly the Russian official import statistics and closely matches the UN Comtrade's mirror exports to Russia and the WTO-reported Russian imports. While there is a persistent difference in levels between the mirror trade data and our dataset, this difference most likely stems from differences in the treatment of insurance and freight costs (CIF vs. FOB valuation). Overall, these estimates suggest that our data correctly reflects the volume and evolution of Russian imports. This is in line with Babina et al. (2023), Chupilkin et al. (2023), and Huang et al. (2025), who also find that the quality of the Russian customs data was not severely affected by the start of the war.[11]

When merging the customs data with the import sanctions dataset, we account for changes in HS codes introduced in January 2022. Following Pierce and Schott (2012), we retire the HS codes and replace them with synthetic product codes that remain consistent throughout our study period. Specifically, for cases where HS codes split or merged during the classification transition, synthetic codes represent the connected set of altered codes. Throughout, we define each product's HS2 or HS3 codes based on the modal HS2 or HS3 codes within its respective connected set.

Firm Accounting Data. Further, we use the universe of reporting firm balance sheets and financial statements from 2017 through 2023. These data are collected and made available by the Federal Tax Authority. Firm balance sheets record the firm yearly revenues, profits, capital, material, and labor expenditures, along with other firm-level variables. We merge this dataset with the import transactions using buyer firm tax ID ("INN") to assess the impact of import sanctions on firms.

Data on Domestic Railway Shipments. We also use data on the universe of firm-to-firm railway shipments within Russia, collected by the state-owned monopolist Russian Railways. For each shipment, the dataset records its weight, product code and description, buyer and seller information, and the nature of the shipment (import, export, or domestic shipment). In our context, railway shipment data are helpful as, for a subset of firms, they offer granular proxy measures for the quan-

[11] A potential limitation of the Russian customs data is its incomplete coverage of shipments within the Eurasian Economic Union (EAEU). To verify that this omission does not drive our results, we fully replicate our main trade estimates using mirror export statistics from UN Comtrade, which include these flows. See Online Appendix C.2.

tity of their domestic outgoing and incoming shipments and provide insight into the structure of their supply chain network. As such, we restrict our attention to domestic shipments.

Government Procurement Data. We extract the data on procurement purchases from the Marker database, which compiles publicly available records of purchases by government and state-owned entities from *zakupki.gov.ru* for the years 2012–2024. In principle, all domestic purchases of goods and services by public entities are required to be reported in this database. In 2023, the total volume of such purchases amounted to approximately 18% of Russian GDP. To identify military-related procurement, we search for a set of relevant keywords appearing in contract titles or descriptions, such as "GOZ" or "gosoboronzakaz." Each contract record provides the seller's name and, in most cases (unless classified), that of the buyer. Using this approach, we identify 10,588 firms that acted as buyers and 24,240 firms that served as suppliers in military procurement contracts at any point between 2012 and 2024.

Summary Statistics. Tables A.1 and A.2 display the summary statistics for Russian imports and firms, respectively. Table A.1 describes quarterly import flows between 2019Q1 and 2023Q4, showing significant variation in import values, transaction counts, and weights. Notably, 28% of country-product-quarter observations correspond to flows ever subject to sanctions, with 7% under active sanctions in a given quarter. Table A.2 presents firm-level statistics for Russian enterprises from 2017 to 2023, highlighting substantial heterogeneity in their sales, capital, and profitability. Only 2.5% of firms were directly exposed to import sanctions, i.e., imported soon-to-be-sanctioned country-product flows before the war. About 9.8% and 9.1% of all firms are in the manufacturing and science and technology industries, respectively. Additional data on railway shipments in Panel C of Table A.2 highlight the firms' extensive domestic logistical networks, showing substantial variation in shipment weights and the number of trading partners.[12]

[12]For summary statistics in Panels A and B of Table A.2 and throughout the rest of the manuscript, we exclude one firm with an abnormally high reported revenue of 30 trillion rubles—an amount exceeding the entire Russian federal budget. The exclusion of this outlier does not affect our results.

4 Stylized Facts

Using our comprehensive data, we first establish several stylized facts about the sanctions against Russian imports after February 2022. These patterns highlight substantial variation in sanctions and imports across countries, products, and time, enabling our empirical analysis.[13]

Magnitude and Evolution of Import Sanctions. First, we examine the size of imposed sanctions as well as how it evolves with the timeline of the sanctions' introduction.

Figure 1 depicts the cumulative shares of all sanctioned country-product and product-level imports over time. According to our calculations, more than 36% of all country-product imports to Russia, weighted by prewar trade value, had been sanctioned by July 2024 (Figure 1a). At the product level, more than 80% of all imports in prewar trade value were sanctioned by at least one country by July 2024 (Figure 1b). Given Russia's status as one of the world's largest economies, sanctions of this magnitude represent one of the most significant trade shocks in recent history.

The timeline of sanction impositions informs our empirical strategy for assessing the impact on imports. Nearly two-thirds of sanctions were introduced within the first few months of the war, making a simple pre-post DiD approach—comparing sanctioned and non-sanctioned import flows before and after the war's onset—a suitable baseline. However, since there was still substantial variation in sanction impositions between July 2022 and July 2024, a staggered DiD approach offers an additional layer of rigor, allowing us to leverage this timing variation to strengthen identification.

Most Sanctioned Products. Figure A.2a lists the twenty most sanctioned two-digit product categories, ranked by the share of their 2021 import value to Russia that was later prohibited. Consistent with the stated goals of the sanctions, the most heavily targeted categories fall under HS2 codes 84, 85, and 87, which include technologically sophisticated goods, such as consumer electronics, drones, vehicles, and microchips. At the same time, sanctions extend well beyond the high-tech sectors. Notably, across all the sanctioned product categories, non-sanctioned imports still account

[13] See Egorov, Korovkin, Makarin, and Nigmatulina (2025) for an extended discussion. Note, however, that the figures in Egorov et al. (2025) may differ slightly from those reported here, as they rely on trade data coming from aggregated UN Comtrade rather than the granular Russian customs records used in this paper.

for a substantial share of prewar import value—often more than half. This rich variation enables us to identify the effects of sanctions on import flows even within broad product groups.

Most Sanctioning Countries. Figure A.2b ranks countries by the volume of their 2021 exports to Russia sanctioned while also showing their total prewar exports to Russia. Out of all countries, Germany stands out as the country that contributed the most to sanctions on Russian imports in absolute terms, banning around $25 billion of its own 2021 exports and leaving only $7 billion untouched. Notably, however, for nearly all sanctioning countries, some portion of exports remained non-sanctioned—providing variation that helps distinguish the effects of sanctions from broader country-specific shocks to Russian imports.

Not All Countries Sanctioned the Same Products. Table A.3 reports pairwise correlations between the lists of sanctioned products across countries from Egorov et al. (2025). While some country pairs, such as the EU and the United Kingdom, exhibit a high degree of alignment in their sanctioned product lists, coordination appears significantly weaker among other country pairs. Notably, there is minimal overlap between the EU's list and those of Australia, Canada, or Taiwan. These gaps in coordination further assure us that substantial variation exists in sanctioned products across sanctioning countries, further strengthening our identification strategy.

Aggregate Trends By Sanctioning Country Status. Next, we examine the evolution of total Russian imports in the raw data shipped from sanctioning and other countries. Figure A.3a reveals a sharp decline in monthly imports shipped from countries that imposed sanctions. These imports plummeted by roughly two-thirds, falling from around $15 billion to just above $5 billion in March 2022, continuing to gradually decline afterwards. In contrast, monthly imports shipped from non-sanctioning countries also experienced an initial drop—by approximately one-third, from $12 billion to $8 billion, likely due to heightened aggregate uncertainty—but then quickly rebounded, eventually surpassing prewar levels and reaching around $15 billion per month.

Aggregate Trends By Sanctioned Product Status. Figure A.3b highlights trends in imports by the product sanctioned status. Imports of products sanctioned by at least one country fell sharply after the invasion, from a prewar peak of $24 billion to $14 billion in March 2022. By 2023, they had partially recovered to about $18 billion, though remaining below the 2021 average. In

contrast, imports of non-sanctioned products remained stable throughout 2018–2023. Together, these patterns suggest that the primary adjustment in Russian import flows occurred via a shift from sanctioning to non-sanctioning countries, rather than through extensive substitution or relabeling between sanctioned and non-sanctioned product categories.

Figure A.4 further disaggregates imports of sanctioned products by route: from sanctioning countries (blue area), from non-sanctioning countries shipping their own goods (purple), and from non-sanctioning countries shipping goods originating elsewhere (grey). The initial collapse in sanctioned imports was nearly offset by the end of 2022 through increased flows from non-sanctioning countries, along both route types. At first glance, this figure may suggest that import sanctions had minimal impact on either the flow of sanctioned goods or the Russian economy—an assertion we rigorously evaluate in the rest of the paper.

Online Appendix B complements these aggregate patterns by zooming in on two product categories critical to wartime production: semiconductors and critical components. These case studies underscore the richness of our data but also illustrate the limitations of relying on descriptive patterns alone. In particular, they show how confounding factors—such as surging wartime demand in the case of semiconductors—can obscure the true effects of sanctions. This highlights the importance of our econometric framework in isolating causal impacts.

5 Results: Impact on Trade

We start by estimating the impact of import sanctions on Russian import patterns. Our analysis proceeds in three steps. First, we quantify the relative decline in imports of sanctioned country-product varieties into Russia. Second, we evaluate the extent to which there has been rerouting through and substitution to third countries that remained neutral or friendly to the Russian regime. Third, we examine whether the combined volume of rerouted and substituted imports was sufficient to compensate for the loss of sanctioned imports within sanctioned product categories.

5.1 Impact on Sanctioned Country-Product Imports

We start by estimating the impact of sanctions on the sanctioned imports by, first, comparing the import flows of sanctioned and non-sanctioned country-product varieties before and after the

war's onset. Specifically, we estimate the following pre-post DiD equation:

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

Here, y_{gct} are (log-)import flows from country of shipment c to Russia of a ten-digit product code g at quarter t, measured either by total value or by total weight shipped; $Sanctioned_{gc}$ is an indicator that takes a value of 1 if a product-g-country-c 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, which absorb time-varying shocks specific to product categories, such as surging demand for war-related inputs; 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.

Figure 2 presents the estimated impact of sanctions on Russian imports at the country-product level. Prior to the invasion, trends in sanctioned and non-sanctioned import flows were closely aligned, providing support for the parallel trends assumption underlying our identification argument. Following the invasion, however, we observe a sharp and growing divergence: imports of sanctioned country-product varieties declined substantially relative to their non-sanctioned counterparts. In the second quarter of 2022—almost immediately after the war's onset—sanctioned imports had already fallen by 0.5 log points, equivalent to a 39% decline. This decline continued to deepen over time, and by the fourth quarter of 2023, the value of sanctioned imports was 1.5 log points below the prewar trend, corresponding to a total decline of approximately 78%. These results suggest that the sanctions were not only quickly binding but that their scope and enforcement has increased over time.

Table C.1 in Online Appendix C reports estimates from a nondynamic version of Equation (1), where we interact $Sanctioned_{gc}$ with a simple post-invasion indicator instead of the yearly dummies. Across columns, we progressively introduce richer sets of fixed effects. The estimates are consistently large and negative, with the inclusion of country-quarter fixed effects playing a particularly important role in absorbing the overall decline in imports from sanctioning countries stemming from broader geopolitical and logistical disruptions unrelated to import sanctions per se.

Our preferred specification in column (7) implies an average decline of 62% ($= \exp^{-0.962} - 1$) in the value of sanctioned imports after the war's onset.

To further demonstrate that the observed declining patterns are attributable to sanctions rather than omitted country-product-specific shocks caused by the war, we employ a staggered DiD design. This approach exploits variation in the timing of sanctions across different country-product pairs, comparing import flows that were recently sanctioned to those not yet sanctioned and those never sanctioned at a given point in time. Specifically, we estimate the following equation, allowing for flexible patterns of heterogeneity in sanctions' impact across time and treated flows:

$$y_{gct} = \sum_{e} \sum_{s \geq e} \beta_{es} \mathbb{1}(E_{gc} = e) \times \mathbb{1}(t = s) + \tau_{gc} + \eta_{gt} + \omega_{ct} + \zeta_{gct}, \tag{2}$$

where E_{gc} is the month when sanctions take effect on product g by country c (for non-sanctioned imports, $E_{gc} = \infty$). The rest of the notation follows equation (1), though, importantly, t now represents a month (instead of a quarter) to closely examine the timing of the sanctions' introduction. Under the assumptions of parallel trends and no anticipation, the coefficients β_{es} recover the causal dynamic effects of trade sanctions on each cohort e. The latter assumption may be more demanding here than in the pre-post design, as some cohorts are sanctioned later into the war; we address this issue in robustness checks.

Following the recent research highlighting potential biases in staggered DiD designs when treatment effects vary substantially across units and over time (Arkhangelsky and Imbens, 2024), we estimate equation (2) using the ETWFE estimator from Wooldridge (2021), which is particularly well-suited for estimating computationally intensive gravity models (Rios-Avila et al., 2024). All staggered DiD event-study figures include pre-trend coefficients, which we estimate separately, closely following specification (2) but omitting all treated observations from the estimation (*cf.* Borusyak, Jaravel, and Spiess, 2024).

Figure 3 presents the resulting estimates averaged across all cohorts. Similar to the pre-post DiD design, the estimates indicate that sanctions had an immediate adverse impact on the sanctioned import flows, which intensified over time. For the log value of imports, the decline reaches approximately -0.65 log point (equivalent to a 48% reduction) within 5–7 months of the sanc-

tions' imposition, and then continues to intensify, eventually reaching close to -1.2 log points (a 70% reduction) in the following months. In the first two columns of Table C.2, we further aggregate these dynamic estimates to a single average. Column (1) suggests a 64% ($= \exp^{-1.014} - 1$) relative decline in the value of sanctioned imports after the sanctions' imposition.

Overall, the results from both pre-post and staggered DiD designs indicate an immediate and large decline in sanctioned country-product imports as a result of import sanctions. Such a decline is perhaps not surprising—if anything, one may wonder why the bans did not result in a complete 100% halt in sanctioned imports. This likely reflects a combination of imperfect enforcement, the presence of sanction exemptions, or measurement limitations, as some sanctions may apply only to specific product descriptions even within a given ten-digit HS code. Nevertheless, the sharp reduction in sanctioned imports, observed without pretrends despite numerous simultaneous shocks, provides strong validation of our identification strategy and establishes a robust first stage necessary for examining further pass-through effects of import sanctions.

Robustness. We confirm the robustness of our baseline estimates through a series of checks, with full details reported in Online Appendix C.1. First, we show that our findings are not driven by the log-plus-one transformation used to accommodate zero trade flows: the results remain sizable when using a simple logarithm transformation that omits zeros and estimating extensive-margin effects separately. Second, we show that our estimates are not overly inflated by the rise in imports from non-sanctioning countries; restricting the sample to sanctioning countries yields broadly similar estimates. Third, excluding the earliest sanction cohorts from the staggered specification does not alter the results, suggesting that the staggered DiD is indeed leveraging variation distinct from the pre-post design. Finally, we adjust for possible anticipation of later sanctions in the staggered DiD design by redefining the reference period to pre-war months for all sanctioned flows; the resulting estimates closely match our baseline.

5.2 Rerouting and Substitution

Next, we quantitatively examine the extent to which third-country imports of sanctioned products to Russia have increased—either through the re-export of goods originally produced in sanctioning countries (*rerouting*) or through independent production of those goods within third coun-

tries (*substitution*). To operationalize this analysis, we first identify a set of countries that we classify as relatively *friendly* to the Russian regime.[14] We then estimate a modified version of equation (1) that separately tracks the evolution of imports from these friendly countries for products sanctioned by at least one country:

$$y_{gct} = \theta_t \, Sanctioned_{gc} + \gamma_t \left(Sanctioned_g \times Friendly_c \right) + \tau_{gc} + \eta_{gt} + \omega_{ct} + \zeta_{gct}, \qquad (3)$$

where $Sanctioned_g$ is an indicator for whether a product g was ever sanctioned by any country, $Friendly_c$ indicates whether country c is classified as friendly, and the coefficients γ_t thus trace the relative changes in imports of sanctioned products from friendly countries, compared to the evolution of imports of non-sanctioned products from friendly countries and imports of sanctioned products from neutral countries. All other variables are defined as in equation (1).

Figure 4 presents the results. The impact on sanctioned country-product imports remains large and negative—even after removing potentially contaminating flows from friendly countries from the comparison group—closely mirroring the estimates in Figure 2. At the same time, imports of sanctioned products from friendly countries increased sharply post-invasion, consistent with rerouting or substitution. These alternative channels are economically meaningful: by the end of 2023, sanctioned imports from friendly countries had risen by 1.1–1.2 log points, corresponding to a 200–232% increase in value.[15] Table C.3 shows the non-dynamic analog of these estimates, with increasingly more stringent sets of fixed effects. The estimates are large and statistically significant across columns. Our preferred specification in column (7) reveals an average post-invasion increase of 150% ($= \exp^{-0.916} - 1$) in sanctioned imports from friendly countries.

Figure C.5 replicates this analysis using a staggered DiD design and yields similar patterns

[14] We define friendly countries as Armenia, Belarus, China, Georgia, Hong Kong, Kazakhstan, Kyrgyzstan, Serbia, Turkey, and the UAE. This classification is based on journalistic accounts documenting these countries as common rerouting hubs for Russian imports. However, our results are robust to alternative classifications.

[15] We note that although the estimates for θ_t and γ_t are similar in absolute magnitude, the total volume of prewar imports, indicated via dashed lines on Figure 4, was significantly larger for the enemy countries than for the friendly ones. As such, the increase in imports from the friendly countries due to substitution and rerouting was unlikely to fully compensate for the decline in sanctioned flows—a point we further investigate in greater detail in Section 5.3.

and magnitudes.[16] Notably, the increase in imports of sanctioned products from friendly countries takes a couple of months to materialize, becoming statistically significant for both value and weight only around the fourth month after sanctions are imposed. This pattern broadly mirrors the gradual decline in sanctioned imports and may reflect firms' search frictions in finding alternative suppliers or a gradual depletion of their inventories.

We further disentangle the roles of rerouting and substitution in Figures 5 and C.6. Using data on the country of origin recorded for each shipment, we decompose imports of sanctioned products from friendly countries into three categories: (i) goods produced in the country of shipment (*substitution*), (ii) goods produced in sanctioning countries (*rerouting from sanctioning countries*), and (iii) goods produced in other non-sanctioning countries (*rerouting from other countries*). We then re-estimate the specifications from Figures 4 and C.5, replacing total imports of sanctioned products from friendly countries with these three disaggregated flows. Direct imports from sanctioning countries are excluded, and imports from neutral countries serve as the control group.

We find that the post-invasion increase in imports of sanctioned products from friendly countries is almost entirely accounted for by rerouting, with substitution playing only a limited role. Moreover, the bulk of this additional rerouting involves goods originally produced in sanctioning countries. The fact that this pattern emerges despite strong incentives to misreport the origin of sanctioned products lends additional credibility to our customs data and further supports the interpretation of widespread enforcement evasion of import sanctions.

Overall, our findings in this section indicate a significant increase in the inflows of sanctioned products from third countries, primarily driven by rerouting rather than substitution—and particularly by rerouting from sanctioning countries. This pattern suggests that Russian firms and their foreign intermediaries actively adapted to trade restrictions, thus potentially undermining their effectiveness. In the next section, we assess whether these channels fully offset the decline in sanctioned imports by conducting estimation at a more aggregate product level.

[16]The key difference of this analysis relative to equation (2) is that the timing for imports of sanctioned products from friendly countries is defined based on when the first country imposed sanctions on that product. All other aspects of the specification remain unchanged.

