To Comply or Not to Comply: Understanding Neutral Country Supply Chain Responses to Russian Sanctions*

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Abstract

Using transaction-level bill of lading data from major neutral countries, we study how their firms adjusted supply chains in response to Western sanctions on Russia following the 2022 invasion of Ukraine. Firms with headquarters in sanctioning countries reduced sanctioned product exports to Russia, showing multinationals' geopolitical influence. However, domestic firms in neutral countries increased sanctioned exports, weakening sanctions. Firms exporting more to sanctioning countries complied more, while those sourcing more inputs rerouted sanctioned products to Russia. Sanctioning multinationals expanded exports to both sanctioning and Russia-friendly countries, blending compliance and evasion. Financial sanctions led sanctioning multinationals to reduce imports from Russia in trade finance intensive sectors. To improve sanctions, stronger secondary sanctions and multinational involvement are essential.

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1 Introduction

In today's geopolitical landscape that is often characterized as the "New Cold War," many countries harbor objectives that do not fully align with either side of this global rivalry. For instance, while they show little interest in challenging US leadership, they contemplate whether to comply with or evade the US-led coalition's sanctions against Russia. Neutral countries often lack incentives to comply with these sanctions, as many sanctions severely restrict trade, yet their economies heavily depend on globalization. Given these countries' significant role in global trade, their non-participation could greatly undermine the effectiveness of Western sanctions.[1]

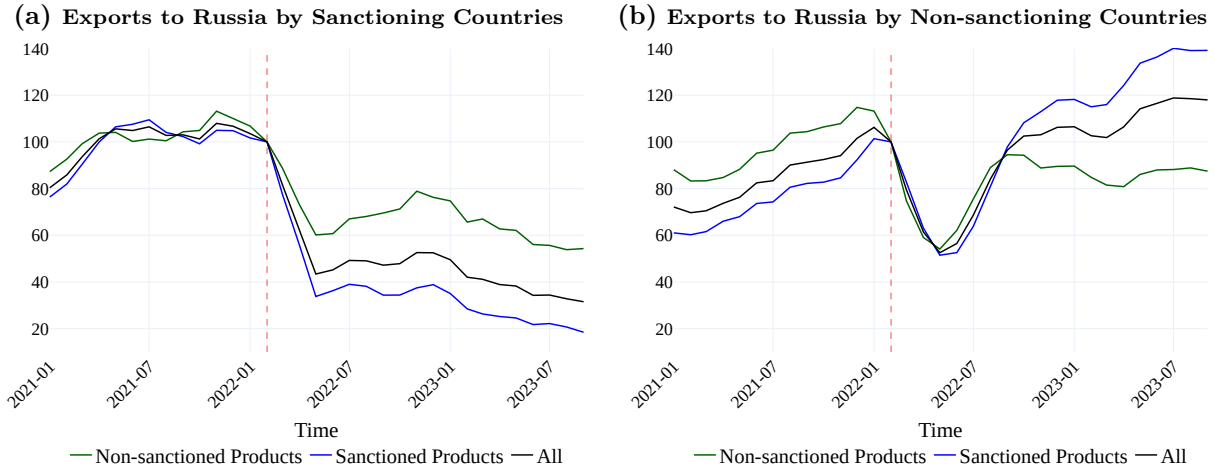

Figure 1: Exports to Russia by Sanctioning Country Status and Sanctioned Product Status
Notes: Figures 1a and 1b present the 3-month moving average of the monthly value of exports to Russia from sanctioning countries, non-sanctioning countries, and all countries, respectively. Green, blue, and black lines refer to non-sanctioned products, sanctioned products, and all products, respectively. Each line is normalized to a value of 100 in February 2022. The graph for exports from all countries to Russia is presented in Figure A.1a. The analogous figures for the quantity of exports are presented in Figure A.1. Data source: UN Comtrade.

The importance of neutral countries in the effectiveness of sanctions is evident in Figure 1. Sanctioning countries considerably reduced exports of the products facing export sanctions to Russia, with a drop of 80% compared to 40% for non-sanctioned products (Figure 1a).[2] In contrast, non-sanctioning countries increased their exports of sanctioned products to Russia by 40% and reduced exports of non-sanctioned products by 20% (Figure 1b). As a result, despite the intended effect of export sanctions, Russian total imports of sanctioned products did not substantially decrease relative to non-sanctioned products, due to non-sanctioning countries.[3]

[1] According to the International Monetary Fund's Direction of Trade Statistics, in 2022, countries that refused to participate in sanctions against Russia accounted for 41% and 45% of global exports and imports.

[2] Sanctioned products refer to those facing export sanctions imposed by the US-led coalition. Sanctioning countries refer to the countries that have imposed these export sanctions on Russia, which include the US, the UK, the EU members, Switzerland, Japan, South Korea, Taiwan, Australia, and New Zealand. See details in Section 2.

[3] See Figure A.1a. Furthermore, Figure A.2a shows that while sanctioning countries reduced imports from Russia by over 80%, non-sanctioning countries increased imports from Russia by 40%. Figures A.1b, A.1c, A.1d, and A.2b show the corresponding data for quantities, which reveal similar trends.

As enhancing compliance by firms in non-sanctioning countries remains a political priority, in this paper, we investigate how these firms adjusted their supply chains to geopolitical fragmentation and whether they comply with or evade Western sanctions on Russia. We focus on trade adjustments due to one of today's most significant military conflicts, the Russo-Ukrainian War. Our analysis centers on major developing countries – India, Pakistan, Vietnam, and Mexico – which all have officially declined to participate in Western sanctions against Russia.[4]

We highlight two important mechanisms through which Western sanctions on Russia affect supply chains in neutral countries: (1) extraterritorial sanctions on product exports that multinational enterprises from sanctioning countries (sanctioning MNEs) must follow, and (2) financial sanctions. The US-led coalition has imposed extraterritorial, or "long-arm," export sanctions on Russia. These export sanctions stipulate that any sanctioned product, regardless of where in the world it is produced, requires a government license to be exported to Russia if its production involves software, technology, or a significant share of inputs from sanctioning countries.[5] Sanctioning MNEs are bound by this policy and, consequently, are likely to decrease their exports of the sanctioned products.

While domestic firms and MNEs from non-sanctioning countries (non-sanctioning MNEs) are technically subject to this regulation if they rely on software, technology, or inputs from sanctioning countries, their compliance is uncertain. Non-compliance exposes firms to secondary sanctions, including criminal and civil penalties, asset freezes and blocked market access through the Special Designated Nationals and Blocked Persons List (SDN List), or similar export sanctions under the Entity List.[6] Firms reliant on sanctioning countries for their markets face higher penalties, while those with limited sales in sanctioning countries are primarily at risk of losing access to Western inputs and technology. This risk can be mitigated by using proxies that import from sanctioning countries and export sanctioned products to Russia, as few such proxies have faced secondary export sanctions. Overall, enforcement is more challenging for domestic firms and non-sanctioning MNEs compared to sanctioning MNEs.

Financial sanctions, such as disconnecting many Russian banks from SWIFT and freezing foreign reserves of the Russian central bank and other financial institutions, increased production and trade risks in the Russian economy, especially in sectors that depend more on trade finance. Sanctioning MNEs, which rely on financing from banks in their headquarters country that restrict

[4] As explained in Section 2.4, among the non-sanctioning countries for which S&P provides data, these are the only countries that (1) engage in substantial trade with Russia and (2) have comprehensive data covering all modes of trade.

[5] See https://www.bis.gov/ear/title-15/subtitle-b/chapter-vii/subchapter-c/part-734/ss-7343-items-subject-ear.

[6] The Special Designated Nationals and Blocked Persons List (SDN List) (see https://sanctionssearch.ofac.treas.gov/) freezes the assets of listed entities in sanctioning countries and prohibits sanctioning countries from engaging in transactions with these listed entities. The Entity List (see https://www.bis.doc.gov/index.php/policy-guidance/lists-of-parties-of-concern/entity-list) identifies firms and individuals requiring a license for entities subject to export control policies to sell them sanctioned products. As a result, entities included on the list due to Russian sanctions are subject to the same export restrictions as Russian entities.

financial transactions with Russia, are likely to reduce their imports from Russia more significantly in these trade finance intensive sectors.

Figure 2a shows that MNEs from sanctioning countries, even when located in non-sanctioning countries, significantly reduced their exports of sanctioned products to Russia more than for non-sanctioned products. This suggests compliance with their headquarters' export sanction policies due to extraterritorial regulations. In contrast, Figure 2b shows that domestic firms and non-sanctioning MNEs in non-sanctioning countries significantly increased exports of sanctioned products to Russia.[7] Since sanctions on product exports do not directly impact imports from Russia, sanctioning MNEs did not significantly reduce their imports from Russia, while domestic firms and non-sanctioning MNEs increased their imports.[8] These patterns highlight the need for alternative sanctions, such as financial sanctions, to decrease sanctioning MNEs' imports from Russia.

We draw on detailed transaction-level bill of lading data from India, Pakistan, Vietnam, and Mexico, sourced from the S&P, and combine it with the Orbis database.[9] In this way, we identify MNEs and their headquarters' locations, as well as obtain firm financial information. We acquire the list of products that face export sanctions to Russia and the list of countries that impose similar sanctions on product exports against Russia from the US Bureau of Industry and Security website.