5.3 Impact on Total Imports of Sanctioned Products

We now assess whether the rerouting and substitution documented earlier fully compensated for the decline in sanctioned imports. Specifically, we examine whether trade sanctions led to an overall reduction in the total imports of sanctioned products, irrespective of their country of shipment or origin. To do so, we estimate a product-level version of equation (1):

$$y_{gt} = \theta_t \, Sanctioned_g + \omega_{h(g)t} + \tau_g + \eta_t + \zeta_{gt}, \tag{4}$$

where y_{gt} are the (log-)import flows of a product g into Russia at quarter t; $Sanctioned_g$ is an indicator that takes a value of 1 if the product g has been sanctioned at any point by *any* country, and zero otherwise; $\omega_{h(g)t}$ are the higher-level (three-digit in our baseline specification) product category-quarter fixed effects, which absorb time-varying shocks affecting broader product groups, such as surging wartime demand for certain types of electronics; and the τ_g and η_t are the ten-digit product and quarter fixed effects. The standard errors are clustered at the product level.

Figure 6 presents the results. We find that total imports of sanctioned products to Russia declined sharply and persistently, though by a smaller magnitude than in the country-product-level analysis. Specifically, the decline ranges from -0.4 to -0.5 log points, corresponding to a 32–39% reduction. Table 1 reports the nondynamic estimates, first without and then with the HS3-quarter fixed effects. Across specifications, the estimates confirm the sizable decline, with our preferred specification in column (4) implying an average reduction of 27% ($= \exp^{-0.31} - 1$). Column (6) additionally shows that the unit values of sanctioned products—calculated as the ratio of total value to total weight—did not exhibit a differential increase following the war's onset. While this may initially appear surprising, it is consistent with the possibility of quality downgrades within product categories or the substitution toward lower-cost varieties.

Figure C.7 further corroborates these patterns in a staggered DiD design, in which the treatment timing is defined as the month when the earliest sanctions were imposed on the product by any country. Although the estimates are somewhat noisier, likely reflecting the more limited variation in sanction dates at the product level, they nonetheless indicate a consistent decline of about 0.2–0.3 log points. The last two columns of Table C.2 further aggregate these dynamic estimates to

a single average, implying that, following the earliest introduction of import sanctions on a given product, total monthly imports of that product in value fall by 17.8% ($= \exp^{-0.196} - 1$).

Taken together, these patterns suggest that while substitution and, in particular, rerouting substantially mitigated the decline in sanctioned country-product import flows, these two adjustment channels did not fully offset the overall reduction in total imports of sanctioned product categories.[17] The remaining shortfall is substantial in magnitude and persists over time. Given such a sustained decline in sanctioned imports, one would expect downstream effects on firm-level production and supply chains within Russia—an issue we explore in detail in the following section.[18]

6 Results: Impact on Firms

While the results in Section 5 suggest that import sanctions reduced imports of targeted products, it remains an open question whether they caused meaningful disruptions to production and supply chains within the targeted economy. In other words, even with a sustained decline in sanctioned imports, sanctions may have fallen short of their intended objective if domestic producers could readily substitute with locally available inputs or if the government was able to effectively compensate the affected firms. In this section, we leverage the richness of our data to examine the downstream effects of import sanctions on the performance of firms that, prior to the sanctions, had relied on inputs now subject to restrictions.

We construct an annual panel of firms and merge it with the customs data 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 whether a firm ever imported any country-product varieties that were later sanctioned. We then estimate the following DiD specification:

$$y_{ft} = \beta_t \, Exposure_f + \delta_t \mathbf{X}_f + \mu_f + \gamma_t + \epsilon_{ft}, \tag{5}$$

[17] One concern is that incomplete rerouting could reflect reporting limitations in the Russian customs data, which has incomplete coverage of within-EAEU shipments. In Online Appendix C.2, we replicate the analysis using more aggregated mirror exports from UN Comtrade, which include these flows. The resulting estimates are, if anything, larger in magnitude and exhibit even smoother pretrends. As such, within-EAEU flows do not drive our results.

[18] In Online Appendix C.3, we also confirm that the negative impact on sanctioned imports is also present in a firm-product-level specification with firm-quarter fixed effects, thereby bridging the results on imports and firms and also mitigating concerns that firm-specific shocks driving the observed declines in sanctioned imports.

where, $Exposure_f$ is an indicator for whether a firm f ever imported a soon-to-be-sanctioned country-product variety; y_{ft} represents firm-year outcomes such as yearly revenues; μ_f and γ_t respectively denote the firm and year fixed effects; and $\delta_t \mathbf{X}_f$ flexibly controls for year fixed effects interacted with firm characteristics that could be correlated with import sanctions exposure but may also have an independent time-varying influence on firm outcomes due to heterogenous wartime shocks. In our preferred specification, these characteristics include whether the firm was ever an importer, an exporter, or subject to targeted sanctions, as well as its two-digit OKVED industry classification, thus focusing on within-industry comparisons. The coefficients of interest are β_t's, which, under the conditional parallel trends assumption, estimate the causal impact of import sanctions on firm outcomes. We cluster the standard errors at the firm level.

Firm Output and Performance. Figure 7 presents the estimates of Equation (5) using firm revenue as the outcome variable. Firms exposed to sanctions through their prewar imports saw a sharp and persistent 14–17% decline in revenues following the war's onset, after having their revenues evolve in parallel with firms that never imported sanctioned varieties before the war. The sustained decline through both 2022 and 2023 suggests that any adaptation strategies firms may have employed failed to fully offset the shock, and that the effect was not substantially delayed by preexisting inventories. These findings provide indirect validation of the import disruptions documented in Section 5, helping to assuage concerns that the Russian customs data might omit significant volumes of black-market or unregistered transactions.

Table 2 presents the corresponding nondynamic pre-post estimates of the impact of import sanctions on the performance of exposed firms in the target country. Column (1) confirms a significant 13.7% average decline in revenues among exposed firms.

Consistent with the revenue decline reflecting a real contraction in output, we observe similar negative effects across a range of other firm-level outcomes. Figure D.1 in Online Appendix D documents a sharp 15–17% drop in total cost of goods sold; Figure D.2 shows a 12–13% decline in gross profits (measured as revenues minus cost of goods sold); while Figure D.3 reports a 9–11% reduction in value added (measured as revenues minus material expenditures). Table 2 confirms these patterns and further reveals sizable declines in specific input categories: a 6.7% reduction in

capital expenditures (column 4), an 9.4% decline in labor expenditures (column 5), and a 15.0% drop in material expenditures (column 6). Additionally, there is a 1.3 percentage point increase in the likelihood of missing sales data, which may indicate a higher exit rate among exposed firms (column 7). When we impute missing sales as zeroes, we observe a massive 45% ($= \exp^{-0.598} - 1$) decline in exposed firms' sales (column 8). However, caution is warranted in interpreting this magnitude, as some missing data may stem from nonrandom reporting issues rather than firm closures. Taken together, these findings indicate that the import sanctions had substantial and persistent disruptive effects on firm operations across multiple dimensions.

Robustness. We confirm the robustness of our baseline estimates through a series of checks, with full details reported in Online Appendix D.1. Specifically, the estimated negative effects of import sanctions on exposed firms are robust to a broad set of controls and alternative sample definitions. Adding increasingly stringent controls accounting for possible spillovers onto firms in the control group—such as the post-invasion indicator interacted with the prewar imports of sanctioned products from friendly or neutral countries and separately with supply-chain linkages to exposed firms—does not materially affect the results. Likewise, our estimates are not driven by changes in the sample composition, as restricting the analysis to strictly balanced panels, or excluding firms that entered during the war or exited in its first year, yields similar magnitudes. Across all specifications, the coefficients remain large, negative, and precisely estimated, indicating a 9–14% decline in revenue for exposed firms.

Effects By Industry. Figure 8 displays the estimates for differential changes in firm revenue across different industry subsamples. We find that the downstream impact of import sanctions on firm revenue is present even when focusing exclusively on firms in the manufacturing sector (Panel A), but is particularly pronounced for firms in the science and technology sector (Panel B). Table D.3 provides a tabular representation of these industry-specific heterogeneity patterns, showing that similar effects extend beyond revenue to other key firm outcomes. Similarly, the table further confirms that firms in the science and technology sector are particularly affected compared to other industries, with an estimated 20% decline in output and nearly a 30% decline in material costs—indicative of their reduced ability to import critical inputs. These findings are consistent

with one of the key strategic aims of the sanctions regime—namely, to disrupt the target country's industrial and technological capabilities by limiting access to critical manufacturing and high-tech inputs. They also align with the stylized facts in Section 4, which show that high-tech and manufacturing inputs rank among the most heavily sanctioned product categories. However, the negative impact is present in the wholesale and transportation sectors, as well as other industries, including, for example, agriculture.

Government Procurement. We further examine whether the disruptions in firm operations caused by import sanctions had downstream effects on government procurement. Table 3 presents the results of estimating a pre-post version of equation (5), estimating the impact on the probability of winning at least one government contract (odd-numbered columns) and the log of total value of contracts won (even-numbered columns). Columns (1)–(2) report estimates for the full sample, while columns (3)–(4) restrict the sample to firms that secured government contracts in at least two years of the period and re-estimate the same outcomes. Across all specifications, we find large and statistically significant negative effects. Exposed firms became 2.1–2.4 percentage points less likely to win any government contract in a given year and experienced a 31% ($= \exp^{-0.372} - 1$) decline in the total value of contracts won after the war's onset.

These findings not only reinforce the evidence of a contraction in exposed firms' output but also indicate that the government did not compensate these firms through increased procurement spending. This contrasts with Nigmatulina (2021), who documented that Russian firms targeted by post-2014 sanctions received compensatory government support, including through additional procurement contracts. Overall, these results provide further evidence of a substantial pass-through effect: import sanctions not only disrupted firm-level production but also significantly impaired affected firms' ability to compete in public procurement markets and supply the Russian state.

Railway Shipments, Domestic Substitution, and Propagation. Next, we leverage detailed firm-to-firm railway shipment data, which allows us to identify a subset of buyers and suppliers for each firm. We then use these data to examine two key questions: (i) whether firms directly exposed to import sanctions exhibit changes in their incoming or outgoing domestic shipments—shedding light on domestic substitution, shifts in demand for domestic inputs, or overall bulk output—and

(ii) whether firms indirectly exposed, through connections to buyers or suppliers affected by import sanctions, experience (additional) declines in their output.

Table 4 addresses the first question by examining whether firms exposed to import sanctions experience a contraction in their domestic trade, both in terms of volume and number of partners. Specifically, we estimate equation (5) looking at both measures of trade intensity for firms' in-shipments, out-shipments, and total trade. The results in columns (1)–(3) show a significant 10% decline in total shipment volume, driven entirely by a 16% drop in in-shipments, while out-shipments remain statistically unchanged. Columns (4)–(6) report no differential change in firms' total number of suppliers, buyers, and overall trading partners. While it is important to note that railway data primarily captures shipments of heavier inputs and bulk goods, these findings suggest that firms exposed to import sanctions were largely unable to substitute inputs domestically and instead scaled back their in-shipments, mostly through extensive-margin adjustments.

We address the second question by incorporating measures of indirect exposure into our baseline specification in equation (5). Table 5 presents the results, where we include indicator variables for whether a firm's immediate buyer or supplier was exposed to import sanctions (first-degree exposure), or whether their buyer's or supplier's trading partners were exposed (second-degree exposure). All specifications except for the baseline specification in column (1) control for whether the firm ever engaged in railway trade, interacted with yearly fixed effects.

Columns (3)–(5) show that first-degree exposure to sanctions through a supplier imposes an additional negative effect amounting to more than half the magnitude of the direct effect, while exposure through buyers leads to a smaller, though still significant, impact of approximately one-fourth of the direct effect. The estimates for second-degree exposures, reported in columns (6)–(8), are generally small and imprecise. However, importantly, the main coefficient remains stable across all specifications, with an estimated decline of approximately 14%.

These findings suggest that import sanctions not only caused direct disruptions by depriving certain Russian firms of critical inputs but also led to substantial indirect disruptions through supply chain linkages. Firms that relied on domestic suppliers, which in turn depended on sanctioned imports, experienced additional declines in sales, as did firms selling to exposed downstream buyers. These propagation effects amplify the overall economic impact of import sanctions, further

constraining domestic production beyond the directly affected firms.

7 Impact on Military Supply Chains

Given that one of the primary objectives of import sanctions was to disrupt military-related production, it is crucial to examine their impact specifically on military-related imports and output. We address this question in three steps.

First, we assess whether import sanctions were equally effective in curbing imports of products deemed critical for military applications. In both pre-post and staggered DiD designs, Figures E.1 and E.2 show no significant decline in the imports of sanctioned critical components identified by Main Directorate of Intelligence of Ukraine (2025) as relevant for Russian weapons production. If anything, we observe a relative *increase* in the total value of these flows, though the smaller increase in weight suggests a potential rise in import prices. Instead, the sharp declines documented in Figure 6 are concentrated in less strategically prioritized product categories.

Second, we test whether import sanctions successfully restricted military-related firms' access to sanctioned products. For the purpose of this exercise, we define military-related firms using government procurement data as those that ever engaged in contracts under the military procurement law. Following the analysis detailed in Online Appendix C.3, Figure E.3 presents the firm-product-level import estimates specifically for military-related firms and shows negative and significant effects, comparable in magnitude to the estimates for the whole sample. That is, sanctions constrained access to targeted products even for firms with direct ties to the defense sector.

Third, we examine whether military-related firms experienced differential downstream effects of import sanctions. Table E.1 presents results from a triple-difference specification, augmenting equation (5) with an interaction between a post-2022 indicator and a military-related firm indicator, along with year-by-military fixed effects. Column (1) uses the procurement-based definition of military-related firms; column (2) uses an alternative definition, classifying firms located in closed administrative-territorial formations (ZATOs) as military-related; column (3) combines both criteria. In all cases, the estimated triple interaction terms are small and statistically insignificant, suggesting that exposed military-related firms did not experience differential effects from import sanctions relative to the broader group of exposed firms. In other words, the pass-through effects

documented earlier hold robustly for this subsample as well.

Taken together, these findings paint a nuanced picture. While the Russian state appears to have prioritized and preserved access to select critical military components—likely through deliberate circumvention—import sanctions nonetheless appear to have disrupted broader military supply chains by constraining access to sanctioned inputs and reducing firm-level output.

8 Conclusion

In an era marked by nuclear deterrence and reluctance to engage in direct military confrontation, trade sanctions have become a central tool of economic statecraft. Among these, import sanctions aim to degrade the industrial capacity of a target country by restricting access to critical foreign inputs. Yet their effectiveness in achieving this goal remains an open empirical question.

We address this question in the context of the unprecedented import sanctions imposed on Russia following its 2022 invasion of Ukraine. Leveraging a unique combination of administrative data—including the Russian customs data, firm-level balance sheets, domestic railway shipment records, and government procurement contracts—we provide the most comprehensive causal micro-level assessment of the economic impact of import sanctions to date.

Our findings reveal that sanctioned country-product trade flows fell sharply following the war's onset and continued to decline through the end of 2023. While we observe substantial rerouting through friendly third countries—particularly of sanctioned products originally produced in sanctioning countries—and, to a lesser extent, substitution, these adjustment channels did not fully offset the decline in overall imports of sanctioned products.

At the firm level, import sanctions also had large and persistent effects. Firms with prewar exposure to sanctioned imports experienced sizable declines in sales, cost of goods sold, profits, input expenditures, and government procurement contract volumes, along with increased likelihood of exit. These effects propagated through production networks, with firms linked to exposed trading partners also seeing significant performance declines. The impacts were particularly pronounced in the science and technology sector but extended to manufacturing firms and those engaged in military-related procurement.

Taken together, our findings challenge the notion that import sanctions on Russia were largely

symbolic or easily circumvented. Instead, they reveal substantial disruptions to firm-level production and supply chains—including in strategic sectors—thereby constraining the economic and technological capabilities of the Russian economy.

While our findings provide robust evidence of the disruptive effects of import sanctions, several limitations merit further exploration. First, our analysis captures short- to medium-term effects, whereas longer-term responses, such as technological upgrading or innovation,[19] remain outside the scope of this study. Second, our analysis adopts a positive approach, focusing on documenting the impact of sanctions rather than engaging with normative questions around welfare implications or the optimal sanctions design. Third, the extent to which our results generalize to other sanctioned economies is inherently context-dependent: the structure of the targeted economy, the nature of its trade dependencies, and the level of international coordination all shape the efficacy of import sanctions in other real or hypothetical settings. Finally, while we focus on import sanctions, studying the pass-through effects of sanctions on Russian exports is another important avenue for future work. We view these limitations as opportunities for further research—particularly in tracing firms' long-term adaptation strategies, studying the role of enforcement in explaining evasion dynamics, analyzing the effects of export sanctions, and assessing the broader welfare implications for consumers and workers in both target and sanctioning countries. As sanctions continue to shape the landscape of international conflict and economic diplomacy, understanding their mechanisms and consequences remains a pressing priority for researchers and policymakers alike.

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[19] See Liu, Liu, and Wen (2024); Clayton, Coppola, Maggiori, and Schreger (2025); Flynn, Levy, Moscona, and Wo (2025) for evidence that export controls and foreign political risk can spur R&D investments and innovation.

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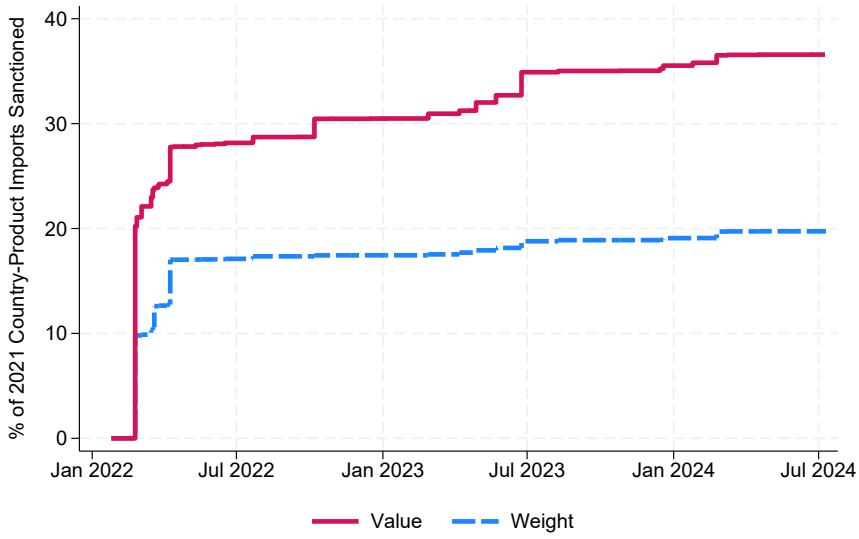
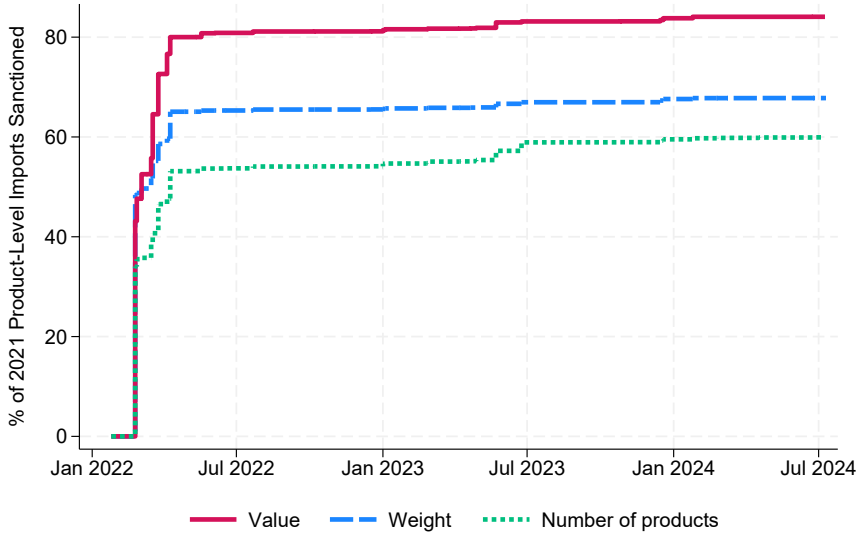
Figure 1: Timing of Sanctions' Introduction on Russian Imports, Expressed as a Share of 2021 Trade Volume



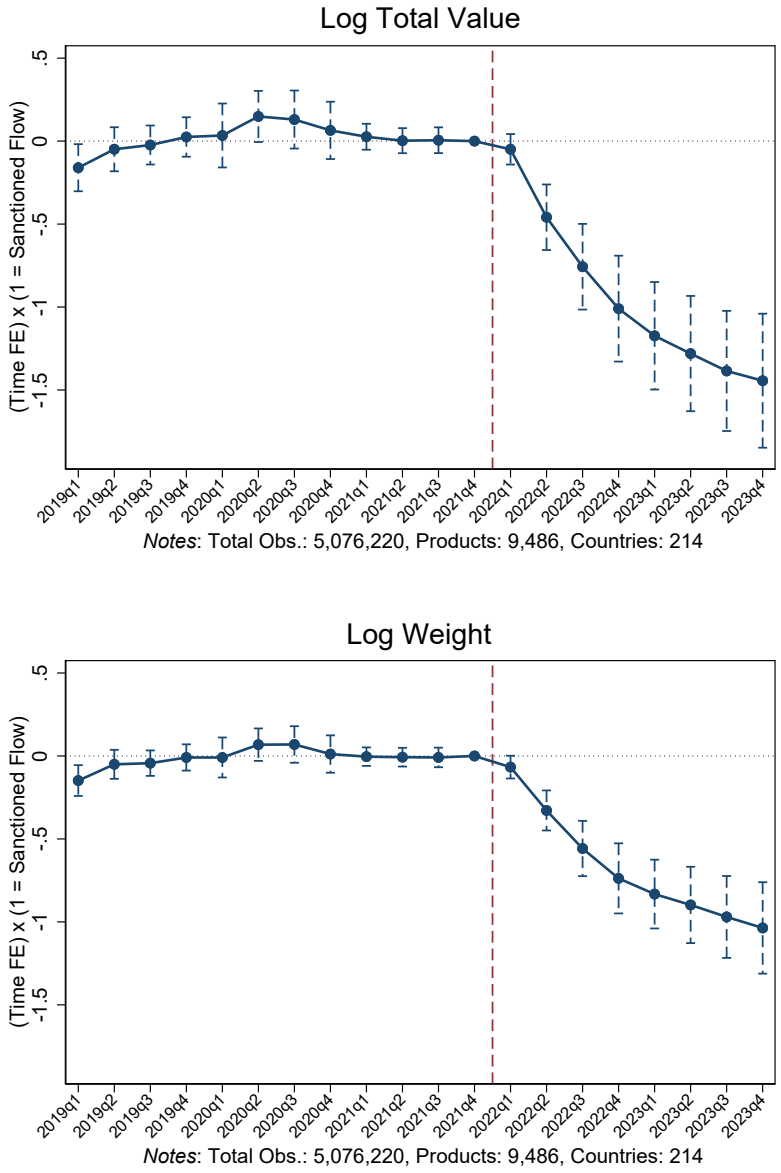
(a) Country-Product-Level Imports



(b) Product-Level Imports

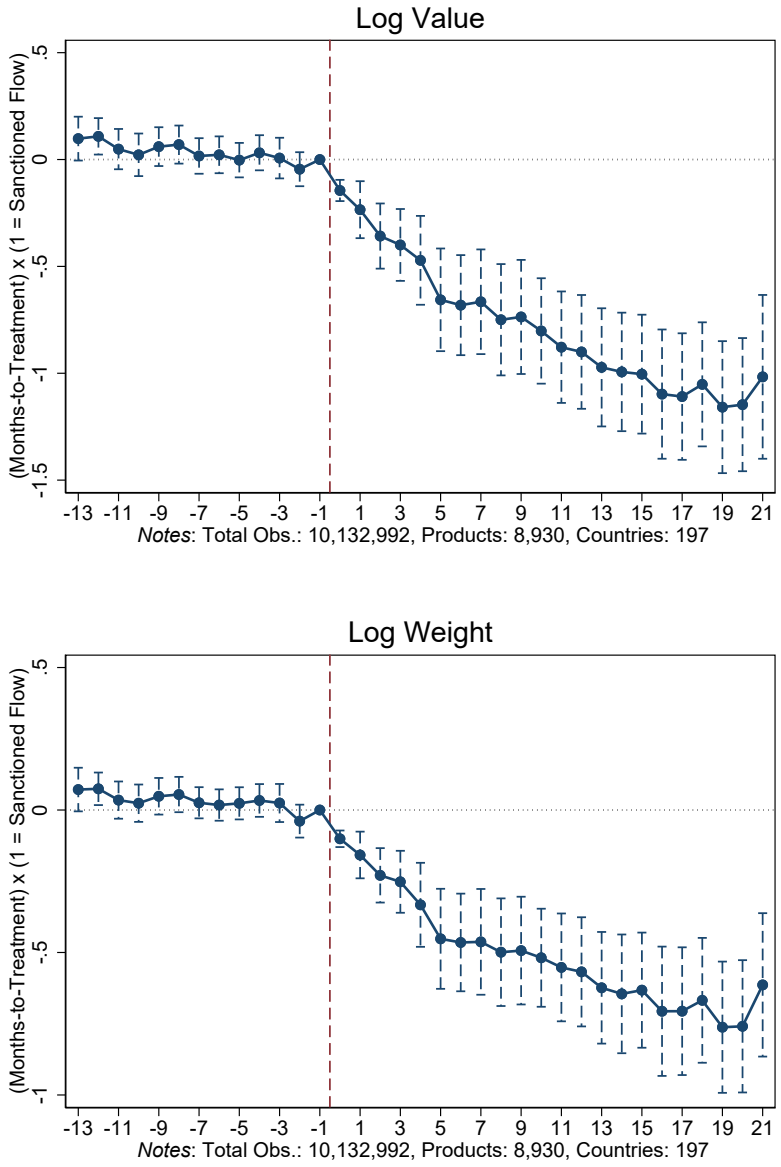
Notes: This figure displays the timing and volume of sanctions imposed on Russia's imports, measured based on their prewar levels. Specifically, for each date from February 2022 to July 2024, we compute the share of Russian imports sanctioned by any country, using 2021 trade data as a baseline. Panel (a) calculates this share at the country-product level. Panel (b) calculates this share at the product level, assigning each product the earliest date at which it was sanctioned by any country. The shares are reported across three dimensions: by value (in red), by weight (in blue, long-dashed), and, for Panel (b) only, by the number of sanctioned products (in green, short-dashed).

Figure 2: The Impact on Russian Imports of Sanctioned Country-Product Varieties



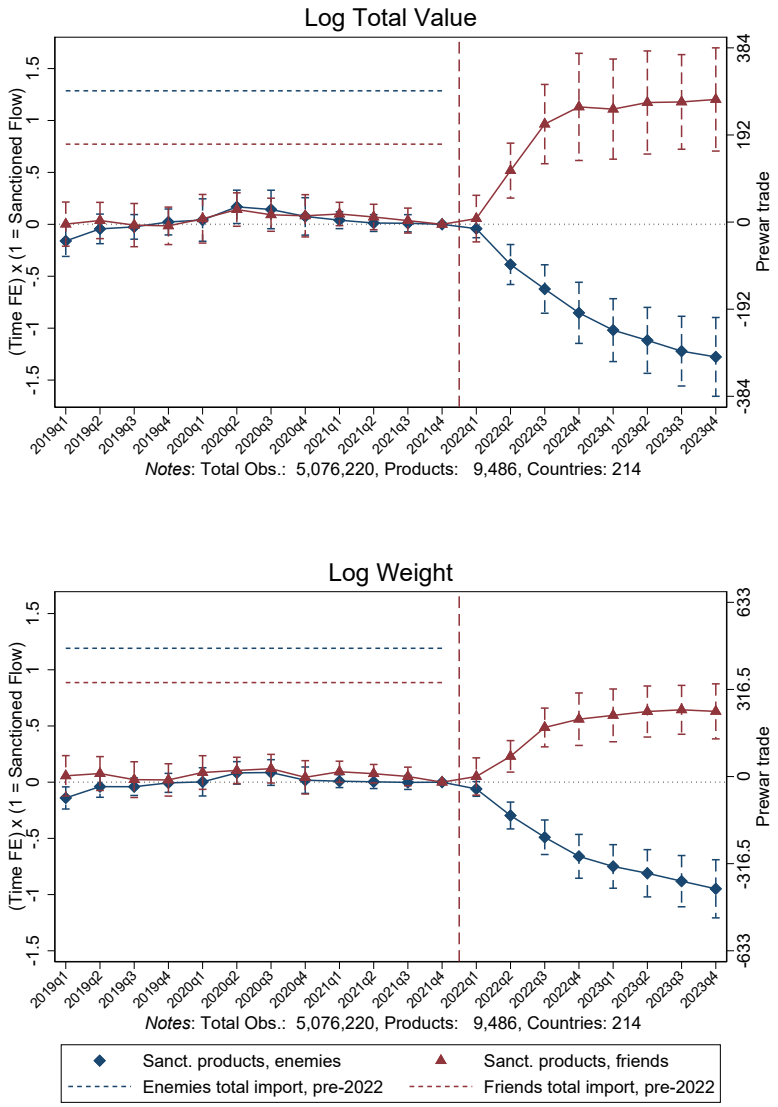
Notes: These figures present the dynamic difference-in-differences estimates of Equation (1), which assess the impact of sanctions on Russian imports by comparing the volume of sanctioned country-product imports to that of non-sanctioned imports before and after the war's onset. The data is aggregated quarterly, with 2021Q4 serving as the baseline period. The red vertical line indicates the start of the war. 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 add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure 3: The Impact on Russian Imports of Sanctioned Country-Product Varieties, Staggered Design, Monthly



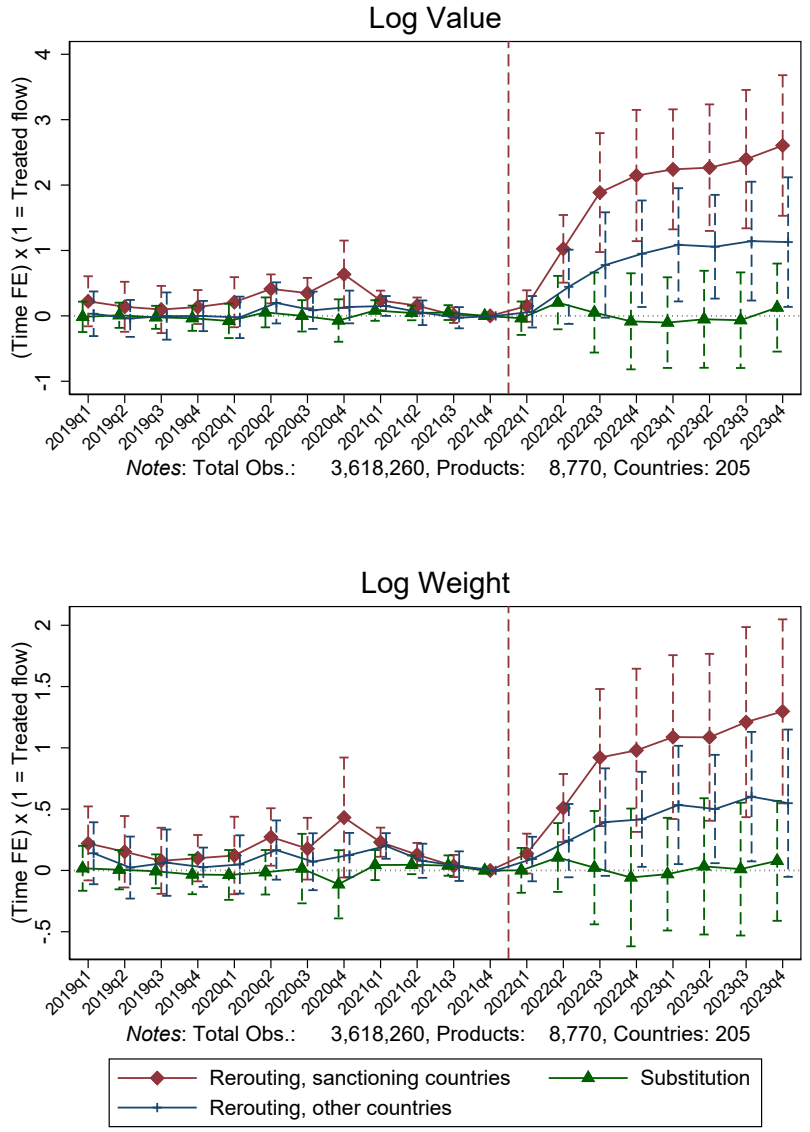
Notes: These figures present the staggered difference-in-differences estimates of Equation (2), which assess the impact of sanctions on Russian imports by comparing the volume of sanctioned country-product imports to that of non-sanctioned imports before and after the imposition of sanctions on the former. The data is aggregated at the monthly level, and the estimates are aggregated across cohorts at the time level. The red vertical line indicates the start of the war. Pre-trend coefficients are estimated based on a separate regression, where all treated observations are omitted. The top (bottom) figure uses the total import value (net weight) of a given product from a given country in a given month as an outcome. The logarithms add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure 4: The Impact on Russian Imports of Sanctioned Country-Product Varieties, Accounting for Substitution and Rerouting via Friendly Countries



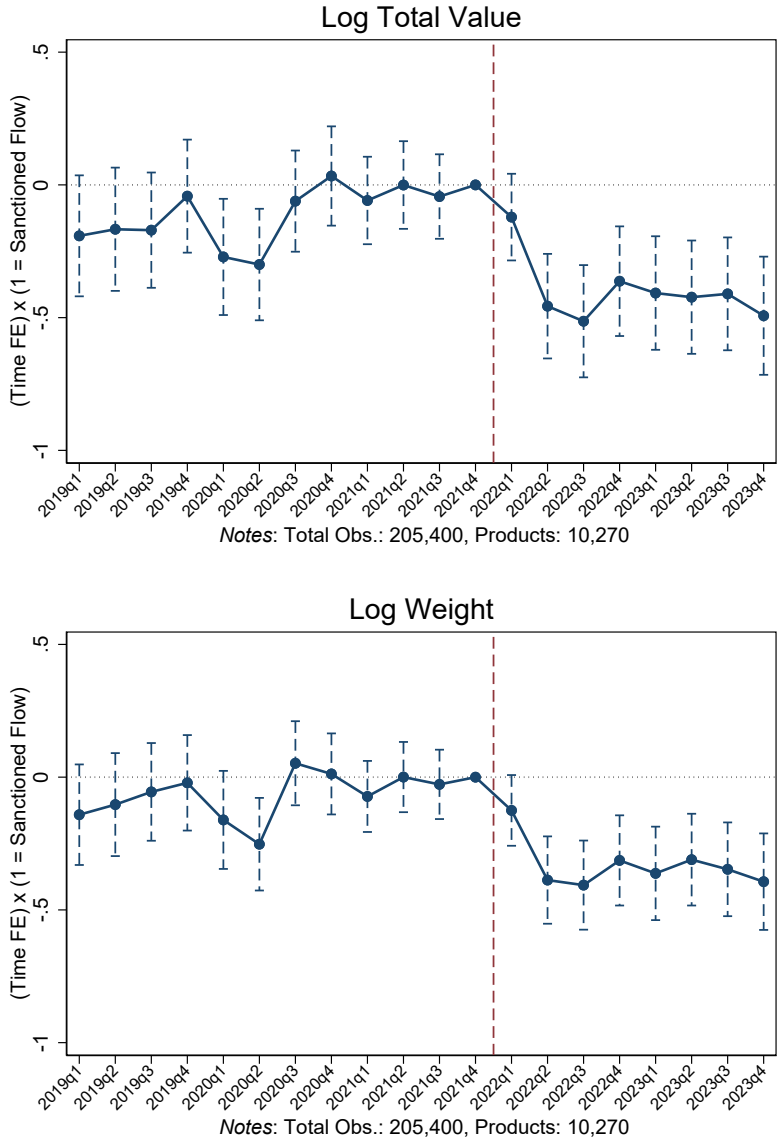
Notes: These figures investigate the presence of substitution to and rerouting through third countries by estimating Equation (3), which compares the volume of sanctioned country-product imports to that of non-sanctioned imports, before and after the war's onset, but separating out the imports of ever-sanctioned products from the 'friendly' countries. 'Friends' are the countries that remained relatively friendly to the Russian regime after the war's onset: Armenia, Belarus, China, Georgia, Hong Kong, Kazakhstan, Kyrgyzstan, Serbia, Turkey, 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 red vertical line indicates the start of the war. 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 add 1 to the argument's value to avoid missing values. 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 5: Decomposing Substitution vs. Rerouting via Friendly Countries



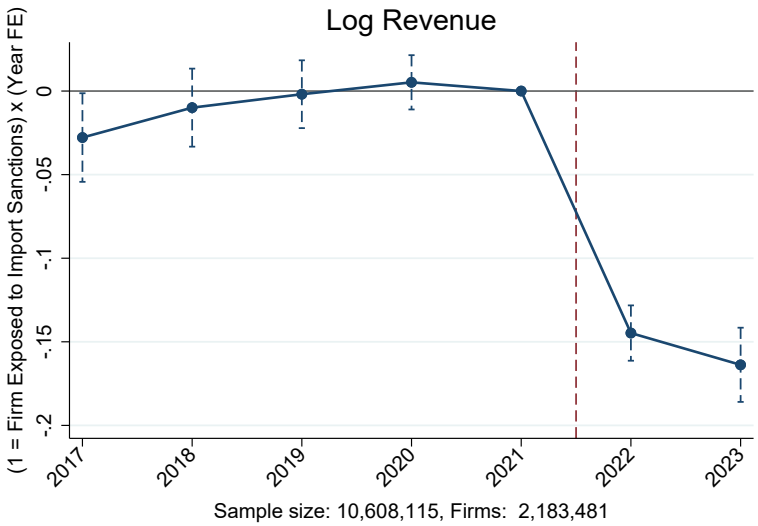
Notes: These figures disentangle the effects of substitution to and rerouting through friendly countries. Specifically, each import flow of the sanctioned products from friendly countries is separated into three flows: those produced within the same friendly country (in green), those produced in sanctioning countries (in red), and those produced elsewhere (in blue). The impact of import sanctions is estimated on each of these flows, with the non-sanctioned imports from third countries serving as a control group. Directly sanctioned flows from sanctioning countries are not included in the estimation sample. Friendly countries are defined as Armenia, Belarus, China, Georgia, Hong Kong, Kazakhstan, Kyrgyzstan, Serbia, Turkey, and the UAE. The data is aggregated at the quarterly level. The red vertical line indicates the start of the war. 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 add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure 6: The Impact on Russian Imports of Sanctioned Products



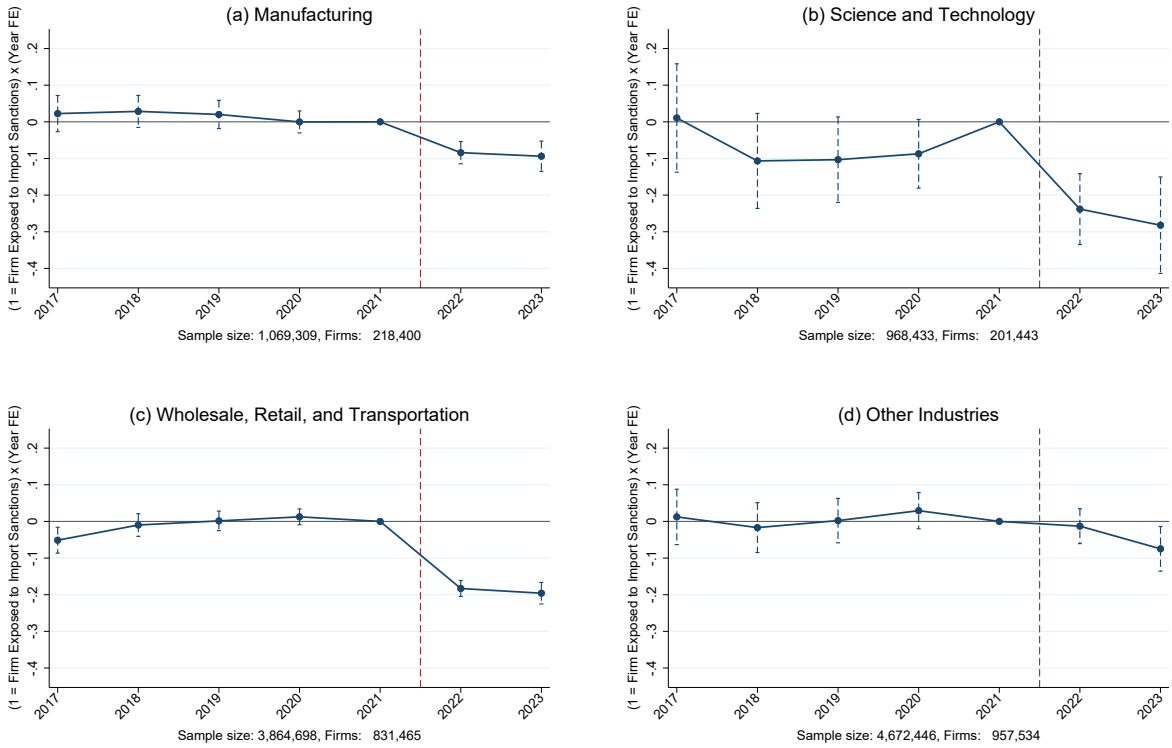
Notes: These figures assess the impact of sanctions on the total imports of sanctioned products, independent of the identity of countries-importers. Specifically, they present the dynamic difference-in-differences estimates of Equation (4), which compares the volume of sanctioned product imports to that 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 red vertical line indicates the start of the war. The top (bottom) figure uses the total import value (net weight) of a given product in a given quarter as an outcome. The logarithms add 1 to the argument's value to avoid missing values. Regressions control for HS3-product-year fixed effects. The bars represent 95% confidence intervals. Standard errors are clustered at the product level.