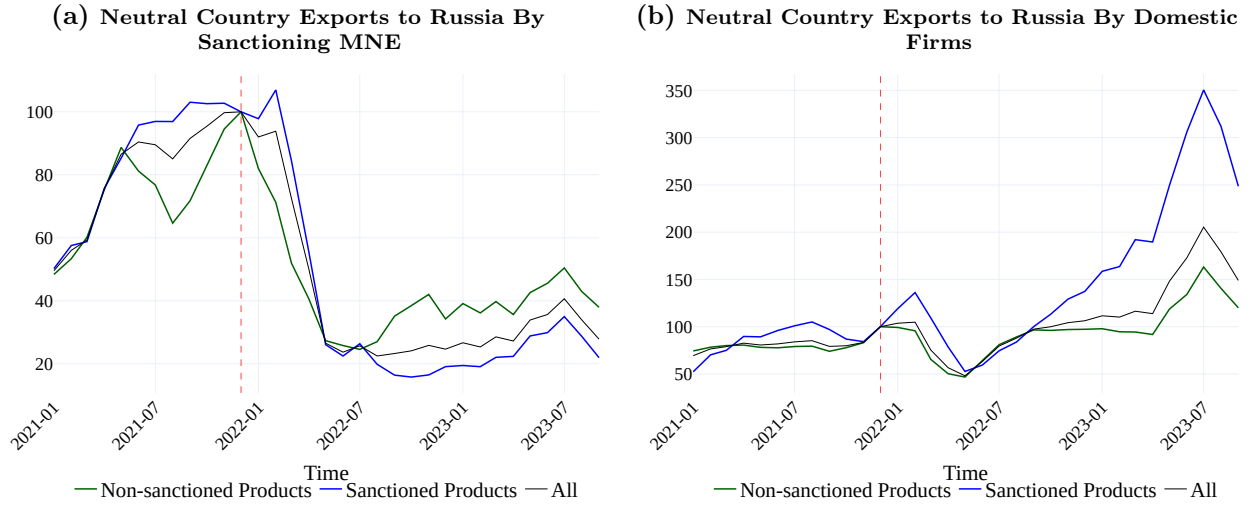

Figure 2: Trade with Russia by Product Sanction Status and Firm Type

Notes: Figures present the 3-month moving average of export value froim the four non-sanctioning countries (Mexico, Vietnam, India, and Pakistan) to Russia. Figure 2a displays the exports to Russia by multinational subsidiaries headquartered in sanctioning countries (sanctioning MNEs), whereas Figure 2b depicts those by domestic firms. Each line is normalized to a value of 100 in February 2022. The trends for subsidiaries headquartered in non-sanctioning countries and the combined imports from Russia are presented in Figure A.3. The analogous trend for the quantity of exports is presented in Figure A.4. Data source: S&P Panjiva.

[7] Figure A.3a shows that non-sanctioning MNEs also significantly increased exports of sanctioned products to Russia.

[8] See Figure A.3b.

[9] S&P Panjiva acquires the bill of lading data from customs declarations and trade bureau statistics. Figure B.1 shows that the bill of lading data provided by S&P Panjiva exhibits a high correlation with UN Comtrade data at the product level.

We find that sanctioning MNE status and export dependence on sanctioning countries contributed to compliance by firms in neutral countries, while non-compliance was prevalent among domestic firms in neutral countries, particularly those importing from sanctioning countries. Sanctioning MNEs in neutral countries adhered to Western export sanctions, but domestic firms increased sanctioned exports on average, more than offsetting the reduction by sanctioning MNEs. Among domestic firms, those with higher export shares to sanctioning countries complied better, suggesting that limiting violators' market access can improve compliance. Domestic firms with greater import shares from sanctioning countries increased sanctioned exports and rerouted sanctioned products to Russia, highlighting the need for stronger secondary sanctions. Although sanctioning MNEs reduced direct sanctioned exports to Russia, they exhibited mixed compliance by increasing exports of these products to both sanctioning countries and countries close to Russia geographically or diplomatically. In trade finance intensive sectors, sanctioning MNEs significantly reduced imports from Russia, suggesting that financial sanctions can decrease firm imports from Russia.

Our analysis consists of five parts. First, we examine the impact of product export sanctions imposed by sanctioning countries on MNEs and domestic firms located in non-sanctioning countries. We find that MNEs headquartered in sanctioning countries reduced their exports of sanctioned products to Russia by 34% more than non-sanctioned products, extending their headquarters' geopolitical influence globally. In contrast, domestic firms increased exports of sanctioned products to Russia by 36%, and non-sanctioning MNEs by 6%, as they filled the market gap left by sanctioning MNEs. Overall, exports of sanctioned products from neutral countries to Russia increased compared to non-sanctioned products, suggesting that the effectiveness of future sanctions depends on improving compliance by domestic firms and non-sanctioning MNEs in neutral countries.

We use a difference-in-differences strategy to identify these effects, interacting an indicator for products on the US-led coalition's export sanction list with a firm's status as a multinational headquartered in a sanctioning country. This approach creates firm-product level variations. To control for confounding factors, we include other product attributes and granular fixed effects. Our analysis spans different levels, including product, firm-product, and firm-Russian firm-product (i.e., supply chain).[10]

To address potential omitted variable bias and reverse causality – where a product might be sanctioned due to high Russian imports – we introduce a novel instrumental variable (IV) approach. We use whether a product faces export controls to Iran, North Korea, Iraq, Syria, or Cuba as an

[10]Products are defined at the Harmonized System (HS) 6-digit level. In the firm-product analysis, firm-time fixed effects control for all time-varying and time-invariant firm and country characteristics, such as domestic policies related to the Russo-Ukrainian War. Additionally, product-time fixed effects account for all time-varying and time-invariant industry characteristics that Russia may have experienced during the war. For example, after the war began, Russia may have shifted from a normal economy to a war economy, decreasing demand for light manufacturing products and increasing demand for inputs used in weapons production. These changes are captured by the product-time fixed effects. Due to the page limit for this submission, we are unable to present the supply chain-level analysis in the current draft. However, our findings remain robust at the supply chain level.

instrument for whether it is sanctioned against Russia. These export controls were implemented before the Russo-Ukrainian War and are less likely to correlate with unobserved factors affecting neutral countries' trade with Russia. Under this IV strategy, our baseline findings remain robust.

Our findings remain robust when incorporating all non-Russian export destinations as an additional control group, along with a range of product, headquarters country, and firm-level controls. Exports to non-Russian countries serve as an effective control group, as they are not directly impacted by Western sanctions on Russia or changes in Russian demand. Robustness tests further account for alternative product characteristics that might correlate with inclusion on the export sanctions list. The results consistently hold when considering various attributes of headquarters countries. Moreover, controlling for firms' import and export shares with sanctioning countries does not diminish the significant reduction in sanctioning MNEs' exports of sanctioned products.

We find that domestic firms were the main drivers of increased exports of sanctioned products to Russia. Enhancing compliance from these firms could significantly limit Russia's access to these goods. Using a new decomposition formula, we find that domestic firms contributed 146% of the rise in sanctioned product exports from non-sanctioning countries to Russia, while sanctioning MNEs contributed -51% as they reduced sanctioned product exports. If domestic firms and non-sanctioning MNEs could comply as much as sanctioning MNEs, Russia's total imports of sanctioned products could decrease by 76%, and overall imports by 53%, as Russia is now heavily relying on non-sanctioning countries for these supplies.

Second, consumer markets play a significant role in shaping compliance among domestic firms in non-sanctioning countries. Firms with a higher export share to sanctioning countries reduced their sanctioned product exports to Russia, likely deterred by the risk of having their revenues in sanctioning countries frozen or confiscated and losing future market access through the SDN List. In contrast, domestic firms with a higher import share from sanctioning countries increased their sanctioned product exports to Russia. These firms are, in principle, more subject to the extraterritorial export sanctions. However, the risk of losing access to Western technologies and inputs alone has been insufficient to deter these firms, as they often mitigate this risk by using proxies that import from sanctioning countries and re-export to Russia. These patterns underscore the need for stronger enforcement of secondary sanctions, particularly through the Entity List, which targets importers reliant on inputs from sanctioning countries.

Third, we find evidence of trade rerouting, where sanctioning countries indirectly export to Russia through domestic firms in neutral countries. Specifically, domestic firms in neutral countries significantly increased imports from sanctioning countries and exports to Russia of the same sanctioned products in the same quarter. This pattern is particularly concerning for policymakers because it enables Russia to continue accessing components from sanctioning countries made with Western technology. We observe this pattern consistently across various measures, including number of firms engaged in this practice, the likelihood of a firm importing and exporting the same sanctioned

product, and trade value. Decomposition analysis shows that such trade rerouting contributed 69% of the increase in exports of sanctioned products from neutral country domestic firms to Russia.

Fourth, while sanctioning MNEs reduced exports of sanctioned products to Russia, they significantly increased exports of these products to non-Russian destinations, indicating both compliance with sanctions and potential sanction-avoidance behavior. The increase in exports of sanctioned products to sanctioning countries suggests a genuine effort to find alternative buyers. However, there was also a marked rise in exports of these products to Russia-friendly countries, including members of the Commonwealth of Independent States and those using Russia's payment system. In contrast, domestic firms and non-sanctioning MNEs showed insignificant growth in exports to Russia-friendly countries, as they were less constrained by Western export sanctions against Russia and exported sanctioned products to Russia directly. Instead, they increased exports more to other destinations, likely benefiting from economies of scale and learning by doing.

To explore policies that could potentially reduce non-sanctioning country firms' imports from Russia, the final part of the paper examines whether financial sanctions decreased sanctioning MNEs' imports from Russia.[11] With headquarters banks restricting trade with Russia, sanctioning MNEs significantly reduced imports from Russia, particularly in sectors that are more reliant on trade finance. This finding is robust across different measures of sectoral trade finance intensity and when controlling for firm-level financial characteristics.

The paper contributes to the literature on how geopolitical and economic fragmentation (see Aiyar et al. 2023a, Aiyar et al. 2023b, and Gopinath et al. 2024 for surveys) affects global supply chains and economic development. The literature has examined the consequences of various deglobalizing events, including Brexit (Crowley et al., 2018; Fernandes and Winters, 2021; Graziano et al., 2021), the US-China trade war (Amiti et al., 2019; Flaaen and Pierce, 2019; Fajgelbaum et al., 2020; Handley et al., 2020; Freund et al., 2023; Huang et al., 2023), and Covid-19 (Antràs, 2020; Khanna et al., 2022).[12] Prior works have also studied the impact of 2014 Russia-Ukraine Crisis on trade and production in Ukraine and Russia (Nigmatulina, 2021; Korovkin and Makarin, 2023; Korovkin et al., 2024). Flaaen et al. (2020), Alfaro and Chor (2023), Mayr-Dorn et al. (2023), Utar et al. (2023), Fajgelbaum et al. (2024), Wu (2024), among others, have investigated the impact of supply chain disruptions on trade reallocation to non-conflict countries.[13] Works including Flaaen et al. (2020), McCaig et al. (2022) and Xue (2023) have studied the effect of trade disputes on FDI.