Figure 7: The Impact of Import Sanctions on Exposed Firms' Sales



Notes: This figure examines the impact of import sanctions on the revenues of firms that, prior to the war, imported any country-product variety that was later sanctioned. Specifically, it presents the dynamic difference-in-differences estimates of Equation (5), which compares firm revenues between firms with and without prewar exposure to future import sanctions, before and after the war's onset. The outcome data are presented at the yearly level, with 2021 serving as the baseline period. The red vertical line indicates the start of the war. The bars represent 95% confidence intervals. Standard errors are clustered at the firm level.

Figure 8: The Impact of Import Sanctions on Exposed Firms' Sales, By Industry



Notes: This figure examines the impact of import sanctions on the revenues of exposed firms by industry. Specifically, the plots display the dynamic difference-in-differences estimates of Equation (5), comparing firm revenues between firms with and without prewar exposure to future import sanctions, before and after the war's onset. A firm is considered exposed if, prior to the war, it imported any country-product variety that was later sanctioned. The revenue data come at the yearly level, and 2021 serves as the baseline period. The red vertical line indicates the start of the war. The bars represent 95% confidence intervals. Standard errors are clustered at the firm level.

Table 1: The Impact on Russian Imports of Sanctioned Products

	(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	-0.273***	-0.168***	-0.074***	-0.310***	-0.273***	0.010
	(0.049)	(0.043)	(0.015)	(0.073)	(0.063)	(0.022)
Quarter FE	✓	✓	✓			
Product FE	✓	✓	✓	✓	✓	✓
2-Digit Product-Quarter FE				✓	✓	✓
Mean Dep. Var.	10.24	8.49	3.24	10.24	8.49	3.24
SD Dep. Var.	6.00	5.49	2.53	6.00	5.49	2.53
Observations	205,460	205,460	160,127	205,460	205,460	160,127
Number of Products	10,273	10,273	9,417	10,273	10,273	9,417

Notes: This table examines whether total imports of sanctioned products into Russia, independent of country-exporter, declined following the onset of the Russian invasion of Ukraine in 2022. Specifically, it presents the estimates of equation (4) modified by replacing θ_t with a single post-war indicator. The outcome variable in columns (1) and (4) is the log of total value imported; in columns (2) and (5)—log of total weight imported; and in columns (3) and (6)—log-unit price, defined as value per weight calculated for each transaction and then averaged at the product-code level weighted by transactions' value. The logarithms add 1 to the argument's value to avoid missing values. The time span is from 2019Q1 through 2023Q4. Product codes refer to ten digit HS codes, unless they needed to be aggregated due to changes in HS classification over time following Pierce and Schott (2012). Standard errors in parentheses are clustered at the product level. * p<0.1, ** p<0.05, *** p<0.01.

Table 2: The Impact of Import Sanctions on Exposed Russian Firms

	(1) Log Sales	(2) Log Total Production Costs	(3) Log Gross Profit	(4) Log Capital Costs	(5) Log Labor Costs	(6) Log Materials Costs	(7) 𝟙[Sales Missing]	(8) Log Sales (Zeroes if Missing)
Post-2022 × Exposed to Import Sanctions	-0.137***	-0.147***	-0.108***	-0.067***	-0.094***	-0.150***	0.013***	-0.598***
	(0.010)	(0.009)	(0.011)	(0.013)	(0.012)	(0.016)	(0.002)	(0.048)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Importer FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Exporter FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Industry FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Target Sanctioned FE	✓	✓	✓	✓	✓	✓	✓	✓
Mean Dep. Var.	15.91	15.85	13.98	14.40	15.38	17.14	0.24	11.06
SD Dep. Ver.	2.29	2.24	2.40	2.59	2.37	2.72	0.43	7.57
Observations	10,597,168	9,881,593	8,447,082	4,620,059	1,377,628	1,433,613	15,247,428	15,245,129
Number of Firms	2,178,204	2,063,893	1,922,658	979,529	323,064	338,753	2,178,204	2,178,202

Notes: This table examines the impact of import sanctions on the performance of the exposed Russian firms. Specifically, it presents the non-dynamic version of the estimates of equation (5), comparing revenues (and other financials) of firms exposed to the import sanctions and not, before and after the war's onset. A firm is considered exposed if prior to the war, it imported any country-product variety that was later sanctioned. With the exception of the missing sales indicator, all dependent variables are in logarithms of Russian rubles. The firm outcome variables come at the yearly level from 2017 through 2023. Standard errors in parentheses are clustered at the firm level. * p<0.1, ** p<0.05, *** p<0.01.

Table 3: The Impact on Exposed Firms' Government Procurement Contracts

	(1) 𝟙[Won At Least One Contract]	(2) Log Value of Contracts Won	(3) 𝟙[Won At Least One Contract]	(4) Log Value of Contracts Won
Post-2022 × Exposed to Import Sanctions	-0.024***	-0.372***	-0.021***	-0.373***
	(0.002)	(0.024)	(0.007)	(0.102)
Firm FE	✓	✓	✓	✓
Year-Importer FE	✓	✓	✓	✓
Year-Exporter FE	✓	✓	✓	✓
Year-Industry FE	✓	✓	✓	✓
Year-Target Sanctioned FE	✓	✓	✓	✓
Only Firms With Contracts In > 2 Years			✓	✓
Mean Dep. Var.	0.11	1.58	0.63	9.45
SD Dep. Ver.	0.31	4.63	0.48	7.46
Observations	10,597,168	10,597,167	1,552,070	1,552,070
Number of Firms	2,178,204	2,178,204	261,981	261,981

Notes: This table examines the impact of import sanctions on the government procurement activity of the exposed Russian firms, estimated using a pre-post version of equation (5). Columns (1) and (3) present estimates for the likelihood that a firm won at least one government contract in a given year. Columns (2) and (4) report the effects on the (log of one plus) total value of contracts won (in rubles). Columns (3) and (4) restrict the sample to firms that secured contracts in at least two years of the sample. The government procurement outcome variables are aggregated at the firm-year level from 2017 through 2023. Standard errors in parentheses are clustered at the firm level. * p<0.1, ** p<0.05, *** p<0.01.

Table 4: The Impact of Import Sanctions on Exposed Firms' Railway Shipments

	(1) Log In-Shipments	(2) Log Out-Shipments	(3) Log Total Shipments	(4) Log # Suppliers	(5) Log # Buyers	(6) Log # Partners
Post-2022 × Firm Exposed to Import Sanctions	-0.175***	0.031	-0.106***	-0.003	0.004	-0.012
	(0.039)	(0.055)	(0.036)	(0.019)	(0.032)	(0.019)
Firm FE	✓	✓	✓	✓	✓	✓
Year-Importer FE	✓	✓	✓	✓	✓	✓
Year-Exporter FE	✓	✓	✓	✓	✓	✓
Year-Industry FE	✓	✓	✓	✓	✓	✓
Mean Dep. Var.	7.73	8.18	8.10	1.21	1.48	1.44
SD Dep. Ver.	2.53	2.66	2.60	1.10	1.35	1.26
Observations	106,165	53,288	127,925	106,219	53,323	127,962
Number of Firms	23,224	12,009	27,710	23,240	12,021	27,719

Notes: This table examines the impact of import sanctions on railway shipments of exposed Russian firms, estimated using a pre-post version of equation (5). Columns (1)–(3) report effects on the (log of one plus) total weight of incoming, outgoing, and combined shipments, respectively. Columns (4)–(6) present results for the extensive margin, measured by the log number of suppliers, buyers, and total trading partners. A firm is considered exposed if, before the war, it imported any country-product variety that was later sanctioned. The railway outcome variables are aggregated at the firm-year level from 2017 through 2023. Standard errors in parentheses are clustered at the firm level. * p<0.1, ** p<0.05, *** p<0.01.

Table 5: The Impact on Firms Through Supply Chain Linkages

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Log Sales							
Post-2022 ×	-0.137***	-0.143***	-0.143***	-0.143***	-0.143***	-0.143***	-0.143***	-0.142***
× Firm Exposed to Import Sanctions	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Post-2022 ×			-0.076***		-0.074***	-0.044*	-0.040	-0.032
× Supplier Exposed to Import Sanctions			(0.016)		(0.016)	(0.024)	(0.027)	(0.027)
Post-2022 ×				-0.037**	-0.033*	-0.057*	-0.076**	-0.066*
× Buyer Exposed to Import Sanctions				(0.018)	(0.018)	(0.031)	(0.037)	(0.037)
Post-2022 × Supplier's						-0.039		
Partner Exposed to Import Sanctions						(0.024)		
Post-2022 × Buyer's						0.028		
Partner Exposed to Import Sanctions						(0.030)		
Post-2022 × Supplier's							-0.004	-0.001
Supplier Exposed to Import Sanctions							(0.043)	(0.043)
Post-2022 × Supplier's							-0.040	-0.040
Buyer Exposed to Import Sanctions							(0.039)	(0.039)
Post-2022 × Buyer's							0.000	0.006
Supplier Exposed to Import Sanctions							(0.043)	(0.043)
Post-2022 × Buyer's							0.048	0.051
Buyer Exposed to Import Sanctions							(0.050)	(0.050)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Importer FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Exporter FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Industry FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Target Sanctioned FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Railway Trader FE		✓	✓	✓	✓	✓	✓	✓
Year FE × Log Total Railway Partners								✓
Mean Dep. Var.	15.91	15.91	15.91	15.91	15.91	15.91	15.91	15.91
SD Dep. Ver.	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29
Observations	10,597,168	10,597,168	10,597,168	10,597,168	10,597,168	10,597,168	10,597,168	10,597,168
Number of Firms	2,178,204	2,178,204	2,178,204	2,178,204	2,178,204	2,178,204	2,178,204	2,178,204

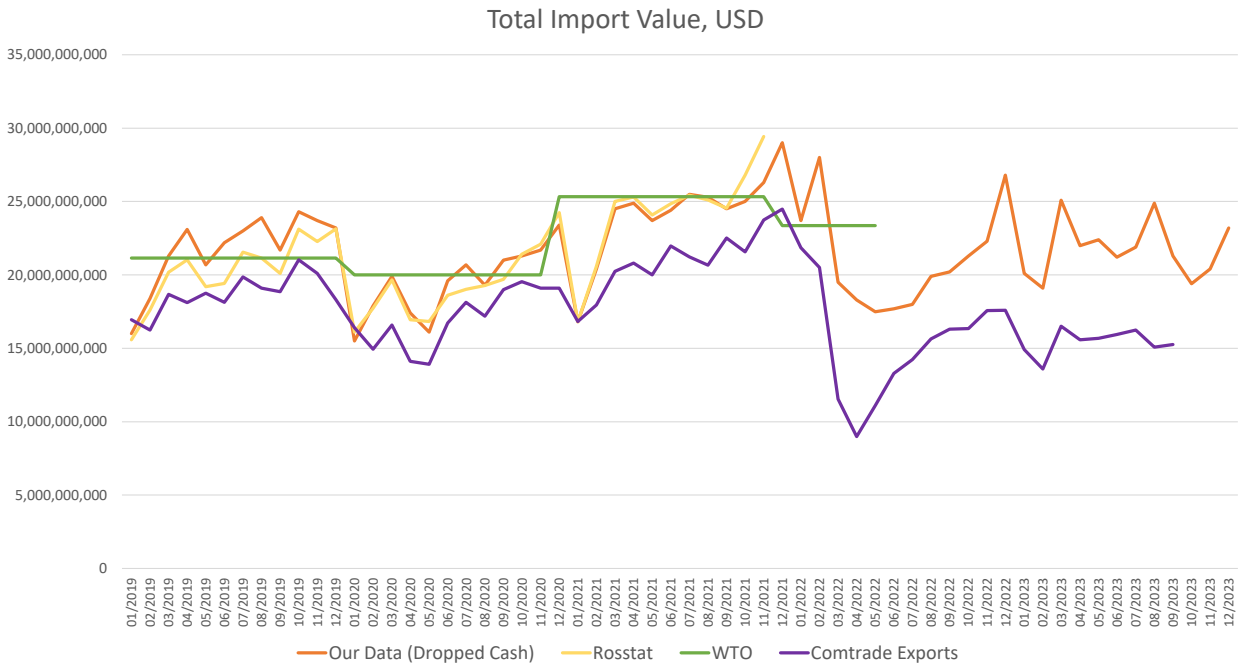
Notes: This table examines the impact of import sanctions on the performance of directly and indirectly exposed Russian firms. Specifically, it extends the baseline estimates in Table 2 by also examining whether firm revenues are affected by whether a given firm's buyers or suppliers were exposed to import sanctions, and in turn, if their buyers or suppliers were. Data on firm-to-firm connections comes from data on railway shipments within Russia. A firm is considered exposed if, prior to the war, it imported any country-product variety that was later sanctioned. The dependent variable in all columns is the logarithm of yearly sales in Russian rubles from 2017 through 2023. Standard errors in parentheses are clustered at the firm level. * p<0.1, ** p<0.05, *** p<0.01.

Online Appendix for "Trade Sanctions" (not for publication)

Konstantin Egorov, Vasily Korovkin, Alexey Makarin, Dzhamilya Nigmatulina

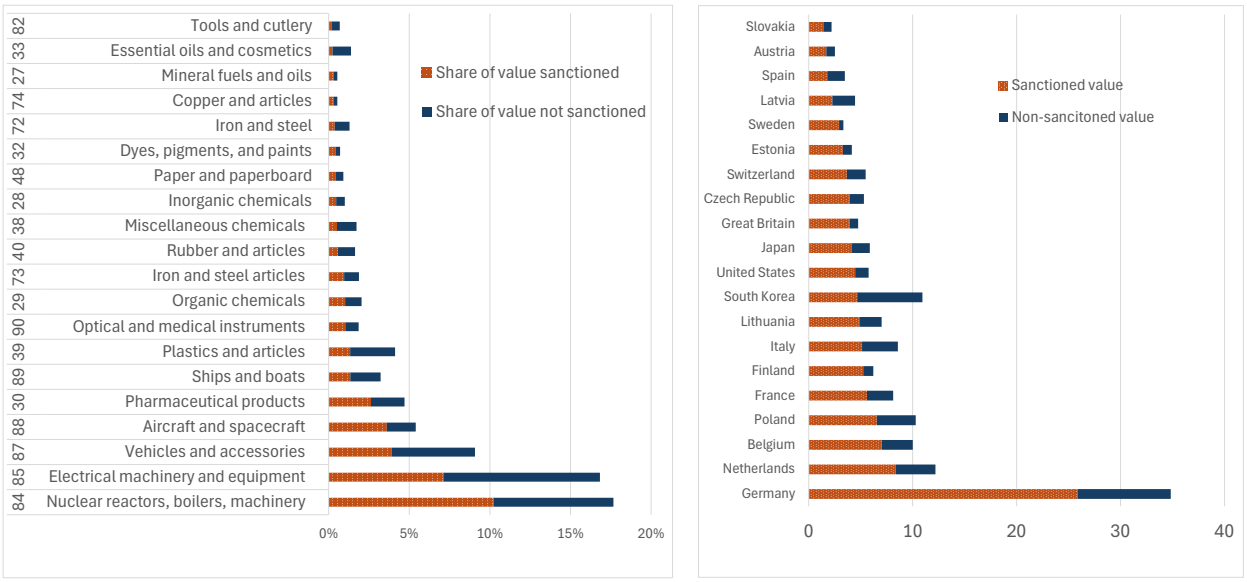
A Descriptive Figures and Tables

Figure A.1: Aggregate Trends In Russia's Imports



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

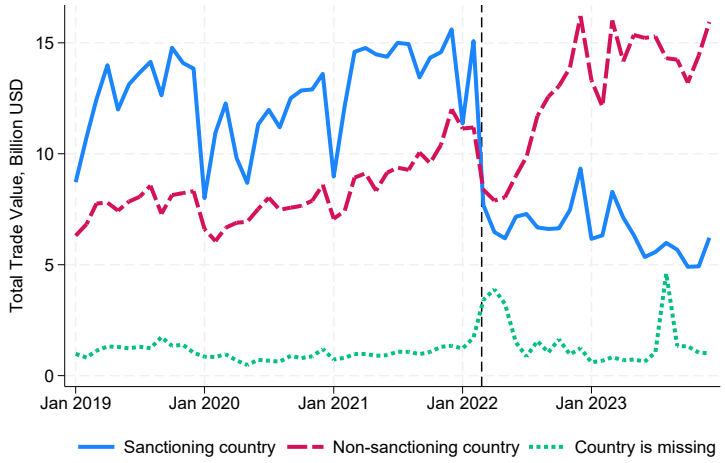
Figure A.2: Sanctioned Volume of Russian Imports: Top-20 Product Categories and Countries



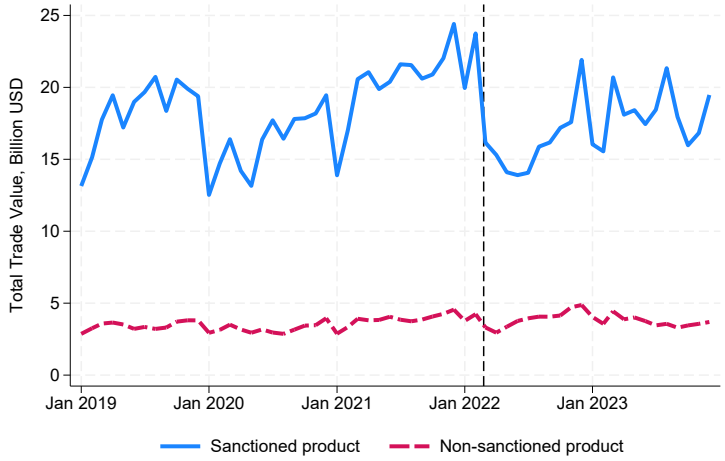
(a) Most Sanctioned Products (% of 2021 Imports) (b) Most Sanctioning Countries (in Bln USD)

Notes: Panel A displays the top-20 sanctioned 2-digit product categories. Each bar shows the share of a category in Russia's total 2021 imports by value, with the first segment (in orange) indicating the portion of the category that was sanctioned. Panel B similarly displays the top-20 countries with highest value of sanctioned exports to Russia. The total length of each bar represents the size of each country's 2021 exports to Russia (in billion USD), while the first segment (in orange) highlights the sanctioned portion of its export value.

Figure A.3: Dynamics of the Total Value of Russian Imports (2018–2023), By Country and Product Sanction Status



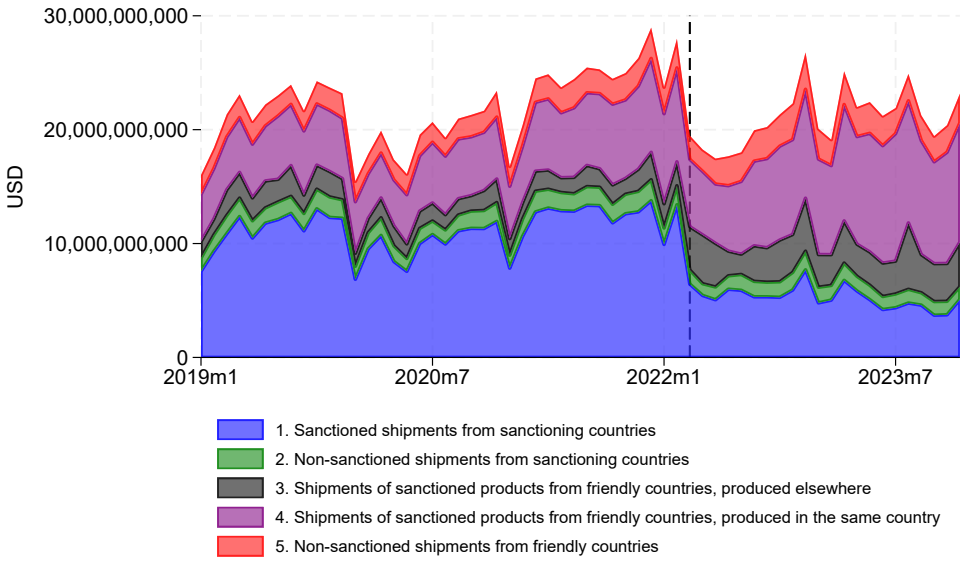
(a) Total Value of Imports: Sanctioning vs. Non-Sanctioning Countries



(b) Total Value of Imports: Products Ever Sanctioned vs. Never Sanctioned

Notes: This figure displays the evolution of Russia's total import value from January 2019 to December 2023. The gray vertical line indicates the start of the war. In Panel (a), the data are broken down by whether the exporting country imposed any sanctions or was missing from the data. In Panel (b), the data are broken down by whether the product was sanctioned by any country for export to Russia.

Figure A.4: Total Import Flows by Type



Notes: This figure displays imported value flows of products by their sanctioned status and categories of country of origin and country of shipment from January 2019 to December 2023. The gray vertical line indicates the start of the war.

Table A.1: Summary Statistics: Russian Imports

	Observations	Mean	SD	Min	Max
Panel A: Country-Product-Quarter Imports					
Number of transactions	7,128,940	19	248	0	101,874
Total value, USD '000	7,128,940	250	5,385	0	4,715,639
Total net weight, tons	7,128,940	70.8	4,588	0	5,477,937
Log total value	7,128,940	3.65	5.09	0	22
Log total weight	7,128,940	2.55	4	0	22
$\mathbb{1}$[Ever sanctioned]	7,128,940	0.28	0.45	0	1
$\mathbb{1}$[Sanctioned at t by c]	7,128,940	0.07	0.24	0	1
$\mathbb{1}$[Critical component]	7,128,940	0.09	0.29	0	1
Panel B: Product-Quarter Imports					
Number of transactions	287,644	470	3,232	0	282,139
Total value, USD '000	287,644	6,200	50,233	0	4,873,493
Total net weight, tons	287,644	1,754	27,164	0	5,477,937
Unit value, USD '000	227,052	146	22,177	0	7,218,129
Log total value	287,644	10.3	5.94	0	22
Log total weight	287,644	8.57	5.45	0	22
$\mathbb{1}$[Ever sanctioned]	287,644	0.60	0.49	0	1
$\mathbb{1}$[Critical component]	287,644	0.04	0.19	0	1

Notes: This table displays the summary statistics for Russian imports. Panel A depicts the summary statistics for country-product quarterly import flows from 2017Q1 through 2023Q4. Panel B depicts the summary statistics for product-level quarterly import flows from 2017Q1 through 2023Q4. Unit value is not defined for quarters with zero imports of a particular product. Products refer to ten digit HS codes, unless they were aggregated due to changes in HS classification following Pierce and Schott (2012).

Table A.2: Summary Statistics: Russian Firms

	Observations	Mean	SD	Min	Max
Panel A: Accounting Outcomes					
Sales, Rub '000 000	10,597,168	168	7,542	6.0e-06	7,979,027
Costs of Goods Sold, Rub '000 000	10,210,547	140	5,728	0	4,815,225
Gross Profits , Rub '000 000	10,210,547	32.8	3,357	-3,833,100	3,640,459
Capital Costs, Rub '000 000	7,046,326	86.2	12,853	-720	14,596,295
Material Costs, Rub '000 000	2,609,932	405	10,154	0	4,820,694
Labour Costs, Rub '000 000	2,572,321	34.9	1,010	-123,851	536,828
Log of Sales	10,597,168	15.9	2.29	1.8	30
Panel B: Measures of Exposure, Firm Characteristics					
𝟙[Firm Exposed to Import Sanctions]	2,178,204	0.025	0.155	0	1
Firm Exposure to Import Sanctions	2,178,204	0.014	0.105	0	1
𝟙[Firm Imported Sanctioned Products from Enemy Countries]	2,178,204	0.029	0.167	0	1
𝟙[Firm Imported Sanctioned Products from Neutral Countries]	2,178,204	0.009	0.094	0	1
𝟙[Firm Imported Sanctioned Products from Friendly Countries]	2,178,204	0.021	0.142	0	1
𝟙[Buyer Exposed to Import Sanctions]	2,178,204	0.003	0.057	0	1
𝟙[Supplier Exposed to Import Sanctions]	2,178,204	0.007	0.084	0	1
𝟙[Importer]	2,178,204	0.044	0.206	0	1
𝟙[Exporter]	2,178,204	0.023	0.148	0	1
𝟙[Railway Trader]	2,178,204	0.010	0.101	0	1
𝟙[Firm Is Target-Sanctioned]	2,178,204	0.002	0.044	0	1
𝟙[Industry=Manufacturing]	2,178,204	0.098	0.294	0	1
𝟙[Industry=Wholesale]	2,178,204	0.318	0.462	0	1
𝟙[Industry=Transportation]	2,178,204	0.060	0.235	0	1
𝟙[Industry=Science and Technology]	2,178,204	0.091	0.285	0	1
𝟙[Industry=Other]	2,178,204	0.434	0.492	0	1
Panel C: Railway Shipments					
In-Shipments Weight, Tons	146,292	57.4	745	0	56,932
Out-Shipments Weight, Tons	146,292	61.3	855	0	70,587
Total Shipments Weight, Tons	146,292	119	1,330	0	92,236
Num. of Suppliers	146,292	5.69	15.6	0	895
Num. of Buyers	146,292	5.83	33.8	0	1,890
Total Partners	146,292	8.09	43.3	0	2,363

Notes: This table presents summary statistics for Russian firms. Panel A provides summary statistics for firm-level yearly accounting outcomes spanning the years 2017 to 2023. Panel B reports various measures of firms' exposure to import sanctions based on their prewar import flows and firm characteristics. Buyers and suppliers are identified using railway shipment data. Panel C summarizes firms' yearly railway shipments from 2017 to 2023.

Table A.3: Correlation of Sanctioned Product Lists Across Countries

	AU	CA	CH	EU	GB	JP	KR	TW	US
AU: Australia	1								
CA: Canada	0.4099	1							
CH: Switzerland	0.4763	0.2571	1						
EU: European Union	0.1335	0.1599	0.6246	1					
GB: Great Britain	0.1688	0.1851	0.6237	0.9217	1				
JP: Japan	0.2669	0.3443	0.2356	0.5294	0.5278	1			
KR: South Korea	0.1890	0.2492	0.2911	0.4094	0.4095	0.5141	1		
TW: Taiwan	0.2088	0.1842	0.1769	0.1900	0.1834	0.2518	0.4520	1	
US: United States	0.3791	0.4059	0.2312	0.5164	0.5447	0.7794	0.5265	0.2251	1

Notes: The table displays pairwise correlations between the sets of 6-digit products eventually sanctioned by different countries. Each correlation coefficient is calculated based on the correlation between two binary variables, where each variable indicates whether a specific 6-digit product code was sanctioned by a particular country or bloc. These variables are defined over the universe of 6-digit codes imported by Russia in 2021. Reproduced from Egorov et al. (2025).

B Case Studies: Semiconductors and Critical Components.

This appendix illustrates how our granular data allow us to track import flows of specific product categories along the various routes through which goods enter Russia, while highlighting the limitations of such descriptive trade patterns. We focus on two categories of particular relevance to wartime production: semiconductors and critical components.

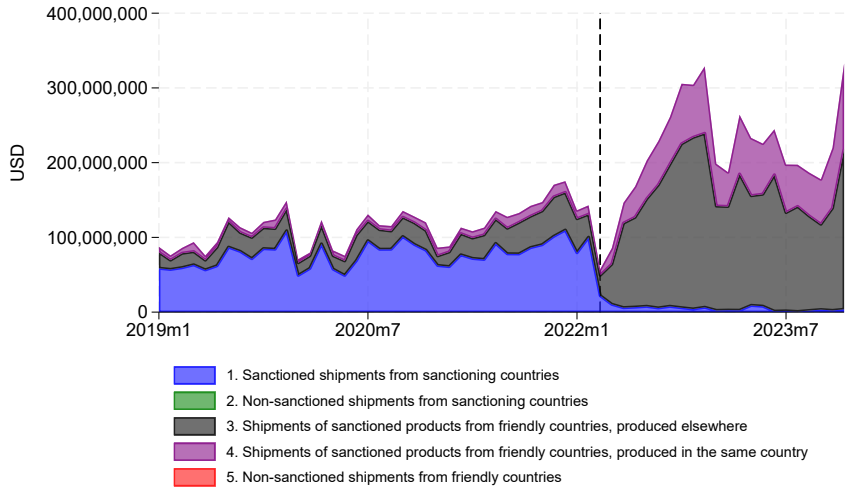
Figure B.1a examines import flows of semiconductors and related products (HS codes starting with 8541 and 8542), disaggregated by route type. Following the invasion, imports of sanctioned semiconductors from sanctioning countries (blue area) collapsed to nearly zero. In contrast, imports shipped from non-sanctioning countries surged, eventually pushing total semiconductor imports to roughly twice their 2021 level. For most of these flows, the country of origin differed from the country of shipment (grey area), consistent with rerouting through third countries. A meaningful share, however, originated and was shipped from the same non-sanctioning country (purple area), indicating direct substitution in production.

Figure B.1b extends the analysis to a broader list of "critical components" directly used in weapons production.[1] Here too, imports from sanctioning countries fell sharply. But compared to semiconductors, rerouting and substitution patterns appear more modest. Imports of critical components produced and shipped from the same friendly country remained stable across the war period, while rerouted flows increased only gradually. However, despite the growth in these alternative supply routes, the total value of critical component imports remained somewhat lower than in 2021, a stark contrast to the trends observed for semiconductors.

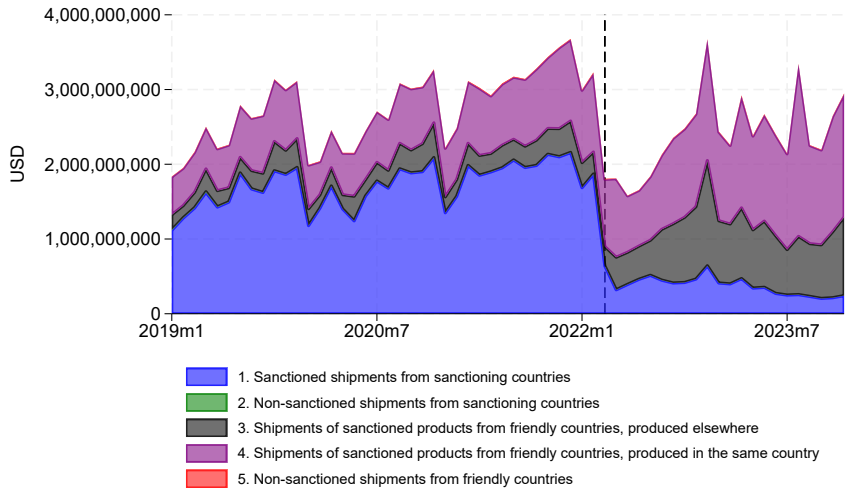
Together, these patterns highlight the granularity of our data and underscore two key points. First, Russia's access to high-tech and war-related imports in the post-sanctions period varied significantly across product categories, reflecting differences in demand, supply availability, and rerouting feasibility. Second, descriptive trends alone can be misleading, as they may confound the impact of sanctions with changes in underlying demand—especially for goods with heightened wartime importance, such as semiconductors. Our econometric approach, presented in the main text, is thus key to separate these confounding factors and isolate the causal effects of sanctions.

[1] The list is drawn from the two lists "Components in Weapons" and "Instruments of War" as categorized in Main Directorate of Intelligence of Ukraine (2025). These items were either recovered from the battlefield or identified by investigators as machinery used in weapons production. The associated product descriptions and models were then matched to the closest 6-digit HS codes manually and with the help of GPT-4o.

Figure B.1: Case Studies: Imports Semiconductors and Critical Components, By Route Type



(a) Imports of Semiconductors



(b) Imports of Critical Components

Notes: This figure displays imported value flows of products by their sanctioned status and categories of country of origin and country of shipment from January 2019 to December 2023. The gray vertical line indicates the start of the war. In Panel (a) the sample is restricted to semiconductors or related products, identified by HS codes starting with 8541 and 8542. In Panel (b) the sample is restricted to the HS10 list of critical components from "Components in Weapons" and "Instruments of War" as classified in Main Directorate of Intelligence of Ukraine (2025), matched to the closest 6-digit HS code manually and with the help of GPT-4o.

C Impact on Sanctioned Imports: Robustness and Additional Results

C.1 Robustness Checks

This appendix discusses in greater detail the robustness checks for the impact of sanctions on the sanctioned imports introduced in Section 5.

First, we verify that our baseline results in Table C.1 are not sensitive to the transformation of the outcome variable. In our main specification, we apply a log-plus-one transformation to retain country-product-quarter cells with zero trade while ensuring computational feasibility. Columns (2)–(3) of Table C.4 show that the estimated declines remain similar when using a simple logarithm transformation that omits zero trade flows: column (2), for instance, implies a 45% reduction in sanctioned imports ($= \exp^{-0.596} - 1$), which is comparable to our baseline estimate of 62%. Column (1) further shows a large effect at the extensive margin, with the likelihood of observing positive imports of a sanctioned variety in a given quarter falling by 7.2 percentage points. Columns (4)–(6) repeat this extensive-intensive margin decomposition for product-level imports (Table 1), again yielding negative and economically sizable estimates throughout.

Second, we assess the degree to which our baseline country-product estimates are biased due to SUTVA violations, given that some non-sanctioning countries have increased their exports of sanctioned products to Russia after the invasion (see Section 5.2). We do so by re-estimating equation (1) using only country-product pairs involving sanctioning countries.[1] This restriction is likely conservative, as even non-sanctioned imports from sanctioning countries declined due to broader disruptions in logistics and finance. Nevertheless, Figure C.1 and Table C.5, columns (1)–(2), show that the estimated effects remain large and comparable to the baseline, suggesting that control group contamination is unlikely to substantially inflate our findings.

Third, we examine whether our country-product staggered DiD results are driven primarily by the first cohort of sanctioned varieties, which coincided with the outbreak of the war. If true, this would limit the ability of the staggered design to address the possibility of complex confounding war-related shocks. However, as shown in columns (3)–(4) of Table C.2, excluding this cohort leaves our estimates largely unchanged—and if anything, the magnitude of the effect increases.

Fourth, we address possible violations of the no-anticipation assumption in the country-product staggered design. While Figure 2 documents flat pretrends prior to the war—supporting this assumption for early sanctions—subsequent cohorts and sanction waves may have been at least partially anticipated. To correct for this, we augment equation (2), where for each treated flow we add additional cohort-specific coefficients for each period after February 2022 and before the

[1] Although the correlation in sanctioned product lists across sanctioning countries is imperfect (as shown in Table A.3), we omit product-quarter fixed effects in this particular specification to improve precision.

month when sanctions take effect.[2] This ensures that the omitted category consists only of pre-war months (and specifically excludes months where sanctions could have been anticipated) for all treated flows. Table C.2, columns (5)–(6), shows that the results remain robust. Aggregated to a single average, the dynamic effects of sanctions in column (5) boil down to a 66% reduction in sanctioned trade flows ($= \exp^{-1.068} - 1$), which is nearly identical to our baseline estimate of 64%.

C.2 Replicating Main Results Using UN Comtrade Data

Our baseline estimates rely on Russian customs data. This dataset has several key advantages: its granularity allows analysis at the ten-digit product code level, helping us residualize highly specific shocks to a product's demand or supply, and at the firm-product level, helping us account for possible omitted firm-specific shocks (see Appendix Section C.3). Its detailed variables also allow us to distinguish between the country of shipment and the country of production, and to analyze shipment weight in addition to shipment value. A limitation, however, is the incomplete coverage of trade flows with some members of the Eurasian Economic Union (EAEU), such as Belarus and Kazakhstan. Given the potential role of these countries in rerouting sanctioned shipments, one might be concerned that our results are significantly biased by this omission.

To address this concern, we turn to UN Comtrade data. Although more aggregated—available only at the HS6 level—and with vastly incomplete reporting of shipment weight, UN Comtrade includes trade flows within the EAEU. Russia ceased reporting to UN Comtrade after the invasion; we therefore use mirror export data, as reported by exporting countries to Russia. We process these data by converting HS6 codes into synthetic product codes following Pierce and Schott (2012) to account for the 2022 HS classification changes, and merge them with our sanctions dataset, treating a synthetic 'six-digit' product code as sanctioned if it is associated with any ten-digit code sanctioned by any country. We then reestimate our baseline specifications in equations (1) and (4) using these mirror exports data to assess whether our main results are replicated.[3]

Figures C.2 and C.3 present the UN-Comtrade-based analogs of Figures 2 and 6, respectively. Both the country–product-level and product-level estimates are fully replicated. If anything, the magnitudes of the updated estimates are slightly larger than in the main figures, corresponding to roughly 86% ($\exp^{-2} - 1$) and 39% ($\exp^{-0.5} - 1$) declines in sanctioned country-product and

[2] Specifically, we estimate

$$y_{gct} = \sum_{e} \sum_{t^* < s < e} \alpha_{es} \mathbb{1}(E_{gc} = e) \times \mathbb{1}(t = s) + \sum_{e} \sum_{s \geq e} \beta_{es} \mathbb{1}(E_{gc} = e) \times \mathbb{1}(t = s) + \tau_{gc} + \eta_{gt} + \omega_{ct} + \zeta_{gct},$$

where t^* denotes February 2022 and $\{\alpha_{es}\}$ is the set of additional coefficients.

[3] The only other necessary modification to equation (4) is that, given the higher level of aggregation in the UN Comtrade data, we include HS1–quarter rather than HS3–quarter fixed effects.

product-level imports by 2023Q4, respectively. Overall, these results indicate that our main trade-related findings—the negative impact of sanctions on imports and the incomplete ability of Russian importers to obtain sanctioned products via rerouting—are not driven by the absence of within-EAEU flows in the Russian customs data.

C.3 Impact on Firm-Level Imports of Sanctioned Products

Before estimating the pass-through of import sanctions onto Russian firms, one may want to assess whether these sanctions negatively affected *firm-level* imports. This exercise serves two key purposes. First, it establishes a firm-level first stage, crucial for interpreting the subsequent firm-level regressions. Second, it provides an additional robustness check by incorporating firm-time fixed effects, thereby addressing concerns that import sanctions may have coincided with other industry-specific shocks affecting firms that import certain types of products.