We contribute to this literature by presenting the first empirical evidence on the impact of the 2022 Russo-Ukrainian War and subsequent Western sanctions against Russia on neutral country

[11] We find that sanctioning MNEs did not significantly reduce exports to Russia more in financially intensive sectors, suggesting that extraterritorial sanctions on product exports are the dominant factor influencing sanctioning MNEs' export behavior to Russia.

[12] Works such as Barrot and Sauvagnat (2016), Boehm et al. (2019), Carvalho et al. (2021), Feng et al. (2023), among others, have also studied supply chain disruptions due to natural disasters.

[13] Chen and Joshi (2010), De Souza and Li (2022), Lee et al. (2023), among others, have investigated the trade diversion effects of trade policies.

supply chains at a global scale.[14] To that end, we are the first to collect detailed and up-to-date supply chain-level information, combining it with headquarters and firm business data, alongside a novel list of products subject to Western export sanctions. The Russo-Ukrainian War, which stands as the largest military confrontation of the 21st century to date, prompted Western countries to impose unprecedented sanctions on Russia. With this comprehensive dataset, we document the spillover effects of the conflict globally and on neutral countries. We highlight the heterogeneous responses of MNEs headquartered in sanctioning countries, those from non-sanctioning countries, and neutral country domestic firms in adjusting their trade with Russia and third countries.

This paper also contributes to the literature on the economic analysis of sanctions. Previous research has explored the motivations of sanction-imposing countries (Eaton and Engers, 1992; Lacy and Niou, 2004; Whang et al., 2013; Baliga and Sjöström, 2022) and empirically examined the effects of various sanctions on recipients (Elliott and Hufbauer, 1999; Lee, 2018; Felbermayr et al., 2020a; Ahn and Ludema, 2020; Crozet et al., 2021; Felbermayr et al., 2021; van Bergeijk, 2022; Hinz and Monastyrenko, 2022; Draca et al., 2023; Kwon et al., 2022), senders (Felbermayr et al., 2020b; Gullstrand, 2020; Besedeš et al., 2021), and international trade (Crozet and Hinz, 2020; Miromanova, 2021a,b; Kwon et al., 2024; Tyazhelnikov and Romalis, 2024). In the context of Western sanctions following the 2022 Russo-Ukrainian War, De Souza et al. (2024) quantifies cost-effective trade sanctions that Western countries should impose based on varying levels of willingness to pay. Theoretical explorations of trade sanctions, through the lens of terms-of-trade manipulation, are offered by Sturm (2023), Chowdhry et al. (2023), and Becko (2024). Additionally, Bachmann et al. (2022), Evenett and Muendler (2022a), Evenett and Muendler (2022b), Imbs and Pauwels (2023), and Ghironi et al. (2024) examine the welfare implications of trade sanctions using quantitative models. Cai and Xiang (2022) investigate the impact of Western MNEs exiting Russia, while Lorenzoni and Werning (2022) and Itskhoki and Mukhin (2022) analyze the effects of financial sanctions.

We contribute to this literature by documenting the propagation of Western sanctions through their MNEs and firms that rely on export markets in sanctioning countries. We discover that these firms, despite being located in neutral countries, have incentives to comply with Western extraterritorial export sanctions by reducing sanctioned products to Russia. However, sanctioning MNEs may also have incentives to circumvent these sanctions by increasing sanctioned product export to countries with stronger economic and political ties to Russia. Furthermore, we reveal that financial sanctions can impede trade, particularly for sanctioning MNEs importing from Russia in trade finance intensive sectors. Consequently, we substantially depart from the existing literature, which has primarily focused on jurisdiction-based sanctions – policies that restrict goods and capital flows between sanctioning countries and Russia.

The rest of the paper is organized as follows. Section 2 introduces the institutional background

[14] Corsetti et al. (2024), a concurrent paper, studies how Turkish firms' trade with Russia was impacted by the 2022 Russo-Ukrainian War.

and data. Section 3 studies how firms in neutral countries adjust their exports to Russia due to extraterritorial sanctions on product exports. Section 4 studies the effect of domestic firm non-compliance on Russia's overall sanctioned product import. Section 5 analyzes whether sanctioning countries can improve neutral country domestic firm compliance through trade. Section 6 studies supply chain restructuring in neutral countries beyond trade adjustment with Russia. Section 7 analyzes the role of financial risks that affect importing from Russia. Section 8 concludes.

2 Institutional Background and Data

We highlight two types of sanctions on Russia that impact supply chains in non-sanctioning countries: (1) extraterritorial sanctions on product exports that MNEs from sanctioning countries (sanctioning MNEs) must follow and (2) financial sanctions.

2.1 Export Sanctions - Products and Participating Countries

Beginning February 24, 2022, three Foreign Direct Product Rules (FDPRs) targeting Russia were introduced by the US, which significantly restricted exports to Russia by global companies bounded by these policies. FDPRs require export licenses for products on the industrial sanctions list, and applications for these licenses are denied by default.[15] The industrial sanctions list covers a significant portion of many neutral countries' exports to Russia. In 2021, products on this list accounted for 57%, 26%, 32%, and 6% of exports by Mexico, Vietnam, India, and Pakistan.[16]

In addition to the US, many Western countries have imposed similar sanctions on product exports against Russia. Countries within this "export control coalition" are exempt from the US government's license requirements, as they must apply for permits from their own governments and are held accountable by their own governments if they fail to comply. To ensure the coalition's effectiveness, a consistent set of controlled products is required for all member countries.[17] The US Bureau of Industry and Security maintains a list of these exempted countries (see Section 2.4).

For humanitarian reasons, sanctions on product exports and financial sanctions do not apply to trade with Russia involving agricultural products. This exemption covers products such as crops, food, and petrochemicals necessary for food production, including pesticides and fertilizers.[18] Therefore, in our empirical analysis, we focus on the manufacturing sector.

[15] In addition to the industrial sanctions list, there are two other FDPRs: the Commerce Control List (CCL) and the Russian Entity List. The CCL regulates the technologies that are not allowed to be exported to Russia. The Russian Entity List comprises over 800 entities, with more than 600 located in Russia. The remaining entities, situated in other countries, are considered crucial for Russia's military capabilities or for evading sanctions. Exports to entities on the Russian Entity List are prohibited. In this paper, we focus on the industrial sanctions list due to its analytical feasibility. See https://www.state.gov/russia-business-advisory/ for more details.

[16] See Section 2.4.

[17] See https://www.cliffordchance.com/content/dam/cliffordchance/briefings/2024/01/ukraine-the-latest-global-sanctions-and-export-controls-03%20January-2024.pdf.

[18] See https://crsreports.congress.gov/product/pdf/IF/IF12092.

2.2 Export Sanctions - Extraterritoriality, Punishments, and Implications for Multinationals and Firms Trading with Sanctioning Countries

The Export Administration Regulations (EAR) are extraterritorial, as they "follow the goods." This means that any sanctioned product, regardless of the country in which it is produced, requires the FDPR license for export to Russia if it is manufactured using software or technology from sanctioning countries or contains a significant share of content originating from these countries.[19]

Entities found violating the EAR are subject to secondary sanctions, which include criminal and civil penalties, as well as being added to the "Specially Designated Nationals and Blocked Persons List" (SDN List) and the "Entity List." Criminal penalties can result in up to 20 years of imprisonment and fines up to $1 million per violation. Civil penalties can reach up to $300,000 per violation or twice the transaction value, whichever is greater. The SDN List, managed by the Office of Foreign Assets Control (OFAC) of the Department of the Treasury, freezes and confiscates an SDN's assets and prohibits all US persons from dealing with the SDN.[20] Entities added to the Entity List by the US Bureau of Industry and Security will require a license for other entities to sell the sanctioned products to them, effectively facing the same export sanctions.[21]

Even when operating in non-sanctioning countries, MNEs from sanctioning countries (sanctioning MNEs) fall under the scope of these "long-arm" export restrictions as they rely on technologies from their headquarters. Moreover, these MNEs, due to significant business operations in sanctioning countries, face increased risks of prosecution and higher liabilities if found to be in violation of the EAR, compared to domestic firms and MNEs from non-sanctioning countries operating in the same neutral country. Consequently, sanctioned product exports by sanctioning MNEs to Russia could be significantly constrained by these export sanctions.

Domestic firms and non-sanctioning MNEs are technically subject to these regulations if they use software, technology, or inputs from sanctioning countries to produce sanctioned products. However, their compliance is less certain. Violating firms reliant on sanctioning countries for their export markets face significant risks, particularly being added to the SDN List, which would freeze their revenues in those countries and deny future market access. As a result, the high stakes of violating the EAR may incentivize better compliance among those exporting to sanctioning countries.

[19] See https://ofac.treasury.gov/media/932746/download?inline. In most countries, firms that import more than 25% of their inputs from the U.S. are subject to the EAR.

[20] See https://ofac.treasury.gov/media/931471/download?inline. For example, the India-based company Innovio Ventures was added to the SDN List because it sent over 200 shipments, including electronic integrated circuits and multilayer ceramic capacitors, to Russia-based end-users, including the U.S.-designated electronic components supplier and military procurement entity LLC Testkomplekt. As a result, all assets owned by the company are blocked, and the company is banned from conducting business in the US. For more examples, see https://home.treasury.gov/news/press-releases/jy2700.

[21] See https://www.bis.doc.gov/index.php/enforcement/oee/penalties.