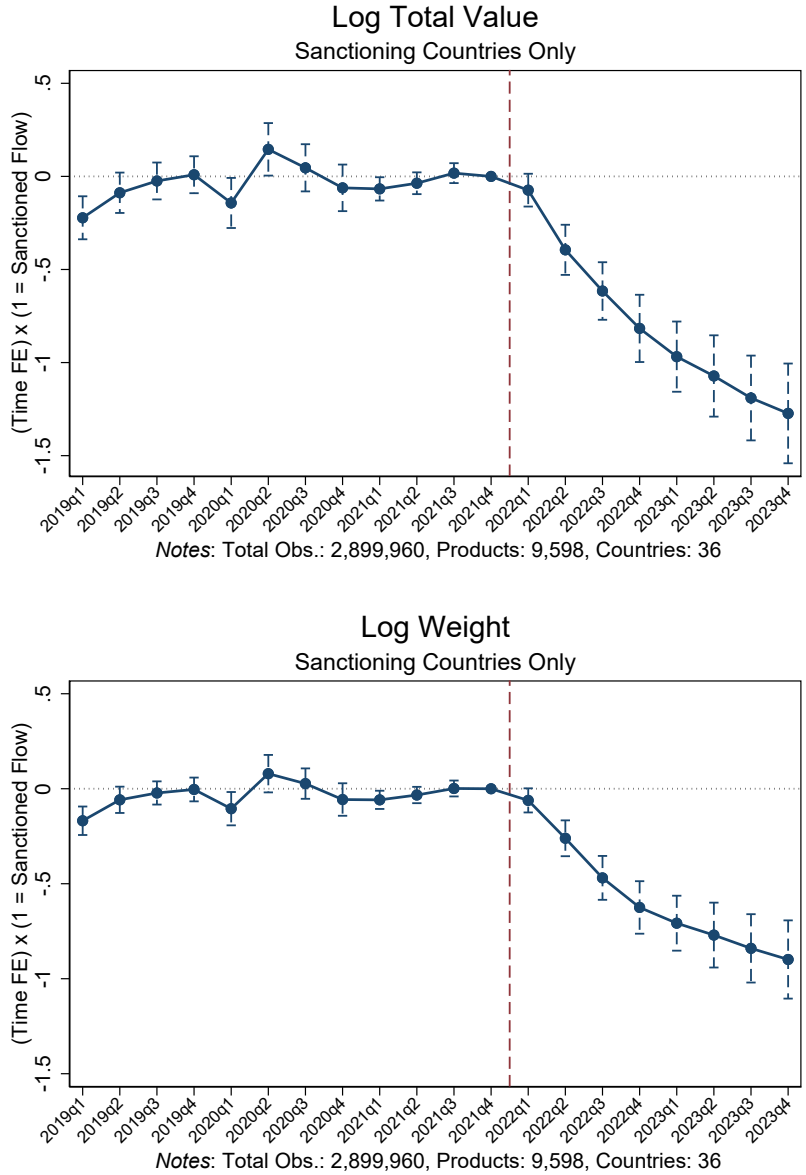
We estimate the impact of import sanctions on firms' imports via the following DiD equation:

$$y_{fgt} = \theta_t \, ImportedSanctioned_{fg(c)} + \tau_{fg} + \eta_{gt} + \omega_{ft} + \zeta_{fgt}, \tag{C1}$$

where y_{fgt} represent the total (log-)imports of product g by a Russian firm f in quarter t, measured either by total value or by total weight shipped; $ImportedSanctioned_{fg(c)}$ is an indicator that equals 1 if, before the war, a firm f imported product g from a country c that later imposed sanctions on its exports of that product to Russia. The specification includes firm-product fixed effects (τ_{fg}), product-quarter fixed effects (η_{gt}), and firm-quarter fixed effects (ω_{ft}), with the latter accounting for any firm-level shocks that may influence its imports independent of the product type. The standard errors are clustered at the product-firm level.

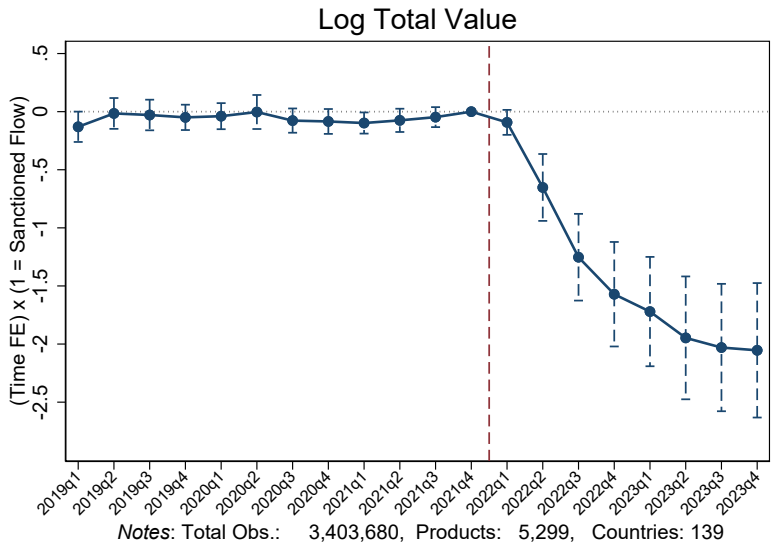
Figure C.4 presents the results. Following the war's onset, the firm's total imports of products where at least some of firm-product flow came from country-product varieties that were later sanctioned decreased by 10–15% in value and 5–10% in weight relative to other firm-product import flows. These estimates suggest that firms were unable to fully compensate for the increased difficulty of importing sanctioned products. As a result, we may indeed expect import sanctions to have a non-negligible pass-through effect on domestic production.

Figure C.1: The Impact on Russian Imports of Sanctioned Country-Product Varieties, Sanctioning Countries Only



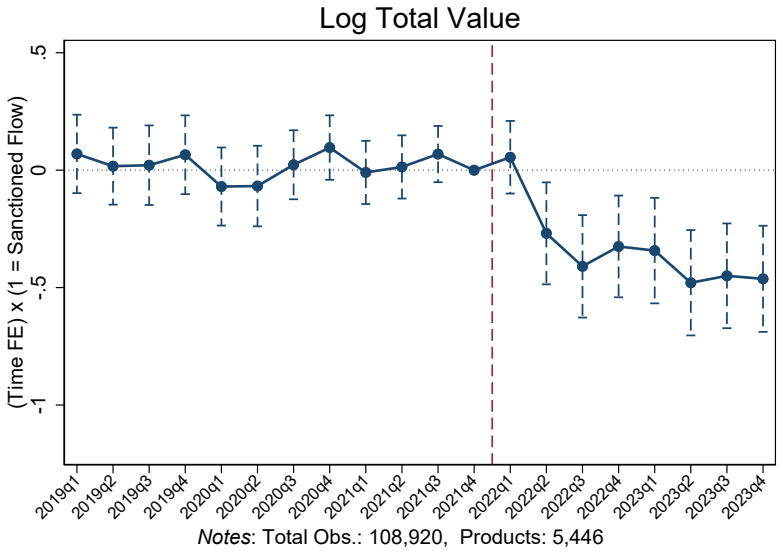
Notes: These figures explore whether the decline in sanctioned imports is present even within a subsample of 'enemy' countries, i.e., those that ever imposed trade sanctions on Russia. Specifically, they present the dynamic difference-in-differences estimates of Equation (1) comparing the volume of sanctioned 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 red vertical line indicates the start of the war. 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 add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure C.2: The Impact on Sanctioned Country-Product Imports, UN Comtrade



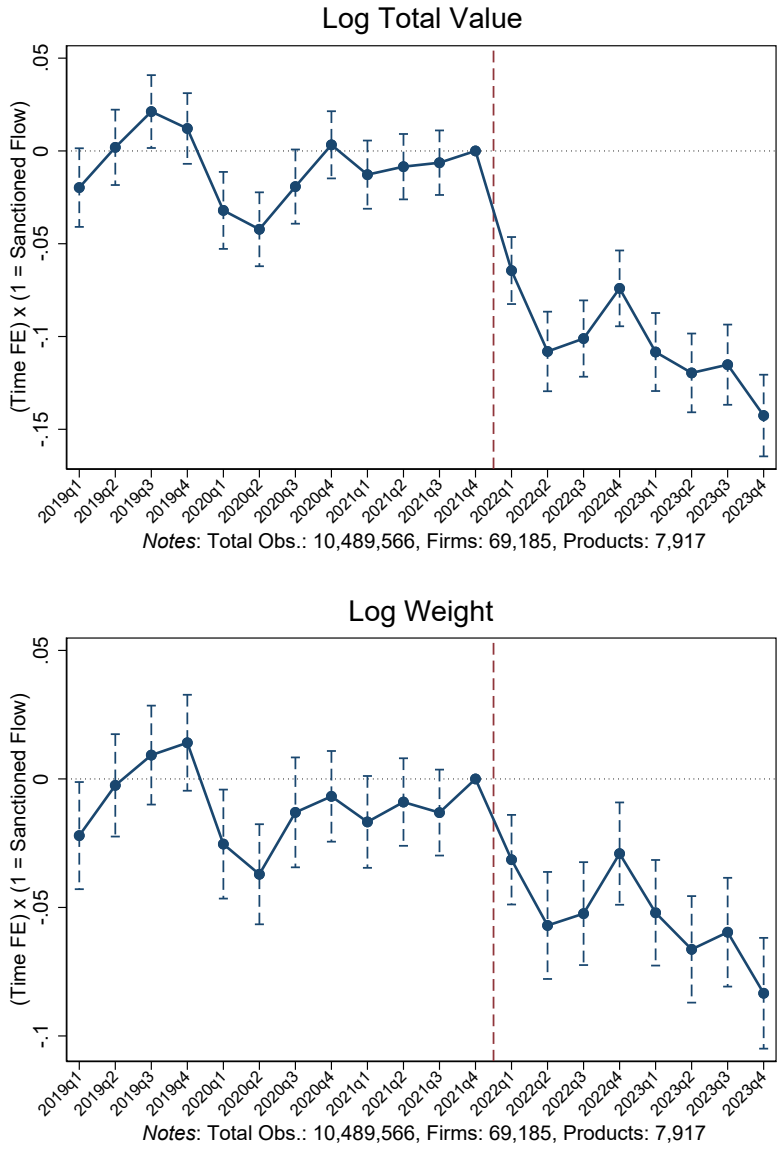
Notes: This figure assesses the impact of sanctions on the imports of sanctioned country-product varieties, using mirror exports data from UN Comtrade instead of the Russian customs data. It presents the dynamic difference-in-differences estimates of equation (1), comparing the volume of sanctioned country-product imports to that of non-sanctioned imports before and after the war's onset. Here, products refer to *six* digit HS codes (the lowest level of aggregation in UN Comtrade data) unless they needed to be aggregated due to changes in HS classification over time following Pierce and Schott (2012). The data is aggregated quarterly, with 2021Q4 serving as the baseline period. The red vertical line indicates the start of the war. The figure uses the total import value of a given product in a given quarter as an outcome; a net-weight counterpart is omitted due to reporting inconsistencies in UN Comtrade data. The logarithms add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure C.3: The Impact on Russian Imports of Sanctioned Products, UN Comtrade



Notes: This figure assesses the impact of sanctions on the total imports of sanctioned products, using mirror exports data from UN Comtrade instead of the Russian customs data. Specifically, it presents the dynamic difference-in-differences estimates of equation (4), comparing the volume of sanctioned product imports to that of non-sanctioned imports before and after the war's onset. Here, products refer to *six* digit HS codes (the lowest level of aggregation in UN Comtrade data) unless they needed to be aggregated due to changes in HS classification over time following Pierce and Schott (2012). The regression accounts for HS1-quarter fixed effects. The data is aggregated at the quarterly level, with 2021Q4 serving as the baseline period. The red vertical line indicates the start of the war. The figure uses the total import value of a given product in a given quarter as an outcome; a net-weight counterpart is omitted due to reporting inconsistencies in UN Comtrade data. The logarithms add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered at the product level.

Figure C.4: The Impact on Russian Firm-Level Imports of Sanctioned Products



Notes: These figures assess the impact of sanctions on the imports of exposed products for each specific firm. Specifically, they display the estimates comparing the import volume for exposed firm-products to that of non-exposed firm-products before and after the first quarter of 2022. Exposed firm-products are those later-sanctioned ten-digit HS codes, which a firm imported from a sanctioning country at least once prior to 2022. An HS code that was always imported from a non-sanctioning country is not exposed. This specification control for any firm-level shocks that take place at the same time as sanctions. The specification additionally controls for product-by-time fixed effects. The data is at the quarterly level. The red vertical line indicates the start of the war. The top (bottom) figure uses the total import value (net weight) of a given product in a given quarter as an outcome. The logarithms add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered at the product-by-firm level.

Table C.1: The Impact on Russian Imports of Sanctioned Country-Product Varieties

	(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
Post-War × Sanctioned Flow	-2.155***	-1.551***	-2.422***	-1.631***	-0.765***	-0.546***	-0.962***	-0.667***
	(0.164)	(0.116)	(0.336)	(0.236)	(0.083)	(0.066)	(0.133)	(0.089)
Product-Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Product-Quarter FE			✓	✓			✓	✓
Country-Quarter FE					✓	✓	✓	✓
Mean Dep. Var.	3.55	2.46	3.56	2.46	3.55	2.46	3.56	2.46
SD Dep. Ver.	5.06	3.96	5.06	3.96	5.06	3.96	5.06	3.96
Observations	5,092,100	5,092,100	5,076,360	5,076,360	5,091,960	5,091,960	5,076,220	5,076,220
Number of Countries	221	221	221	221	214	214	214	214
Number of Products	10,273	10,273	9,486	9,486	10,273	10,273	9,486	9,486

Notes: This table presents the estimates of equation (1) studying whether imports into Russia at the product-country-quarter level declined following the onset of the Russian invasion of Ukraine in 2022, depending on whether that product-country variety was later sanctioned. The outcome variable in the even-numbered columns is the log of total value imported, while in the odd-numbered columns, it is the log of total weight imported. The logarithms add 1 to the argument's value to avoid missing values. The time span is from 2017Q1 through 2023Q4. Products refer to ten digit HS codes, unless they were aggregated due to changes in HS classification following Pierce and Schott (2012). Standard errors in parentheses are two-way clustered at the country and product levels. * p<0.1, ** p<0.05, *** p<0.01.

Table C.2: The Impact on Russian Imports of Sanctioned Country-Product Varieties or Sanctioned Products, Staggered Design

	(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
Post-Treatment × Treated Flow	-1.014***	-0.644***	-1.178***	-0.912***	-1.068***	-0.690***	-0.196**	-0.182*
	(0.136)	(0.099)	(0.113)	(0.121)	(0.138)	(0.097)	(0.078)	(0.094)
Product-Country FE	✓	✓	✓	✓	✓	✓		
Product-Month FE	✓	✓	✓	✓	✓	✓		
Country-Month FE	✓	✓	✓	✓	✓	✓		
No First Cohort			✓	✓				
Anticipation Allowed					✓	✓		
Product FE							✓	✓
3-Digit Product-Month FE							✓	✓
Observations	10,132,992	10,132,992	8,192,304	8,192,304	7,599,744	7,599,744	465,600	465,600
Number of Products	8,930	8,930	8,702	8,702	8,930	8,930	9,700	9,700
Number of Countries	197	197	197	197	197	197	—	—

Notes: This table examines the effect of sanctions on imports of sanctioned country-product varieties (columns 1–6), as well as the effect of sanctions on the imports of sanctioned products from any country (columns 7 and 8). Specifically, the first two columns present the estimates of equation (2), and the last two columns present the estimates of the corresponding product-level equation. Columns (3) and (4) estimate equation (2) without the first cohort, and columns (5) and (6) estimate the more conservative version of equation (2) from footnote 2, where sanctions are allowed to be anticipated after February 2022. All estimates are aggregated across cohorts and months into a single non-dynamic average coefficient. For the last two columns, the first date of imposed sanctions is used as the treatment date for a product. The outcome variable in the even-numbered columns is the log of total value imported, while in the odd-numbered columns, it is the log of total weight imported. The logarithms add 1 to the argument's value to avoid missing values. Products refer to ten-digit HS codes, unless they were aggregated due to changes in HS classification following Pierce and Schott (2012). Standard errors in parentheses are two-way clustered at the country and product levels. * p<0.1, ** p<0.05, *** p<0.01.

Table C.3: The Impact on Russian Imports of Sanctioned Country-Product Varieties, Accounting for Substitution and Rerouting via Friendly Countries

	(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
Post-War × Sanctioned Flow	-2.155***	-1.551***	-1.796***	-1.240***	-0.765***	-0.546***	-0.841***	-0.610***
	(0.164)	(0.116)	(0.312)	(0.219)	(0.083)	(0.066)	(0.120)	(0.082)
Post-War × Sanctioned Product × × Friendly Country	1.767***	1.023***	2.258***	1.410***	0.927***	0.516***	0.867***	0.416***
	(0.358)	(0.237)	(0.443)	(0.291)	(0.124)	(0.050)	(0.154)	(0.066)
Product-Country FE	✓	✓	✓	✓	✓	✓	✓	✓
Product-Quarter FE			✓	✓			✓	✓
Country-Quarter FE					✓	✓	✓	✓
Mean Dep. Var.	3.55	2.46	3.56	2.46	3.55	2.46	3.56	2.46
SD Dep. Ver.	5.06	3.96	5.06	3.96	5.06	3.96	5.06	3.96
Observations	5,092,100	5,092,100	5,076,360	5,076,360	5,091,960	5,091,960	5,076,220	5,076,220
Number of Countries	221	221	221	221	214	214	214	214
Number of Products	10,273	10,273	9,486	9,486	10,273	10,273	9,486	9,486

Notes: This table examines whether imports into Russia at the product-country-quarter level declined following the onset of the Russian invasion of Ukraine in 2022, even accounting for substitution and rerouting through countries that remained relatively friendly to the Russian regime. Specifically, it presents the estimates of equation (1), modified to include an additional interaction term capturing whether a given country-product import flow involved a product that was ever sanctioned and originated from a friendly country, interacted with a post-war indicator. Friendly countries are defined as Armenia, Belarus, China, Georgia, Hong Kong, Kazakhstan, Kyrgyzstan, Serbia, Turkey, and the UAE. The outcome variable in the even-numbered columns is the log of total value imported, while in the odd-numbered columns, it is the log of total weight imported. The logarithms add 1 to the argument's value to avoid missing values. The time span is from 2017Q1 through 2023Q4. Product codes refer to ten digit HS codes, unless they needed to be aggregated due to changes in HS classification over time following Pierce and Schott (2012). Standard errors in parentheses are two-way clustered at the country and product levels. * p<0.1, ** p<0.05, *** p<0.01.

Table C.4: The Impact on Russian Imports of Sanctioned Country-Product Varieties or Sanctioned Products, Extensive and Intensive Margin

	(1)	(2)	(3)	(4)	(5)	(6)
	Country-Product Level			Product Level		
	𝟙[Import>0]	Log Total Value (If Nonzero)	Log Total Weight (If Nonzero)	𝟙[Import>0]	Log Total Value (If Nonzero)	Log Total Weight (If Nonzero)
Post-War × Sanctioned Flow	-0.072***	-0.596***	-0.580***	-0.017**	-0.137***	-0.142***
	(0.012)	(0.106)	(0.117)	(0.006)	(0.031)	(0.036)
Product-Country FE	✓	✓	✓			
Product-Quarter FE	✓	✓	✓			
Country-Quarter FE	✓	✓	✓			
Product FE				✓	✓	✓
3-Digit Product-Quarter FE				✓	✓	✓
Mean Dep. Var.	0.36	9.89	6.73	0.79	13.08	10.84
SD Dep. Var.	0.48	3.01	3.95	0.41	2.93	3.65
Observations	5,076,220	1,767,378	1,765,701	205,460	160,184	160,136
Number of Products	9,486	7,992	7,989	10,273	9,419	9,417
Number of Countries	214	173	173	—	—	—

Notes: This table examines whether the observed decline in sanctioned imports is driven primarily by the extensive or intensive margin. Columns (1)–(3) present the analysis at the country-product level, while columns (4)–(6) focus on the product level estimates. Columns (1) and (4) repeat the baseline estimation at their respective levels but use indicators for non-zero imports in a given quarter as the outcome variables. Columns (2)–(3) and (5)–(6) restrict the sample to only periods with nonzero imports, omitting observations where imports were entirely absent. The logarithms add 1 to the argument's value to avoid missing values. Products refer to ten digit HS codes, unless they were aggregated due to changes in HS classification following Pierce and Schott (2012). Standard errors, reported in parentheses, are two-way clustered at the country and product levels in columns (1)–(3) and at the product level in columns (4)–(6). * p<0.1, ** p<0.05, *** p<0.01.