Table 1: Firms Potentially Violating Export Sanctions and Newly Added to Entity List During the Post-War Period

Country	(1) # Firms That Imported from Sanctioning Countries & Exported Sanctioned Products to Russia	(2) # Firms That Imported Sanctioned Products from Sanctioning Countries & Exported **Same** Sanctioned Products to Russia	(3) # of Sanctioned Firms for Violations of Russia-related Sanctions: Entity List All	(4) Entity List S&P Matched	(5) SDN List All	(6) SDN List S&P Matched
Mexico	63	15	0	0	0	0
Vietnam	521	111	1	0	3	2
India	2993	859	5	3	31	20
Pakistan	79	8	0	0	1	0
All	**3656**	**993**	**6**	**3**	**35**	**22**

Notes: Table presents the number of firms from the country indicated in the first column that, during the post-war period, imported from sanctioning countries and exported sanctioned products to Russia (Column 1), and imported from sanctioning countries and exported to Russia for the same sanctioned product (Column 2). It also lists the number of newly added firms on the BIS Entity List (Column 3) and OFAC SDN List (Column 5) due to violations of Russia-related sanctions, and the number of these sanctioned firms that we can find a match in S&P Panjiva data (Columns 4 and 6). The post-war period refers to the sample beginning after February 2022.

Firms without significant revenues, assets, or personnel in sanctioning countries are less likely to be affected by criminal and civil penalties and may be unconcerned about being added to the SDN List. While the Entity List restricts access to Western technologies and imports from sanctioning countries for violating firms, its slow expansion has created opportunities for circumvention, as firms may establish new entities to import from sanctioning countries and export to Russia.[22] Table 1 shows that, during the post-war period, 63 Mexican firms, 521 Vietnamese firms, 2,993 Indian firms, and 79 Pakistani firms imported from sanctioning countries and exported sanctioned products to Russia. Among them, 15 Mexican firms, 111 Vietnamese firms, 859 Indian firms, and 8 Pakistani firms imported from sanctioning countries and exported the same sanctioned products to Russia, suggesting potential sanction violations.[23] However, only one Vietnamese firm and five Indian firms were added to the Entity List for sanction violations during this period.[24] The low inclusion rate on the Entity List for Russian sanction violations suggests a low risk for firms engaging in such activities and highlights the potential for creating proxies to import from sanctioning countries and export sanctioned products to Russia.[25]

[22]For example, multiple US and foreign nationals have been charged for setting up shell companies and transshipment points in third-party countries to acquire advanced electronics and semiconductors for Russia's defense sector. See, for example, Indictment, United States v. Grinin, et al., Case 1:22-cr-00409-HG (E.D.N.Y. Dec. 5, 2022) ("Grinin Indictment").

[23]These firms might not necessarily breach sanctions if the exported products to Russia do not contain a significant share of components from sanctioning countries.

[24]The names of firms added to the Entity List for violating Russian sanctions can be found here: https://www.ecfr.gov/current/title-15/subtitle-B/chapter-VII/subchapter-C/part-744/. Of these newly listed firms, three Indian firms are found in the Indian Panjiva supply chain data; others may have violated sanctions by exporting through different countries.

[25]Table 1 also indicates that a higher number of firms added to the SDN List can be matched in the Panjiva

2.3 Financial Sanctions

Western countries imposed unprecedented financial sanctions on Russia, including banning numerous Russian banks from SWIFT, which severely restricted their ability to conduct international transactions.[26] Additional measures included freezing the US dollar, Euro, and gold reserves of Russian banks, the central bank, and Russian individuals and entities linked to the war, such as oligarchs.

These financial sanctions significantly impacted Russian trade, especially in sectors reliant on trade finance and external financing. Financial sanctions weakened the capacity of Russian firms to engage in international trade because foreign importers faced higher costs to acquire trade finance from banks involved in the sanctions. Russian firms also faced heightened risks in production and input purchase, as they struggled to settle payments for imports and exports in sanctioning currencies. Financial risks increased more in sectors with a high dependence on trade finance.

While imports by sanctioning MNEs are not directly subject to extraterritorial product sanctions, they may reduce imports from Russia due to financial sanctions, particularly in sectors that are more trade finance intensive. Compared to domestic firms and non-sanctioning MNEs, sanctioning MNEs are less likely to receive trade finance from their headquarters' banks, which have imposed financial sanctions on Russia.[27] As a result, the cost of sourcing from Russia has increased more for sanctioning MNEs, particularly in sectors that require more trade finance.

2.4 Data

We combine international transaction bill of lading data from S&P Panjiva, firm balance sheet information from Orbis, and industry-level measures from various sources. Our sample spans between 2021Q1 and 2023Q3, and we focus on the firms that have ever traded with Russia during this period. In our quarterly analysis, we define the pre-war period as 2021Q1 to 2021Q4 and the post-war period as 2022Q1 to 2023Q3. We choose not to extend the pre-war period into 2020 due to potential confounding effects from the Covid-19 pandemic and subsequent government lockdowns.[28]

S&P Panjiva Bill of Lading Data We acquire transaction-level supply chain data for major developing countries – Mexico, Vietnam, India, and Pakistan.[29] For these four countries both export and import transactions for all modes of transit are reported, and data is continuously updated from

Database. This suggests more effective enforcement of the EAR on firms with assets and business operations in sanctioning countries.

[26] See, https://foreignpolicy.com/2022/03/08/swift-sanctions-ukraine-russia-nato-putin-war-global-finance/.

[27] See, for example, https://www.americanbanker.com/payments/list/these-payment-companies-are-cutting-off-russia, which details Western banks scrutinizing financial transactions potentially related to trade with Russia.

[28] To calculate aggregate trade value growth from the pre-war to the post-war periods, taking into account the differences in time frames, we need to multiply the pre-war trade values by 7/4. This is because the pre-war period includes four quarters, while the post-war period includes seven quarters.

[29] The ultimate data source comes from "publicly available customs declarations and trade bureau statistics," as stated on S&P Panjiva's website https://www.marketplace.spglobal.com/en/datasets/panjiva-supply-chain-intelligence-(22).

the vendor. They are also the only countries, among the non-sanctioning countries for which the bill of lading data is available from S&P, that (1) engage in substantial trade with Russia and (2) have comprehensive data covering all modes of trade.[30] We observe information on the importer and exporter firm, product, and dollar values of each transaction. For firm-level information, the countries, names, and addresses are available. For firms in Mexico and Vietnam, we are also able to retrieve unique firm national IDs. Since Orbis also has the same set of unique firm national IDs, we are able to match firms across the two datasets in these two countries accurately.[31] Depending on the purpose of analysis, we aggregate transactions either at the monthly or quarterly level.

The bill of lading data for these countries exhibit low missing rates and have a strong correlation with UN Comtrade's official trade statistics when aggregated at the product level.[32] From 2021Q1 to 2023Q3, the missing rates (the share of transactions where the value information is not provided) for import and export values are 1.50% and 3.55% for Vietnam, 0.01% and 5.14% for India, 0.02% and 0.43% for Pakistan, and below 0.01% for Mexico. Figure B.1 demonstrates that the trade values derived from S&P and from UN Comtrade at the product level exhibit a high correlation for both pre-war and post-war periods.[33]

Orbis To acquire headquarters and financial information for firms in S&P Panjiva, we match them with the Orbis database.[34] Utilizing Orbis' batch search tool, we input firm national IDs (for Mexico and Vietnam), names, and addresses. The search portal subsequently returns the most accurate match for each firm within the Orbis database.[35] We then download the balance sheet and ownership information for these matched firms.

[30] For other non-sanctioning countries, either they do not engage in substantial trade with Russia, or the data do not sufficiently cover our sample period or modes of trade. The bill of lading data from China is only updated until the onset of the U.S.-China trade war in March 2018. Brazilian data capture only a subset of maritime trade transactions, with most lacking reported trade values. We exclude Bolivia, Indonesia, and Venezuela due to incomplete and non-continuous data coverage during the war period. Ecuador's data lacks trade value information entirely, while trade value data for exports from Uruguay to Russia is entirely missing. Other Central and South American countries are excluded due to the small number of firms exporting to Russia. From Q1 2021 to Q3 2023, we observed the following number of firms exporting manufactured products to Russia: 84 from Chile, 82 from Colombia, 22 from Costa Rica, 3 from Panama, 7 from Paraguay, and 117 from Peru.

[31] In the Mexican data, we can observe the Mexico RFC (Registro Federal de Contribuyentes), whereas in the Vietnamese data, we can see the Trade Register Number. Orbis also provides the corresponding IDs for both countries, enabling us to accurately match the datasets for these two countries.

[32] Flaaen et al. (2023) provides further insights into the benefits and limitations of the S&P Panjiva Bill of Lading data in the US, in comparison to the US Longitudinal Firm Trade Transactions Database.

[33] These figures present trade values from S&P Panjiva and UN Comtrade at the 6-digit HS Code level, covering both pre-war and post-war periods. Each data point refers to the trade flow value of a product between a neutral country and Russia, as calculated by S&P Panjiva and reported in UN Comtrade. Data for Mexico, Vietnam, India, and Pakistan is pooled together.

[34] Orbis, published by the Bureau van Dijk, a Moody's Analytics company, is a database containing information about private and public companies worldwide. It covers over 400 million companies across more than 200 countries and offers an extensive range of business and financial information on global enterprises.

[35] For all unmatched firms, we manually search for potential matches in Orbis to account for any discrepancies resulting from spelling errors. The overall matching rate, defined as the number of matched firms over the total number of firms in Panjiva, is 96.39% for Mexico, 95.44% for Vietnam, 90.41% for India, and 64.9% for Pakistan.

Utilizing the global ultimate owner information from Orbis, we determine whether a firm is domestic or a subsidiary of a foreign MNE. If it is an MNE, we determine if its headquarters is located in a sanctioning country. We refer to an MNE originating from a sanctioning country as a *sanctioning MNE*, and one headquartered in a country that did not participate in these sanctions on Russia as a *non-sanctioning MNE*.[36]

List of Products Facing Export Sanctions and List of Sanctioning Countries We obtain the list of products subject to export sanctions and their corresponding Harmonized System (HS) codes from the websites of the Export Administration Regulations (EAR), issued by the Bureau of Industry and Security (BIS) under the US Department of Commerce.[37] Specifically, Supplement No. 2 of Part 746 of EAR outlines the products critical to Russia's oil industry. Supplement No. 4 targets a broader list of industry sector products. Supplement No. 5 provides lists of luxury goods. Supplement No. 7 includes high-tech products such as aircraft engines and microprocessors. Each of these documents provides HS codes for the products within their respective categories that are subject to sanctions on product exports.

Supplement No. 3 of Part 746 of EAR identifies countries that have imposed similar sanctions on product exports sanctions on Russia. Countries on this list "have committed to implementing substantially similar export controls," and are therefore exempt from license requirements by the US government when their firms export to Russia.[38] Together with the US, we define a total of 39 sanctioning countries that have imposed sanctions on product exports against Russia.

Sectoral Financial Risks and Other Sector Characteristics We acquire sectoral financial risk measures following the methodology in Manova et al. (2015). Like them, we collect ISIC 4-digit level external finance dependence (Rajan and Zingales 1998), (the negative of) asset tangibility, (the negative of) trade credit intensity, and inventory ratio. To derive a single index, we compute the first principal component of the four financial risk measures. Furthermore, we calculate the mean of the standardized financial risk measures, which serves as a robustness test.

Additionally, we obtain several time-invariant industry-level characteristics from various sources. The industry capital and skill intensity and the indicator for entailing advanced technology are taken from Pierce and Schott (2016), contract intensity is from Nunn (2007), and external financial

[36] Non-sanctioning headquarters countries in our sample include United Arab Emirates, Argentina, Bahrain, Bermuda, Brazil, Belize, Chile, China, Curacao, Egypt, Hong Kong, Indonesia, Israel, India, North Korea, Cayman Islands, Sri Lanka, Monaco, Mauritius, Mexico, Malaysia, Panama, Pakistan, Russia, Saudi Arabia, Singapore, Thailand, Turkey, Ukraine, Uruguay, British Virgin Islands, Vietnam, and South Africa.

[37] See https://www.bis.doc.gov/ear and https://www.ecfr.gov/current/title-15/subtitle-B/chapter-VII/subchapter-C/part-746.

[38] These countries include Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, South Korea, Spain, Sweden, Switzerland, Taiwan, United Kingdom.

dependence is from Rajan and Zingales (1998).[39]

Other Country-level Trade and Macro-financial Statistics We determine whether a country is an advanced economy based on the IMF classifications. We obtain measures of a country's financial stability, including the liquid liability to GDP ratio, central bank assets to GDP ratio, deposit money bank assets to GDP ratio from Nunn (2007), which are updated in the World Bank Global Financial Development Database.

2.5 Summary Statistics

Supply Chains. Table 2 shows that, in the pre-war period, 153 Mexican, 893 Vietnamese, 4137 Indian, and 340 Pakistani firms exported to Russia, including 42, 66, 300, and 2 sanctioning MNEs, respectively. On average, sanctioning MNE exporters were larger than non-sanctioning MNE and domestic exporters in terms of the number of products, partner count, number of supply chains, and export value per firm, consistent with Bernard et al. (2009).

In the post-war period, Table C.1 shows the number of exporters has decreased to 61 in Mexico, 820 in Vietnam, and 206 in Pakistan but increased to 5700 in India. The majority of the exporter number growth in India stemmed from domestic firms, while the count of sanctioning MNEs decreased. The export value per sanctioning MNE has almost entirely eliminated the premium over non-sanctioning MNEs and domestic firms in the pre-war period. Non-sanctioning MNEs have the highest export value per firm during the post-war period.

Tables C.2 and C.3 show changes in import activity with Russia. Pre-war, 346 Mexican, 1400 Vietnamese, 2800 Indian, and 370 Pakistani firms imported from Russia, including 78, 87, 170, and 11 sanctioning MNEs, respectively. Post-war, these numbers dropped to 260, 952, 2010, and 146 firms, with 65, 64, 98, and 6 sanctioning MNEs, respectively. Unlike exporters to Russia, sanctioning MNEs are not significantly larger than non-sanctioning MNEs and domestic firms in terms of imports. Moreover, no group of importers displayed a considerable decline in import value per firm between the pre-war and post-war periods.

[39] As in Pierce and Schott (2016), the advanced technology indicator is set to one if the NAICS industry corresponds, at least partially, to a ten-digit HS product classified as an advanced technology product by the US International Trade Commission. The HS-NAICS concordances are sourced from Pierce and Schott (2012).

Table 2: Pre-war Exports Summary Statistics by Multinational Status

Country	Type	# Firms	# Products per Firm	# Partners per Firm	# SCs per Firm	# SCs per Firm-Product	# SCs per Firm-Partner	Value per Firm	Value per SC
Mexico	All	153	3.7	2.1	6.8	1.9	3.3	692,508	101,586
	Non-santioning MNE	33	2.4	2.2	3.5	1.4	1.6	313,127	90,642
	Sanctioning MNE	42	6.0	2.7	15.0	2.5	5.6	1,632,928	108,862
	Domestic	78	2.9	1.7	3.8	1.3	2.2	346,636	90,427
Vietnam	All	893	3.4	2.0	4.7	1.4	2.4	866,731	183,150
	Non-santioning MNE	78	3.2	2.2	5.1	1.6	2.3	816,815	161,295
	Sanctioning MNE	66	5.8	2.0	7.2	1.2	3.7	2,057,224	287,663
	Domestic	749	3.2	2.0	4.5	1.4	2.2	767,026	171,034
India	All	4,137	2.7	2.2	4.5	1.7	2.0	1,002,065	224,289
	Non-santioning MNE	132	2.2	2.3	3.6	1.6	1.6	990,081	276,302
	Sanctioning MNE	300	3.5	2.8	6.3	1.8	2.3	3,291,275	525,763
	Domestic	3,705	2.7	2.2	4.4	1.6	2.0	817,131	187,669
Pakistan	All	340	2.1	1.8	3.0	1.5	1.7	343,224	112,968
	Non-santioning MNE	4	9.5	1.3	9.8	1.0	7.8	2,742,194	281,251
	Sanctioning MNE	2	1.0	1.0	1.0	1.0	1.0	18,429	18,429
	Domestic	334	2.0	1.9	3.0	1.5	1.6	316,438	106,543

Notes: This table presents the number of firms, the number of products, partners, and supply chains per firm, and trade value with Russia per firm and per supply chain within each MNE type for exports in the pre-war periods. A firm's MNE type is based on its global ultimate owner country.

Sanctioned Products. Table 3 shows that 2,131 or 38% of all 6-digit Harmonized System product codes were included in the export sanction list. In terms of exports to Russia, these codes account for 57% for Mexico, 26% for Vietnam, 32% for India, and 6% for Pakistan. In terms of imports from Russia, they account for 61% for Mexico, 57% for Vietnam, 26% for India and 40% for Pakistan. A majority of sanctioned products are concentrated in the durable manufacturing sector. Table C.4 shows the post-war statistics for products subject to export sanctions. For instance, the share of sanctioned products in neutral country trade significantly decreased for Mexican exports but increased for both Vietnamese and Indian exports.

Table 3: Pre-war Summary of Sanctioned Products

Sector	# Sanctioned Products (Share in Sectoral Product #)	Sanctioned Product Share in Sectoral Trade Value							
		Export				Import			
		Mexico	Vietnam	India	Pakistan	Mexico	Vietnam	India	Pakistan
Agriculture	33 (3.34%)	20.56%	0.17%	3.12%	0.00%	0.15%	0.64%	6.53%	2.18%
Mining and Energy	39 (26.53%)	0.00%	100.00%	93.35%	35.90%	96.56%	86.84%	49.68%	93.61%
Durables	1495 (64.58%)	69.62%	65.96%	59.74%	6.90%	82.09%	87.90%	13.65%	30.10%
Nondurables	564 (26.07%)	9.04%	23.43%	8.38%	4.54%	79.53%	33.02%	39.79%	54.00%
All	2131 (37.97%)	56.53%	26.20%	32.01%	5.90%	61.18%	56.87%	25.57%	39.88%

Notes: This table presents the number and share of 6-digit HS code products subject to sanctions across various sectors, as well as the percentage of pre-war trade with Russia that these sanctioned products accounted for. The sanctioned product lists are derived from Supplements No. 2, No. 4, No. 5, and No. 7 of Part 746 of the Export Administration Regulations (EAR) (https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear. Products included in these supplements require licenses for export to Russia.

Additional Trends and Turnover Statistics. In Section C.1, we provide additional trends and turnover statistics with three main findings: (1) MNEs headquartered in sanctioning countries showed a larger decline in exports, a higher rate of exiting supply chains, and a lower rate of entering supply chains compared to non-sanctioning MNEs and domestic firms within the same host country; (2) MNEs headquartered in sanctioning countries did not experience a greater decline in imports from Russia compared to non-sanctioning MNEs and domestic firms; (3) The changes in overall trade with Russia were primarily driven by extensive margins, specifically firms entering and exiting trade, as well as adding or dropping Russian trade partners.

3 Effects of Extraterritorial Export Sanctions against Russia

We investigate how Western sanctions on product exports to Russia affected firm supply chains in major non-sanctioning countries – India, Pakistan, Vietnam, and Mexico. We conduct the analysis at multiple levels: product, firm-product, and supply chain. The product-level analysis helps us understand the aggregate effects of sanctions. Firm-product level and supply chain level studies allow us to account for firm-time fixed effects to eliminate potentially confounding factors.[40]

Our analysis proceeds in three steps. First, for each firm type (sanctioning MNEs, non-sanctioning MNEs, and domestic firms), we compare their exports of sanctioned products versus non-sanctioned products. Next, we pool together all firm types and compare sanctioning MNEs to domestic firms, which allows us to control product-time fixed effect, which is critical to control product-level shocks affecting the Russian economy during the war. In the end, we present various robustness tests and extensions.

[40] A supply chain is defined as a triplet (firm, Russian firm, product). Due to the page limit required for this submission, we are unable to include supply chain-level analysis in the current draft; however, our findings remain robust at the supply chain level.