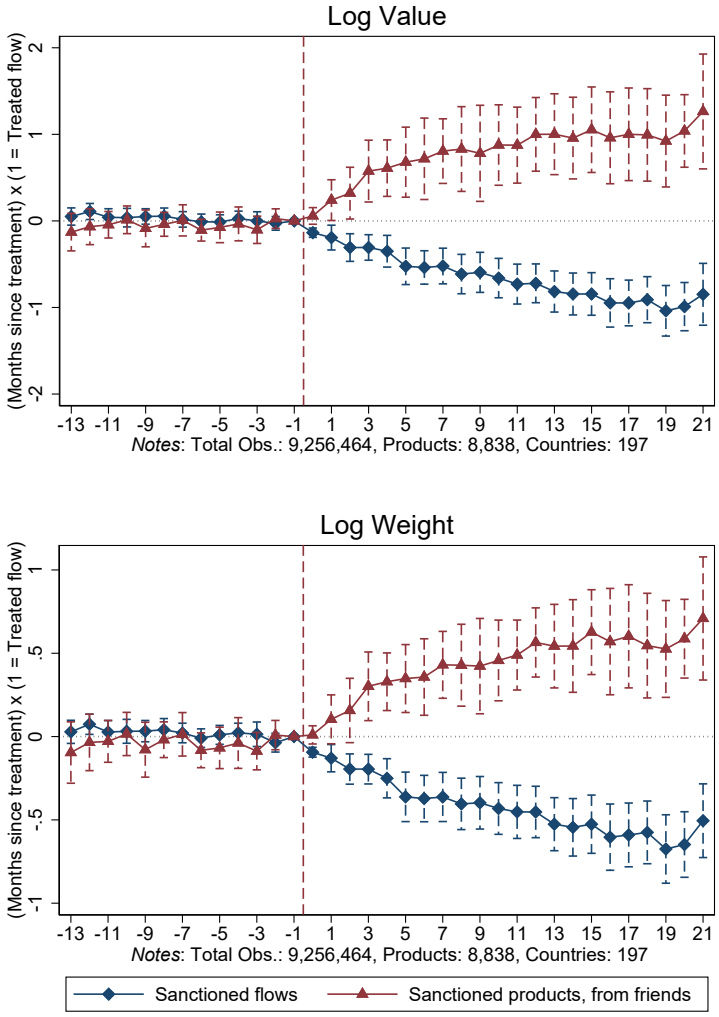
Table C.5: The Impact on Russian Imports of Sanctioned Country-Product Varieties or Sanctioned Products, Friends and Enemies Separately

	(1) Log Total Value	(2) Log Total Weight	(3) Log Total Value	(4) Log Total Weight
	Enemy Countries		*Friendly Countries*	
Post-War × Sanctioned Flow	-0.765***	-0.546***		
	(0.084)	(0.067)		
Post-War × Sanctioned Product			0.927***	0.516***
			(0.130)	(0.053)
Country-Quarter FE	✓	✓	✓	✓
Product-Country FE	✓	✓	✓	✓
Mean Dep. Var.	4.11	2.78	4.44	3.34
SD Dep. Ver.	5.18	3.99	5.67	4.72
Observations	2,899,960	2,899,960	664,260	664,260
Number of Countries	36	36	10	10
Number of Products	9,598	9,598	8,636	8,636

Notes: This table assesses the robustness of our estimates on the impact of trade sanctions on sanctioned imports. Columns (1)–(2) examine whether the effect of trade sanctions on sanctioned trade flows persists when restricting the sample to only the countries that imposed the sanctions. Columns (3)–(4) analyze whether the increase in imports of sanctioned products from friendly countries remains significant even when restricting the sample to only those friendly countries. Friendly countries are defined as Armenia, Belarus, China, Georgia, Hong Kong, Kazakhstan, Kyrgyzstan, Serbia, Turkey, and the UAE. The outcome variable in the even-numbered columns is the log of total value imported, while in the odd-numbered columns, it is the log of total weight imported. The logarithms add 1 to the argument's value to avoid missing values. Product codes refer to ten digit HS codes, unless they needed to be aggregated due to changes in HS classification over time following Pierce and Schott (2012). Standard errors in parentheses are two-way clustered at the country and product levels. * p<0.1, ** p<0.05, *** p<0.01.

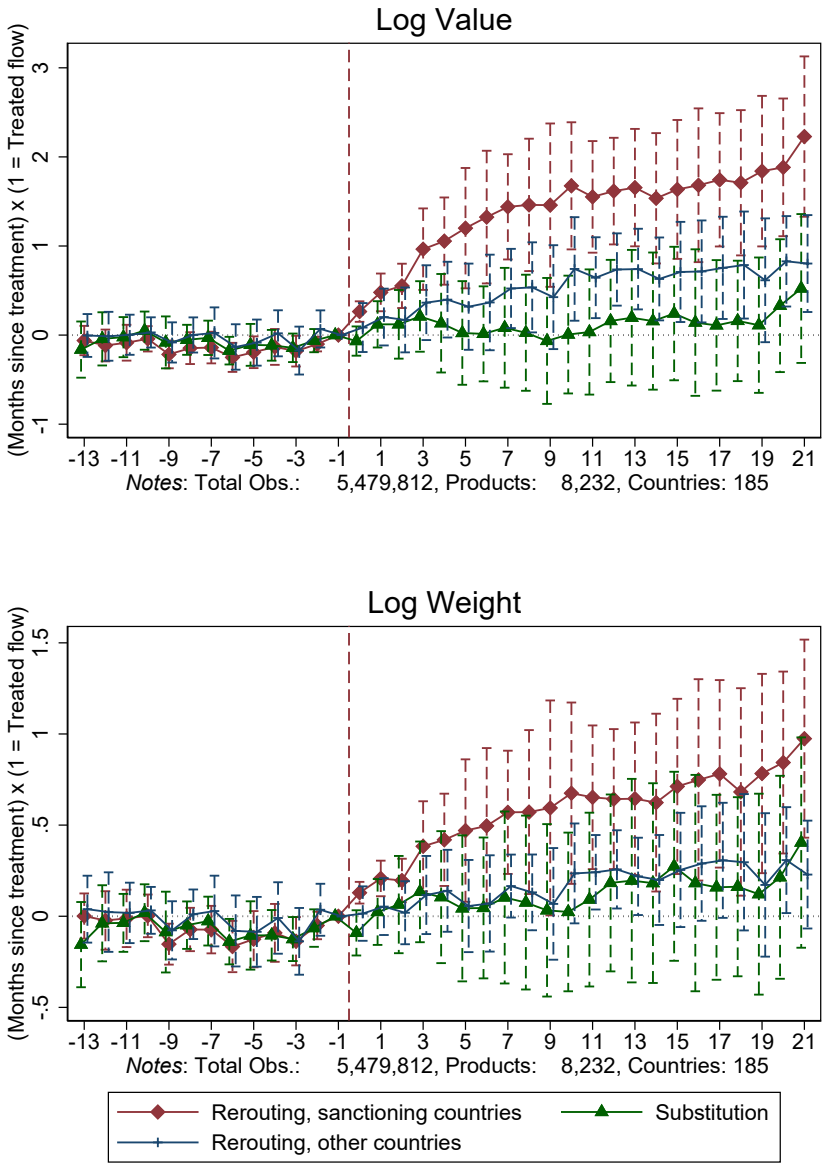
C.4 Additional Staggered DiD Figures

Figure C.5: The Impact on Russian Imports of Sanctioned Country-Product Varieties, Accounting for Substitution and Rerouting via Friendly Countries, Staggered Design



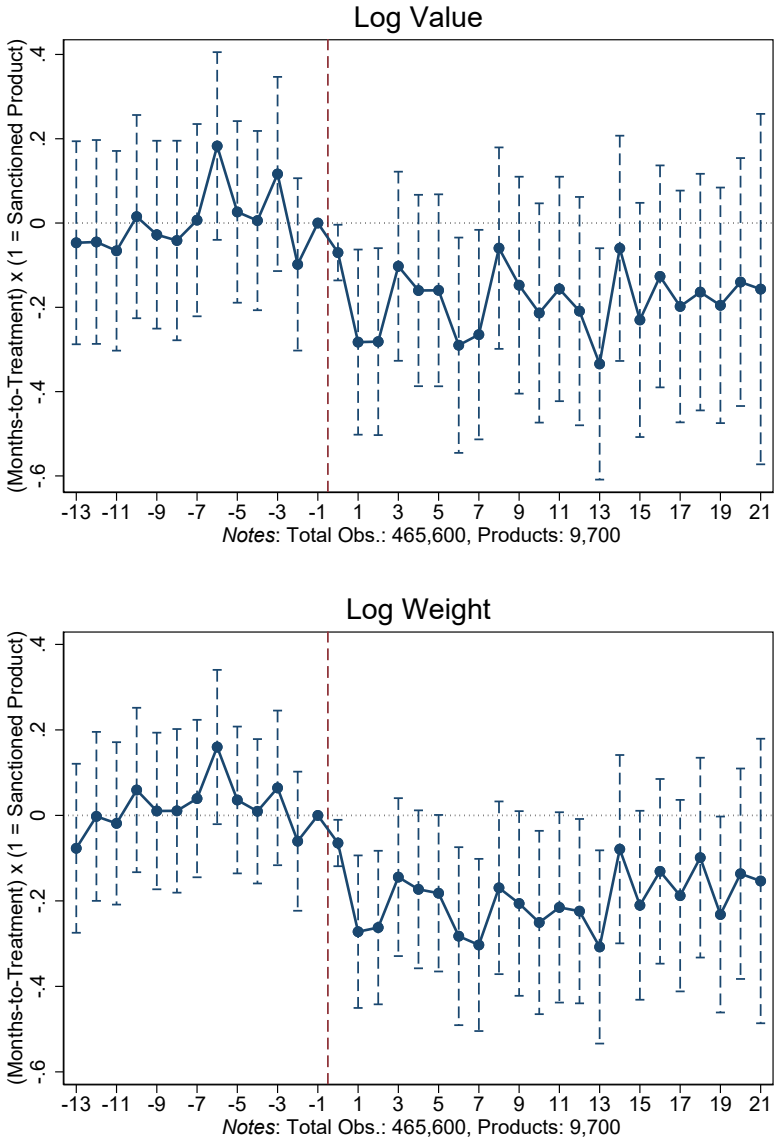
Notes: These figures investigate the presence of substitution to and rerouting through third countries, in a staggered DiD design. Specifically, each figure combines results from two separate regressions: one estimates the impact of import sanctions on sanctioned flows (in blue), and the other estimates the impact of the same sanctions on sanctioned products from friendly countries (in red). In either regression, only one treated group is included, while the non-sanctioned imports from third countries always serve as a control group. Pre-trend coefficients are estimated based on separate regressions, where all treated observations are omitted. An import of a particular product from friendly countries becomes treated during the month when the first sanctioning country imposes sanctions on the same product. Friendly countries are defined as Armenia, Belarus, China, Georgia, Hong Kong, Kazakhstan, Kyrgyzstan, Serbia, Turkey, and the UAE. The data is aggregated at the monthly level, and the estimates are aggregated across cohorts at the time level. The red vertical line indicates the start of the war. The top (bottom) figure uses the total import value (net weight) of a given product from a given country in a given month as an outcome. The logarithms add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure C.6: Decomposing Substitution vs. Rerouting via Friendly Countries, Staggered Design



Notes: These figures disentangle the effect of substitution to and rerouting through friendly countries, in a staggered DiD design. Specifically, each import flow of the sanctioned products from friendly countries is separated into three flows: those produced within the same friendly country (in green), those produced in sanctioning countries (in red), and those produced elsewhere (in blue). The impact of import sanctions is estimated on each of these flows, with the non-sanctioned imports from third countries serving as a control group. Directly sanctioned flows from sanctioning countries are not included in the estimation sample. Pre-trend coefficients are estimated based on a separate regression, where all treated observations are omitted. An import of a particular product from friendly countries becomes treated during the month when the first enemy country imposes sanctions on the same product. Friendly countries are defined as Armenia, Belarus, China, Georgia, Hong Kong, Kazakhstan, Kyrgyzstan, Serbia, Turkey, and the UAE. The data is aggregated at the monthly level, and the estimates are aggregated across cohorts at the time level. The red vertical line indicates the start of the war. The top (bottom) figure uses the total import value (net weight) of a given product from a given country in a given month as an outcome. The logarithms add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered two-way by country and product levels.

Figure C.7: The Impact on Russian Imports of Sanctioned Products, Staggered Design



Notes: These figures assess the impact of sanctions on the total imports of sanctioned products, in a staggered DiD design. Specifically, they display the estimates comparing the import volume for sanctioned products to that of non-sanctioned products before and after the imposition of first sanctions on the former. The data is aggregated at the monthly level, and the estimates are aggregated across cohorts at the time level. Pre-trend coefficients are estimated based on a separate regression, where all treated observations are omitted. Products refer to ten digit HS codes, unless they needed to be aggregated due to changes in HS classification over time following Pierce and Schott (2012). The red vertical line indicates the start of the war. The top (bottom) figure uses the total import value (net weight) of a given product in a given quarter as an outcome. The logarithms add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered at the product level.

D Impact on Exposed Firms: Robustness and Additional Results

D.1 Robustness Checks

This appendix discusses in greater detail the robustness checks for the impact of import sanctions on exposed Russian firms introduced in Section 6.

Table D.1 demonstrates that the baseline effects on exposed firms' sales remain stable after controlling for increasingly stringent sets of controls. Column (1) starts with firm and year $\times$ importer fixed effects. Column (2) adds year $\times$ exporter and year $\times$ industry (i.e., two-digit OKVED category) fixed effects, and column (3) adds the yearly fixed effects interacted with an indicator for whether a firm was ever subject to targeted sanctions. Column (4) adds flexible controls for whether a firm imported any sanctioned products separately from friendly or neutral countries before the war, and column (5) further flexibly accounts for whether a firm had a railway-connected buyer or supplier that was exposed to import sanctions. Across all specifications, the main coefficient remains large, negative, and statistically significant, with estimates ranging from –0.093 to –0.149. These results suggest that the estimated decline in sales among exposed firms is not driven by other concurrent wartime exposures, reinforcing the interpretation that the effects are caused by disruptions in access to key inputs from sanctioning countries.

Table D.2 further shows robustness to alternative sample definitions, addressing concerns related to sample composition and firms' entry and exit. Columns (1)–(2) present the baseline specification; columns (3)–(4) restrict the sample to a balanced panel of firms with non-missing revenue data in every year from 2017 to 2023; columns (5)–(6) exclude firms that entered the dataset only after the war; while columns (7)–(8) exclude firms that exited in the first year of the war (i.e., those with no observations in 2022 or 2023). Across all sample definitions, we continue to find a large and statistically significant negative effect of import sanctions on firm revenue and total cost of goods sold. The coefficient estimates range from –0.101 to –0.150, corresponding to a 9.6–13.9% decline in firm output, depending on the outcome and subsample considered.

Table D.1: The Impact of Import Sanctions on Exposed Firms' Sales
Controlling for Other Types of Exposure

	(1)	(2)	(3)	(4)	(5)
			Log Sales		
Post-2022 × Exposed to Enemies	-0.149***	-0.138***	-0.137***	-0.093***	-0.095***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Firm FE	✓	✓	✓	✓	✓
Year-Importer FE	✓	✓	✓	✓	✓
Year-Exporter FE		✓	✓	✓	✓
Year-Industry FE			✓	✓	✓
Year-Target Sanctioned FE			✓	✓	✓
Post × Imported Sanctioned Products from Friends				✓	✓
Post × Imported Sanctioned Products from Neutrals				✓	✓
Post × Supplier / Buyer Exposed to Import Sanctions					✓
Mean Dep. Var.	15.91	15.91	15.91	15.91	15.91
SD Dep. Ver.	2.29	2.29	2.29	2.29	2.29
Observations	10,608,115	10,608,115	10,597,168	10,597,168	10,597,168
Number of Firms	2,183,481	2,183,481	2,178,204	2,178,204	2,178,204

Notes: This table explores the robustness of the baseline estimates of sanctions' impact on firm revenue by gradually adding fixed effects and controls. A firm is considered exposed if, prior to the war, it imported any country-product variety that was later sanctioned. Column (1) reports the estimates with only firm and year × importer fixed effects. Column (2) adds year × exporter fixed effects. Column (3) further adds year × industry and year × target sanctioned FEs, which correspond to baseline specification in Table 2. Columns (4) and (5) control for firms' prewar imports of sanctioned products from friendly and neutral countries interacted with the post-2022 indicator. Column (5) further controls for whether firms' buyers and suppliers (identified in the railway shipment data) separately were exposed to import sanctions, interacted with the post-2022 indicator. The dependent variable in all columns is the logarithm of yearly sales in Russian rubles from 2017 through 2023. Standard errors in parentheses are clustered at the firm level. * p<0.1, ** p<0.05, *** p<0.01.

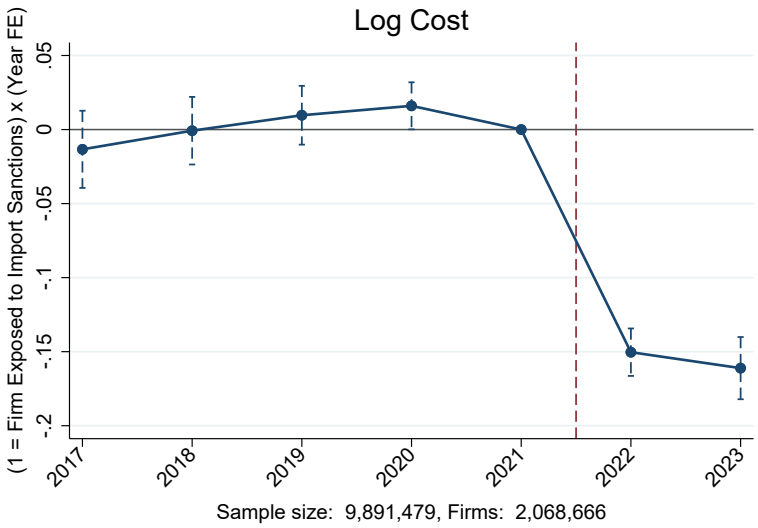
Table D.2: The Impact of Import Sanctions on Exposed Firms' Output, Robustness to Various Sample Definitions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline Sample		Balanced Panel		No Entrants		No Exiteers	
	Log Sales	Log Total Cost of Goods Sold	Log Sales	Log Total Cost of Goods Sold	Log Sales	Log Total Cost of Goods Sold	Log Sales	Log Total Cost of Goods Sold
Post-2022 × Exposed to Import Sanctions	-0.137***	-0.147***	-0.101***	-0.109***	-0.137***	-0.147***	-0.139***	-0.150***
	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Importer FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Exporter FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Industry FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Target Sanctioned FE	✓	✓	✓	✓	✓	✓	✓	✓
Mean Dep. Var.	15.91	15.85	16.35	16.22	15.92	15.86	16.06	15.97
SD Dep. Ver.	2.29	2.24	2.12	2.12	2.29	2.24	2.23	2.19
Observations	10,597,168	9,881,593	5,404,462	5,100,393	10,388,120	9,685,123	8,690,711	8,149,879
Number of Firms	2,178,204	2,063,893	772,066	748,058	2,073,680	1,965,658	1,542,394	1,481,566

Notes: This table examines the robustness of the impact of import sanctions on the performance of the exposed Russian firms to focusing on alternative sample definitions. Specifically, it presents the non-dynamic version of the estimates of equation (5), comparing revenues and cost of goods sold of firms exposed to the import sanctions and not, before and after the war's onset. A firm is considered exposed if, prior to the war, it imported any country-product variety that was later sanctioned. All dependent variables are denominated in the logarithm of Russian rubles. Columns (1) and (2) show the results for the baseline sample. Columns (3) and (4) focus on the fully-balanced panel of firms that reported revenue each year in 2017–2023. Columns (5) and (6) drop all firms that have observations only after the war starts. Finally, columns (7) and (8) drop the firms that exit after the war, i.e., do not have observations after the war's onset. Standard errors in parentheses are clustered at the firm level. * p<0.1, ** p<0.05, *** p<0.01.