3.1 Product Level Exports

Our goal is to test if MNEs located in neutral countries and headquartered in sanctioning countries (sanctioning MNEs) comply with their headquarters' extraterritorial sanctions on product exports. To investigate the question at the product level, we aggregate the supply chain data at the MNE status m, product p, and quarter t levels. Since m represents either domestic firms, sanctioning MNEs, or non-sanctioning MNEs, we obtain total trade in product p with Russia by MNE status for the combined four countries.[41]

In our difference-in-differences analysis, we examine whether products subject to export product sanctions (first difference) experienced differential changes in exports to Russia following the onset of the 2022 Russo-Ukrainian war (second difference). We apply the following difference-in-differences specification to each MNE status:

$$y_{mpt} = \sum_{k=2021q1}^{2023q3} \beta_{mk} \mathbb{I}\{t{=}k\} \times SanProd_p + \sum_{k=2021q1}^{2023q3} \gamma_{mk} \mathbb{I}\{t{=}k\} \times X_p + \delta_{mp} + \delta_{mt} + \epsilon_{mpt}, \tag{3.1}$$
$$m \in \{\text{Domestic}, \text{Sanctioning MNE}, \text{Non-sanctioning MNE}, \text{All}\},$$

where the left-hand side variable, y_{mpt}, represents the total exports of product p by all firms with MNE status m in the four neutral countries to Russia. In the baseline specification, we employ the inverse hyperbolic sine transformation of trade flows to study the aggregate impact of sanctions.[42] On the right-hand side, $SanProd_p$ is 1 if product p faces sanctions on product exports, and $\mathbb{I}\{t{=}k\}$ is a dummy for quarter k. To account for potential correlations between other product characteristics and their inclusion on the export sanction list, we control for alternative product features, summarized with X_p. For instance, we include capital and skill intensity to capture potential changes in the relationship between trade and industry reliance on capital and skilled labor after the war. We also incorporate a dummy variable for advanced technology usage from Pierce and Schott (2016), as the US targeted advanced technologies when sanctioning Russia. Additionally, δ_{mp} and δ_{mt} represent product and time fixed effects, respectively, for MNE status m. These fixed effects control for the level effects of products and the common time trends across all products for each ownership type.

[41] In the following subsection, we also explore regression specifications at the firm-product level and supply chain level. The qualitative conclusions derived from studies at more granular levels are consistent with those obtained from the current product-time level regressions.

[42] Section D.4 separately investigates the intensive margin (with the log of trade flows as the dependent variable), the extensive margin (using an indicator function that equals 1 for positive trade flows), and estimates a Poisson Pseudo Maximum Likelihood (PPML) model.

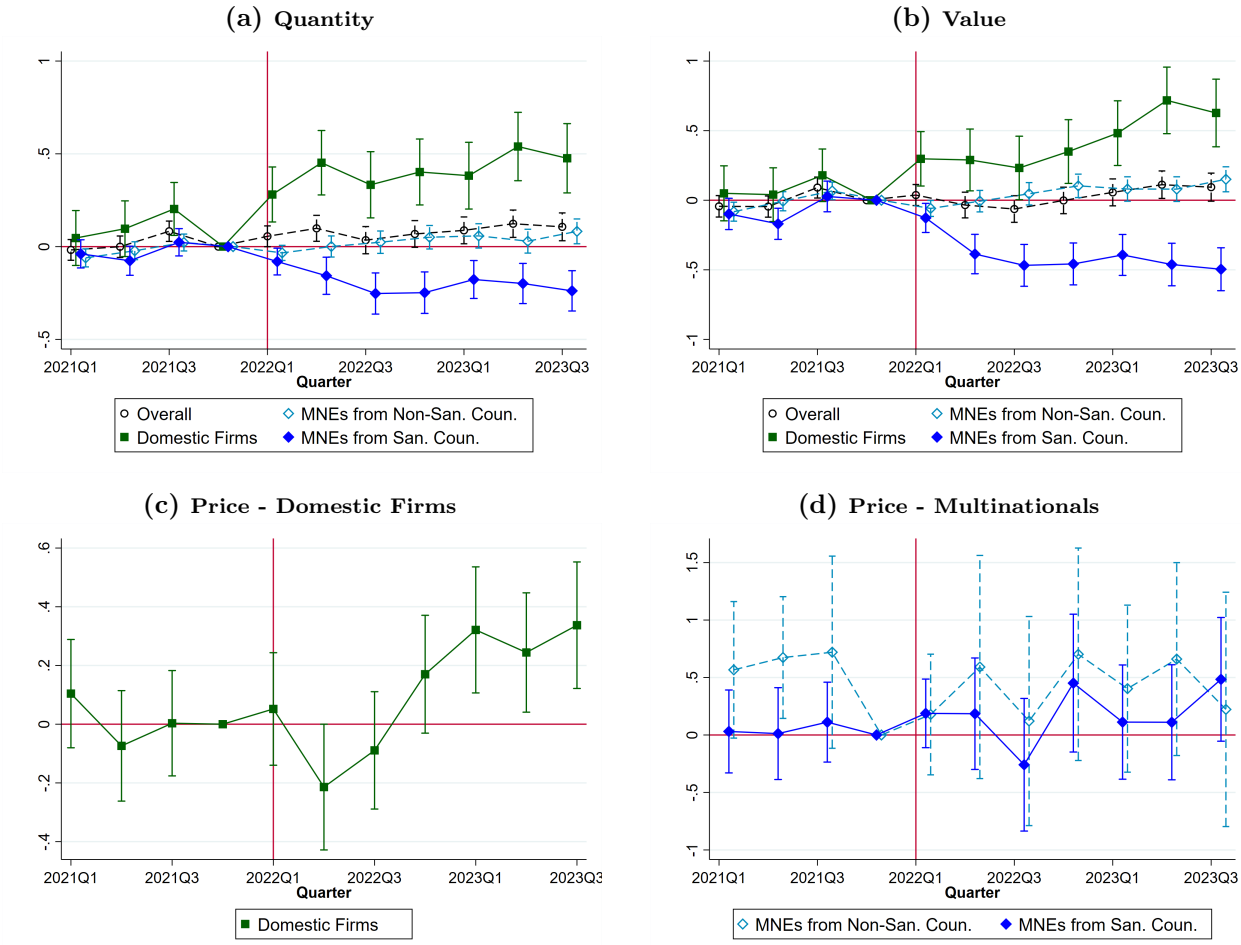

Figure 3: Effects of Sanctions on Exports of Sanctioned Products to Russia by Multinational Status (Product Level)

Notes: Figure displays the coefficients and 90% confidence interval from equation (3.1) for each sample indicated by the legend. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the product (p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

Figure 3 reveals a striking contrast in how neutral country firms with different MNE statuses responded to the export sanctions imposed by Western countries on Russia. Sanctioning MNEs (blue) consistently reduced their exports of sanctioned products to Russia after the onset of the war, while domestic firms (green) steadily increased their exports. Non-sanctioning MNEs (light blue) showed a smaller increase in sanctioned product exports. This pattern holds for both export quantities (Figure 3a) and values (Figure 3b). These results indicate that sanctioning MNEs complied with their headquarters' extraterritorial export sanctions, significantly reducing sanctioned product exports to Russia even when operating in non-sanctioning countries, extending their headquarters' geopolitical influence. In contrast, domestic firms and non-sanctioning MNEs were less likely to comply, instead taking advantage of the opportunity to increase sanctioned product exports to Russia. Prices for sanctioned products rose for domestic firms (Figure 3c), but not for MNEs (Figure 3d), suggesting

that demand from Russia shifted from sanctioning MNEs to domestic firms. This price response is important as it suggests that Western sanctions may have negatively impacted the Russian economy and war operations through higher prices, even if domestic firms in neutral countries did not comply with them. The absence of a pre-trend in all figures further strengthens our findings.

To understand the average treatment effect, we consider the following difference-in-differences specification:

$$\begin{aligned} y_{mpt} =& \beta_m Post_t \times SanProd_p + \gamma_m Post_t \times X_p + \delta_{mp} + \delta_{mt} + \epsilon_{mpt}, \\ & m \in \{\text{Domestic, Sanctioning MNE, Non-sanctioning MNE, All}\}. \end{aligned} \tag{3.2}$$

Table 4: Effects of Sanctions on Exports to Russia (Product Level)

	(1)	(2)	(3)	(4)
	Panel A: IHS(Quantity of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.0660**	0.3230***	-0.1703***	0.0453*
	(0.0286)	(0.0679)	(0.0451)	(0.0242)
R^2	0.292	0.754	0.644	0.618
N	140547	46849	46849	46849
	Panel B: IHS(Value of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.0281	0.3606***	-0.3384***	0.0621**
	(0.0366)	(0.0844)	(0.0598)	(0.0303)
R^2	0.280	0.723	0.617	0.598
N	140547	46849	46849	46849
	Panel C: Log(Price of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.0937	0.1403**	0.1555	-0.1698
	(0.0605)	(0.0679)	(0.1402)	(0.2795)
R^2	0.733	0.785	0.837	0.897
N	18675	14788	2801	766
Product FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Sample	Full Sample	Domestic Firms	MNEs from Sanctioning Countries	MNEs from Non-Sanctioning Countries

Notes: Table reports the regression results of equation (3.2) where the dependent variable is the value of exports of products p in India, Mexico, Vietnam, or Pakistan to Russia. Controls include $\text{Post}_t \times \text{Capital Intensity}_p$, $\text{Post}_t \times \text{Skill Intensity}_p$, and $\text{Post}_t \times \text{Advanced Technology}_p$. Robust standard errors clustered at the product (p) level are displayed in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Column 1 of Table 4 shows that, compared to non-sanctioned products, overall exports of sanctioned products to Russia increased in quantity and (insignificantly) in value. This increase

is entirely driven by domestic firms (Column 2) and non-sanctioning MNEs (Column 4), while sanctioning MNEs significantly reduced their exports of sanctioned products to Russia. Consistent with the event study figures, prices rose significantly for domestic firms, but not for MNEs.

3.2 Extensions and Robustness Tests

Triple Differences with Multinational Statuses In this section, we pool all MNE types, which allows us to compare sanctioned product exports across ownership statuses. Importantly, this approach enables us to control for product-time fixed effects, which account for structural changes within the Russian economy. These fixed effects help control for shifts such as decreased demand for light manufacturing products and increased demand for heavy manufacturing products that serve as critical inputs for weapon production.

We conduct a "triple-differences" event study by interacting the treatment dummy $SanProd_p$ from equation (3.1) with dummy variables representing sanctioning MNEs:

$$y_{mpt} = \sum_{k=2021q1}^{2023q3} \beta_k \mathbb{I}\{t{=}k\} \times SanProd_p \times Multi_m + \sum_{k=2021q1}^{2023q3} \gamma_k \mathbb{I}\{t{=}k\} \times X_p \times Multi_m + \delta_{pt} + \delta_{mp} + \delta_{mt} + \epsilon_{mpt}, \tag{3.3}$$

Consistent with the findings in Section 3.1, Figures D.1a and D.1b show that sanctioning MNEs significantly reduced exports of sanctioned products to Russia, both in quantity and value, compared to non-sanctioning MNEs. Figures D.1c and D.1d show that, after the war, sanctioning MNEs' exports of sanctioned products to Russia declined sharply relative to those of domestic firms, with no significant difference observed before the war. A similar, though less pronounced, pattern is seen between non-sanctioning MNEs and domestic firms.

The average treatment effect is estimated using the following equation and aligns with the findings from the event study specification:[43]

$$y_{mpt} = \beta Post_t \times SanProd_p \times Multi_m + \gamma Post_t \times X_p \times Multi_m + \delta_{pt} + \delta_{mp} + \delta_{mt} + \epsilon_{mpt}. \tag{3.4}$$

Including All Non-Russian Export Destinations as an Additional Control Group. We additionally include product exports by neutral country firms to all non-Russia destinations as an additional control group, as these exports are less likely to be directly affected by Russian sanctions. We append the data of exports of each product to each destination country and interact product sanctions with the indicator of export destination being Russia, $\mathbb{I}(Rus)_d$:

$$y_{pmdt} = \sum_{k=2021q1}^{2023q3} \beta_{mk} \mathbb{I}\{t{=}k\} \times SanProd_p \times \mathbb{I}(Rus)_d + \delta_{pmd} + \delta_{pmt} + \delta_{mdt} + \epsilon_{pmdt}, \tag{3.5}$$
$$m \in \{\text{Domestic}, \text{Sanctioning MNE}, \text{Non-sanctioning MNE}, \text{All}\},$$

[43] To comply with the submission's page limit, the corresponding table is not shown.

where the dependent variable is the exports of product p from neutral countries to destination country d in time t. This specification allows us to include product-destination δ_{pmd}, product-time δ_{pmt}, and destination-time δ_{mdt} fixed effects for each multinational status m.

We find a qualitatively remarkably similar result as the baseline. In fact, both the positive coefficients for domestic firms and the negative coefficients for sanctioning multinationals are larger in magnitude in Figure 4 compared to our baseline results in Figure 3, suggesting that our baseline offers a more conservative estimate of the stark differences between firms with varying multinational statuses. The price response follows a similar pattern: starting in 2023, domestic firms charged higher prices for sanctioned products relative to non-sanctioned ones, while multinationals did not significantly adjust prices.

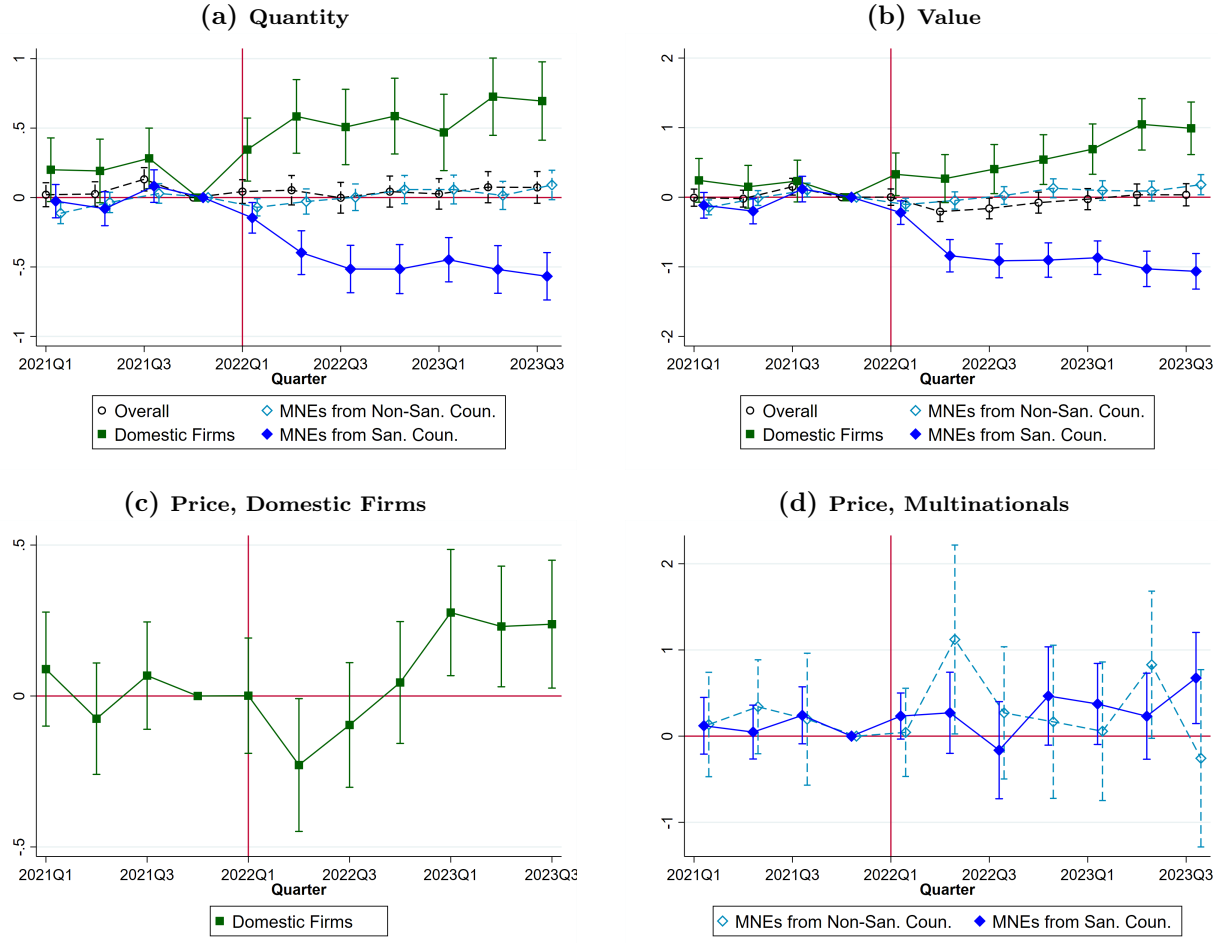

Figure 4: Effects of Export Sanctions on Exporting Sanctioned Products to Russia by Multinational Status (Product-Destination Level)

Notes: Figure displays the coefficients and 90% confidence interval from equation (3.5) for each sample indicated by the legend. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the product-destination (p, d) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

Instrumental Variable (IV) Approach. We adopt an instrumental variable (IV) approach, where we instrument SP_p (whether product p is subject to export sanctions against Russia) by how commonly the US sanctions product p against non-Russian countries. Specifically, we use the number of countries – among Iran, North Korea, Iraq, Syria, and Cuba – that face export controls for product p as the instrumental variable to measure the strength of the export control.[44] These export controls against non-Russian countries were implemented before the Russo-Ukrainian War and are less likely to correlate with unobserved factors affecting neutral countries' trade with Russia.

This approach mitigates reverse causality or omitted variable bias, such as a product being sanctioned due to certain trade flow patterns (e.g., a surge) between neutral countries and Russia. We obtain product-level export control data from the US Commerce Control List (CCL), which details the destinations requiring a license for product-level exports.[45] The identification assumption is that controls on products exported to Iran, North Korea, Iraq, Syria, and Cuba were imposed before the Russo-Ukrainian War and did not affect trade flows from neutral countries to Russia, except through correlation with the set of products facing exports sanctions against Russia. The IV is relevant because both product lists are related to items with potential military applications.

Figure 5 presents the event study estimates using IVs, where the interactions between sanctioned product treatment and time are instrumented with the interactions between the IV and time. These results are also consistent with the baseline findings: domestic firms increased both the sales and prices of sanctioned products to Russia while sanctioning MNEs reduced their exports of these products. As can be seen in Table D.2, most IV regressions show a large F-statistic, indicating a strong instrument.

Firm-Product Level Exports. We conduct an analogous analysis at the firm-product level. The results from this analysis are consistent with the baseline findings and are detailed in Section D.2. Similar to equation (3.1), we implement the following event study specification for each MNE status:

$$y_{impt} = \sum_{k=2021q1}^{2023q3} \beta_{mk} \mathbb{I}\{t{=}k\} \times SanProd_p + \sum_{k=2021q1}^{2023q3} \gamma_{mk} \mathbb{I}\{t{=}k\} \times X_p + \delta_{imp} + \delta_{imt} + \epsilon_{impt}, \tag{3.6}$$
$$i \in \Omega(m), m \in \{\text{Domestic}, \text{Sanctioning MNE}, \text{Non-sanctioning MNE}, \text{All}\}.$$

The dependent variable, y_{impt}, denotes the firm-product level (inverse hyperbolic transformation of) value of exports to Russia for firm i in product p in quarter t, where i belongs to $\Omega(m)$, the set

[44] In their study of the impact of sanctions on the growth of the targeted countries, Kwon et al. (2022) instruments sanctions by the aggressiveness of the sanction sender. They use cross-country variation, whereas sanctions vary across products in our paper.