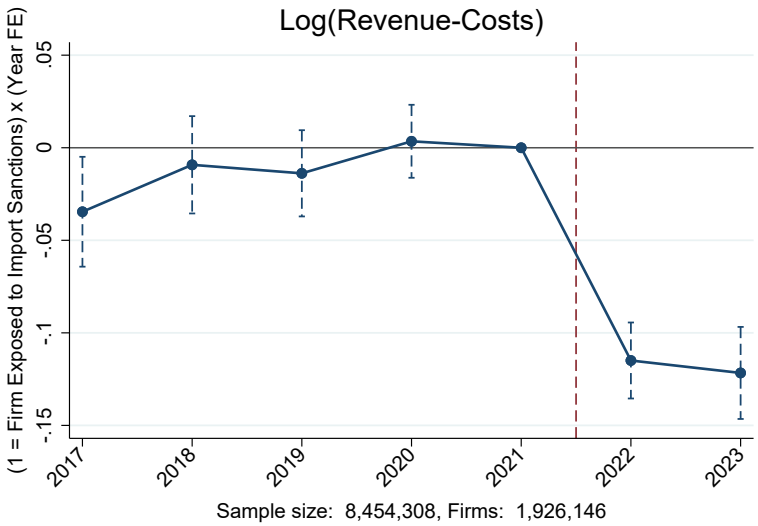
D.2 Additional Results

Figure D.1: The Impact of Import Sanctions on Exposed Firms' Total Cost of Goods Sold



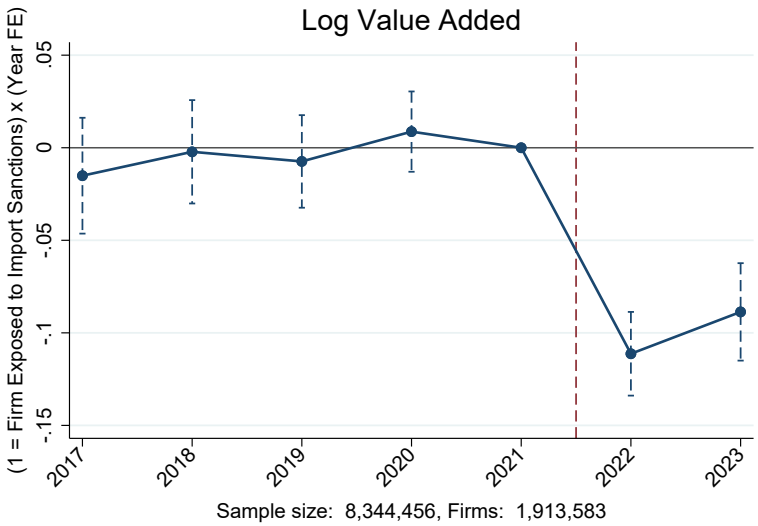
Notes: This figure examines the impact of import sanctions on the total cost of goods sold of firms that, prior to the war, imported any country-product variety that was later sanctioned. Specifically, it presents the dynamic difference-in-differences estimates of Equation (5), which compares firm revenues between firms with and without prewar exposure to future import sanctions, before and after the war's onset. The outcome data are presented at the yearly level, with 2021 serving as the baseline period. The red vertical line indicates the start of the war. The bars represent 95% confidence intervals. Standard errors are clustered at the firm level.

Figure D.2: The Impact of Import Sanctions on Exposed Firms' Gross Profits



Notes: This figure examines the impact of import sanctions on gross profits (revenues minus cost of goods sold) of firms that, prior to the war, imported any country-product variety that was later sanctioned. Specifically, it presents the dynamic difference-in-differences estimates of Equation (5), which compares firm revenues between firms with and without prewar exposure to future import sanctions, before and after the war's onset. The outcome data are presented at the yearly level, with 2021 serving as the baseline period. The red vertical line indicates the start of the war. The bars represent 95% confidence intervals. Standard errors are clustered at the firm level.

Figure D.3: The Impact of Import Sanctions on Exposed Firms' Value Added



Notes: This figure examines the impact of import sanctions on the value added, calculated from revenues minus material costs, of firms that, prior to the war, imported any country-product variety that was later sanctioned. Specifically, it presents the dynamic difference-in-differences estimates of Equation (5), which compares firm revenues between firms with and without prewar exposure to future import sanctions, before and after the war's onset. The outcome data are presented at the yearly level, with 2021 serving as the baseline period. The red vertical line indicates the start of the war. The bars represent 95% confidence intervals. Standard errors are clustered at the firm level.

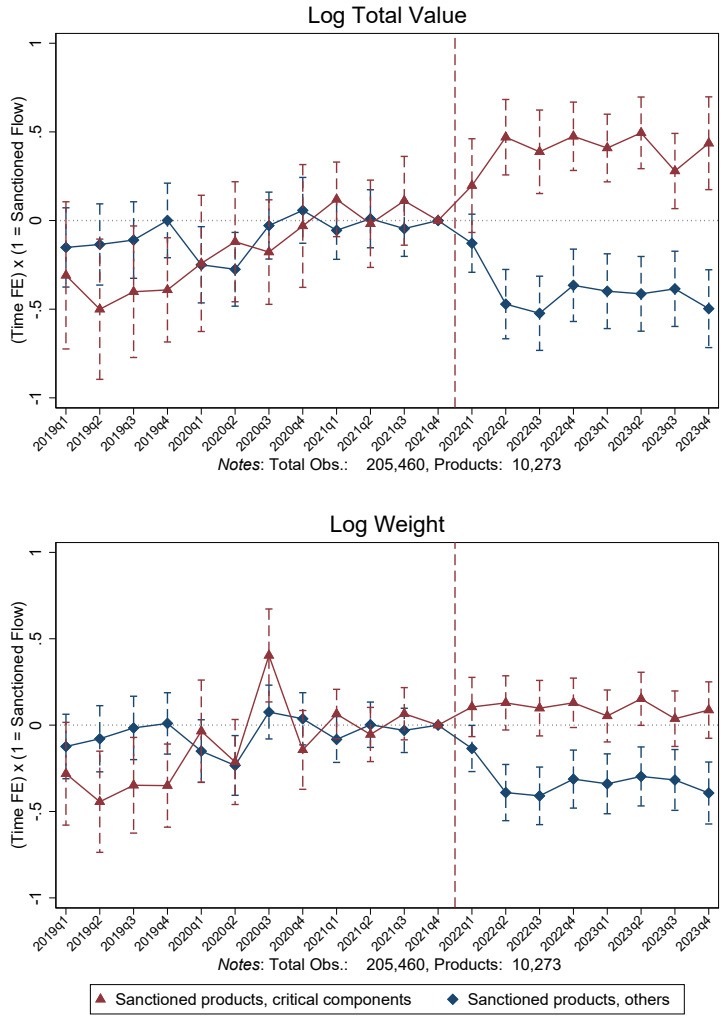
Table D.3: The Impact of Import Sanctions on Exposed Russian Firms, By Industry

	(1) Log Sales	(2) Log Total Cost of Goods Sold	(3) Log Gross Profit	(4) Log Capital Costs	(5) Log Labor Costs	(6) Log Materials Costs	(7) 𝟙[Sales Missing]	(8) Log Sales (Zeroes if Missing)
Post-2022 × Exposed	-0.121***	-0.123***	-0.210***	-0.143***	-0.037*	-0.117***	-0.012***	-0.088
to Import Sanctions	(0.020)	(0.020)	(0.022)	(0.023)	(0.021)	(0.026)	(0.005)	(0.093)
Post-2022 × Exposed	0.058***	0.029	0.124***	0.043*	-0.021	0.033	0.089***	-1.656***
to Import Sanctions × Manufacturing	(0.022)	(0.021)	(0.024)	(0.024)	(0.022)	(0.028)	(0.005)	(0.113)
Post-2022 × Exposed	-0.046**	-0.056***	0.117***	0.121***	-0.090***	-0.074***	0.003	-0.122
to Import Sanctions × Wholesale	(0.020)	(0.020)	(0.022)	(0.025)	(0.021)	(0.027)	(0.005)	(0.095)
Post-2022 × Exposed	0.015	0.058*	0.085**	0.042	-0.159***	-0.065	0.034***	-0.409**
to Import Sanctions × Transportation	(0.035)	(0.034)	(0.041)	(0.046)	(0.036)	(0.050)	(0.008)	(0.166)
Post-2022 × Exposed	-0.072*	-0.041	0.038	0.106**	-0.075*	-0.168***	0.049***	-1.068***
to Import Sanctions × Science and Tech	(0.038)	(0.037)	(0.043)	(0.047)	(0.043)	(0.054)	(0.009)	(0.179)
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Importer FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Exporter FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Industry FE	✓	✓	✓	✓	✓	✓	✓	✓
Year-Target Sanctioned FE	✓	✓	✓	✓	✓	✓	✓	✓
Mean Dep. Var.	15.91	15.85	13.98	14.40	15.38	17.14	0.24	11.06
SD Dep. Ver.	2.29	2.24	2.40	2.59	2.37	2.72	0.43	7.57
Observations	10,597,168	9,881,593	8,447,082	4,620,059	1,377,628	1,433,613	15,247,428	15,245,129
Number of Firms	2,178,204	2,063,893	1,922,658	979,529	323,064	338,753	2,178,204	2,178,202

Notes: This table examines the impact of import sanctions on the performance of exposed Russian firms, allowing for heterogeneity across five industry groups: manufacturing, wholesale, transportation, science and technology, and all others (the omitted category). The estimates are based on a triple-difference specification that builds on equation (5), adding interactions between a post-2022 indicator and industry group indicators. Year-by-industry fixed effects are included as part of the baseline specification. A firm is considered exposed if prior to the war, it imported any country-product variety that was later sanctioned. With the exception of the missing sales indicator, all dependent variables are in logarithms of Russian rubles. The firm outcome variables come at the yearly level from 2017 through 2023. Standard errors in parentheses are clustered at the firm level. * p<0.1, ** p<0.05, *** p<0.01.

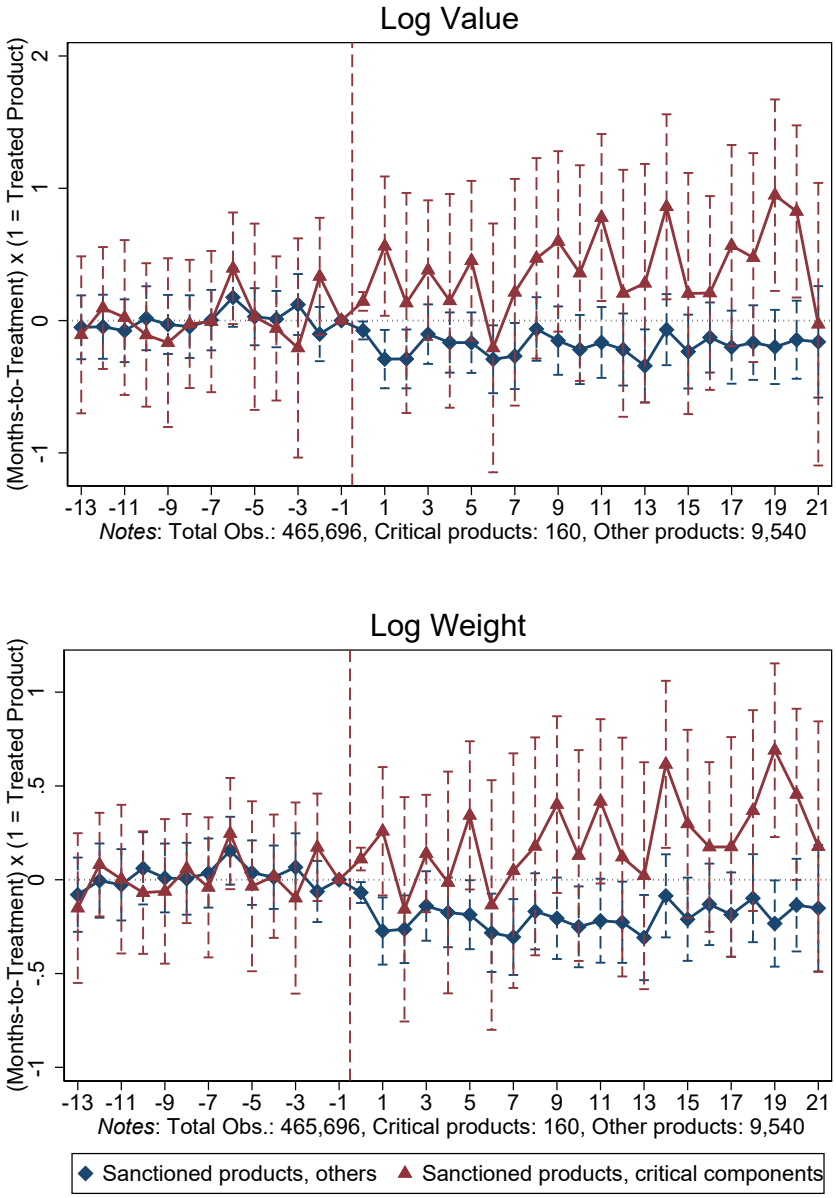
E Impact on Military Supply Chains: Figures and Tables

Figure E.1: The Impact on Russian Imports of Sanctioned Products, Critical Components vs. Others



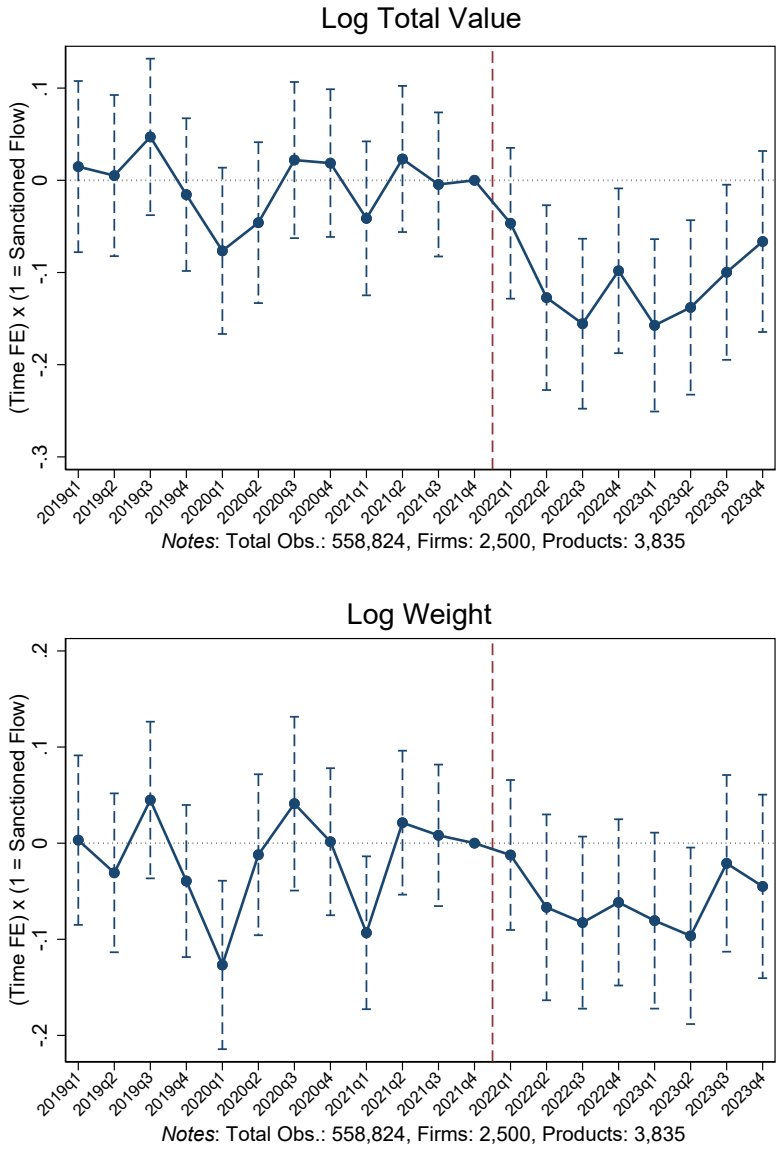
Notes: These figures assess the impact of sanctions on the total imports of sanctioned products, independent of the importing country's identity, distinguishing between critical components and other sanctioned goods. Critical components are "Components in Weapons" and "Instruments of War" as classified in Main Directorate of Intelligence of Ukraine (2025), matched to the closest 6-digit HS code manually and with the help of GPT-4o. Specifically, they present the dynamic difference-in-differences estimates of a modified version of Equation (4), comparing the import volume of sanctioned critical and non-critical products against 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 red vertical line indicates the start of the war. The top (bottom) figure uses the total import value (net weight) of a given product in a given quarter as an outcome. The logarithms add 1 to the argument's value to avoid missing values. Regressions control for HS3-product-quarter fixed effects. The bars represent 95% confidence intervals. Standard errors are clustered at the product level.

Figure E.2: The Impact on Russian Imports of Sanctioned Products, Critical Components vs. Others, Staggered Design



Notes: These figures assess the impact of sanctions on the total imports of sanctioned products, independent of the importing country's identity, distinguishing between critical components and other sanctioned goods. Critical components are "Components in Weapons" and "Instruments of War" as classified in Main Directorate of Intelligence of Ukraine (2025), matched to the closest 6-digit HS code manually and with the help of GPT-4o. The data is aggregated at the monthly level, and the estimates are aggregated across cohorts at the time level. Pre-trend coefficients are estimated based on a separate regression, where all treated observations are omitted. The red vertical line indicates the start of the war. The top (bottom) figure uses the total import value (net weight) of a given product in a given month as an outcome. The logarithms add 1 to the argument's value to avoid missing values. Regressions control for HS3-product-month fixed effects. The bars represent 95% confidence intervals. Standard errors are clustered at the product level.

Figure E.3: The Impact on Russian Firm-Level Imports of Sanctioned Products, Firms Part of Military Supply Chains



Notes: These figures assess the impact of sanctions on the imports of exposed products for each specific firm. The sample is restricted to a list of firms that were part of military supply chains. This list is created by taking all buyers and sellers of procurement contracts that feature "Military Procurement" or related keywords in the contract wording. Specifically, they display the estimates comparing the import volume for exposed firm-products to that of non-exposed firm-products before and after the first quarter of 2022. Exposed firm-products are those later-sanctioned ten-digit HS codes, which a firm imported from a sanctioning country at least once prior to 2022. An HS code that was always imported from a non-sanctioning country is not exposed. This specification control for any firm-level shocks that take place at the same time as sanctions. The specification additionally controls for product-by-time fixed effects. The data is at the quarterly level. The red vertical line indicates the start of the war. The top (bottom) figure uses the total import value (net weight) of a given product in a given quarter as an outcome. The logarithms add 1 to the argument's value to avoid missing values. The bars represent 95% confidence intervals. Standard errors are clustered at the product-by-firm level.

Table E.1: The Impact on Exposed Military-Related Firms

	(1)	(2)	(3)
	Dependent Variable: Log Sales		
	Military Procurement	ZATO	Either
Post-2022 × Firm Exposed to Import Sanctions	-0.136***	-0.136***	-0.136***
	(0.010)	(0.010)	(0.010)
Post-2022 × Firm Exposed to Import Sanctions ×	0.011	-0.047	0.015
× Firm is Part of Military Supply Chains	(0.027)	(0.138)	(0.026)
Firm FE	✓	✓	✓
Year-Importer FE	✓	✓	✓
Year-Exporter FE	✓	✓	✓
Year-Industry FE	✓	✓	✓
Year-Target Sanctioned FE	✓	✓	✓
Year-Military FE	✓	✓	✓
Mean Dep. Var.	15.92	15.92	15.92
SD Dep. Ver.	2.29	2.29	2.29
Observations	10,594,522	10,594,522	10,594,522
Number of Firms	2,177,779	2,177,779	2,177,779

Notes: This table assesses the impact of import sanctions on the sales of military-related Russian firms. The estimates are based on a triple-difference specification that builds on equation (5), adding an interaction between a post-2022 indicator and a military-related firm indicator, as well as year-by-military fixed effects. Column (1) defines military-related firms using government procurement data as those that ever engaged in procurement under the military procurement law. Column (2) uses an alternative definition, identifying military-related firms as those located in closed administrative-territorial formations (ZATOs). Column (3) combines both definitions, classifying a firm as military-related if it meets either criterion. The sales data are at the firm-year level from 2017 through 2023. Standard errors, shown in parentheses, are clustered at the firm level. * $p<0.1$, ** $p<0.05$, *** $p<0.01$.