[45] We retrieve the products on the Commercial Control List (CCL) from Part 774 of the EAR https://www.ecfr.gov/current/title-15/subtitle-B/chapter-VII/subchapter-C/part-774, and the countries for which each product was controlled from Part 738 https://www.ecfr.gov/current/title-15/subtitle-B/chapter-VII/subchapter-C/part-738.

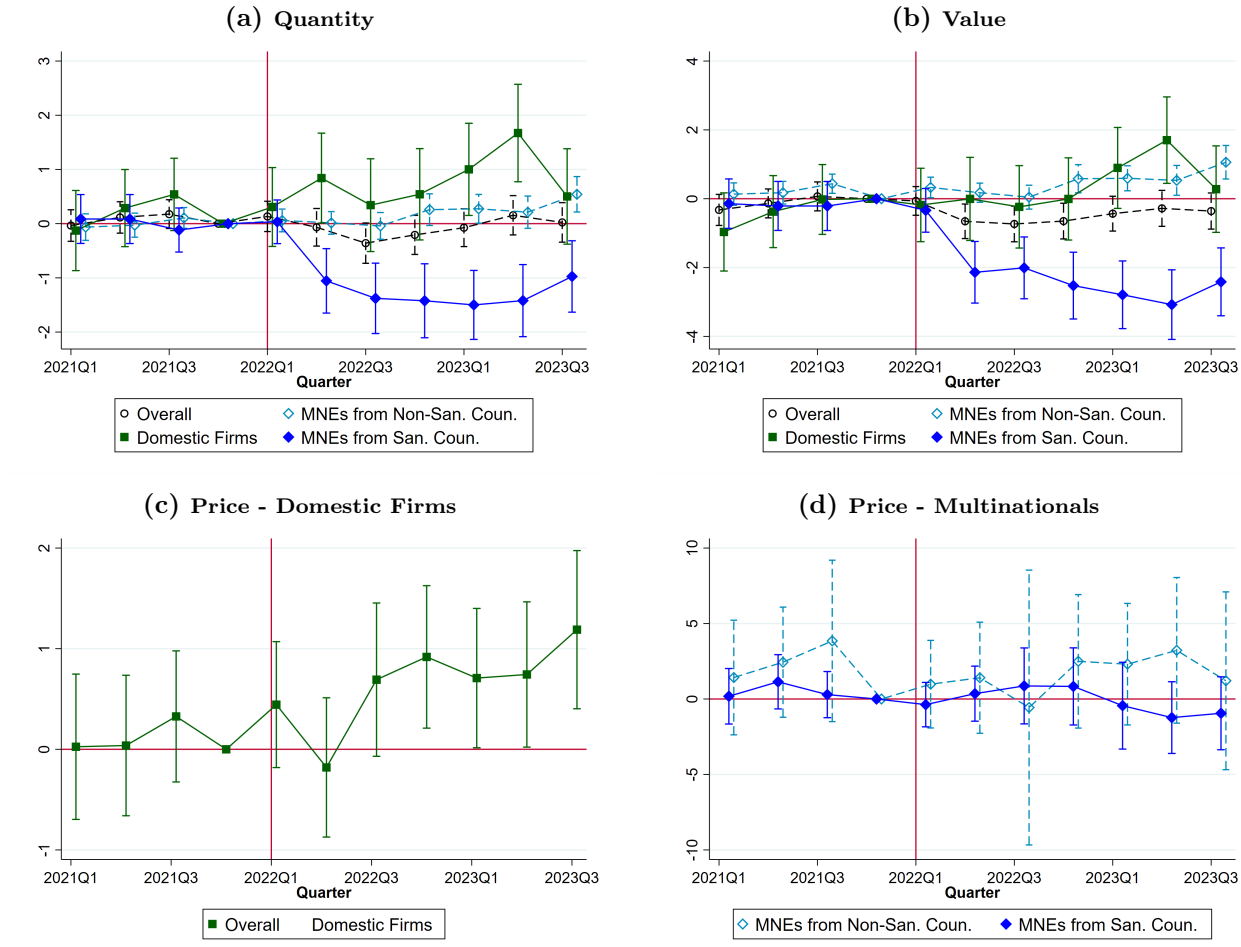

Figure 5: Effects of Sanctions on Exporting Sanctioned Products to Russia by Multinational Status (IV, Product Level)

Notes: Figure displays the coefficients and 90% confidence interval from equation (3.1) for each sample indicated by the legend. Sanctioned product indicator is instrumented by the number of countries – among Iran, North Korea, Iraq, Syria, and Cuba – that face export controls for product p. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the product (p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

of firms of MNE type m. On the right hand side, we control for firm-product and firm-time fixed effects. Other variables are the same as equation (3.1). Moreover, as we did in Section 3.2 for the product-level regression, we also perform a "triple-difference" analysis, comparing sanctioning MNEs to non-sanctioning MNEs and domestic firms. This approach allows us to control for product-time fixed effects, accounting for product- and sector-level shocks affecting the Russian economy. The results are analogous to the baseline findings.

Extensive and Intensive Margins, and PPML Estimations. Section D.4 separately examines the extensive and intensive margins. For the extensive margin, we perform analogous regressions with the dependent variable being an indicator of trading a non-zero amount. For the intensive

margin, we use the log trade value as the dependent variable, where we drop zero trade observations. Overall, we find that the extensive margin dominates the aggregate outcome, although intensive margin adjustment also points in the same direction. PPML regressions also produce qualitatively analogous results.

Controlling Additional Product Characteristics. We obtain reassuringly consistent results as we control for additional product characteristics, including pre-war total product-level or firm-product-level trade value, contract intensity, external finance dependence, asset tangibility, trade credit intensity, and inventory ratio. We report these results in Section D.5.

Controlling Additional Headquarters Country Characteristics. Our baseline findings remain robust when accounting for various other headquarters country characteristics. In Section D.6, we control for whether the headquarters countries are advanced economies and whether they have above-median GDP per capita among all headquarters countries. We also account for neutral country firms' trade linkages with sanctioning countries. We will further explore the role of trade linkages in compliance in Section 5. Finally, considering the involvement of financial sanctions following the war, we include controls for the headquarters countries' liquidity liabilities to GDP ratio, central bank assets to GDP ratio, and deposit money bank assets to GDP ratio.

Results by Individual Neutral Countries. In Section D.7, we present results for individual neutral countries. Comparing India and Mexico, while sanctioning MNEs in both countries significantly reduced exports of sanctioned products, domestic firms in India complied even less than those in Mexico. A plausible explanation is that the US, a major sanctioning country, may have utilized its strong trade ties with Mexico to encourage greater compliance among Mexican domestic firms. This topic is further explored in Section 5.

4 Aggregate Effects of Domestic Firm (Non-)Compliance

In this section, we explore the aggregate counterfactual effects on Russia's ability to acquire sanctioned products if domestic firms and non-sanctioning MNEs in neutral countries had complied with extraterritorial export sanctions. First, we document the significant contribution of neutral country domestic firms to the growth of sanctioned product exports to Russia using a new decomposition formula. Then, we show that compliance by domestic firms and non-sanctioning MNEs would significantly reduce Russia's total imports of sanctioned products.

4.1 Contributions to Neutral Country Exports to Russia by Firm Ownership

We develop a new formula accounting for the contribution of domestic firms to total sanctioned product export growth to Russia. We begin by decomposing total product-level exports to Russia into exports by domestic firms, MNEs from sanctioning countries, and MNEs from non-sanctioning countries:

$$IHS(Export_{pt}) = \hat{\alpha}_{Domestic} IHS(Export_{pt}^{Domestic}) + \hat{\alpha}_{SancMNE} IHS(Export_{pt}^{SancMNE}) + \hat{\alpha}_{NoSancMNE} IHS(Export_{pt}^{NoSancMNE}) + \epsilon_{pt},$$

where $\hat{\alpha}_{Domestic}$, $\hat{\alpha}_{SancMNE}$, and $\hat{\alpha}_{NoSancMNE}$ represent the weights of domestic firms, sanctioning MNEs, and non-sanctioning MNEs, respectively. If the trade values are in levels, these weights correspond to the average market shares by firm type. In our baseline specification, which uses inverse hyperbolic sine of trade as the dependent variable, the weights serve as a first-order approximation of market shares.

We combine these weights with the difference-in-differences estimates obtained from equation (3.2) to calculate the contribution by ownership type m:

$$Contrib_m = \frac{\hat{\alpha}_m \hat{\beta}_m}{\hat{\alpha}_{Domestic}\hat{\beta}_{Domestic} + \hat{\alpha}_{SancMNE}\hat{\beta}_{SancMNE} + \hat{\alpha}_{NoSancMNE}\hat{\beta}_{NoSancMNE}}, \quad m \in \{\text{Domestic}, \text{Sanctioning MNE}, \text{Non-sanctioning MNE}\}.$$

$\hat{\beta}_m$ captures the changes in sanctioned product exports (relative to non-sanctioned product exports) by firm type m to Russia. By multiplying this trade adjustment by the firm type's weight in total trade, we determine its contribution to overall trade changes. To ensure the contributions of all firm types sum to 100%, we include the total contributions of all firm types in the denominator.

Table 5 shows that domestic firms contributed 146% to the increase in sanctioned product exports to Russia, highlighting their dominant role in the rise of such exports from neutral countries. In contrast, MNEs from sanctioning countries contributed -51%, as they significantly reduced their exports of sanctioned products to Russia, while non-sanctioning MNEs contributed 5%.

Table 5: Decomposing the Impact of Export Sanction on Export to Russia

	Domestic Firms		Sanc MNEs		No Sanc MNEs	
	$\hat{\alpha}_{Domestic}$	$\hat{\beta}_{Domestic}$	$\hat{\alpha}_{SancMNE}$	$\hat{\beta}_{SancMNE}$	$\hat{\alpha}_{NoSancMNE}$	$\hat{\beta}_{NoSancMNE}$
Estimates	0.9327	0.3606	0.3481	-0.3384	0.1915	0.0621
Contribution	146.0%		-51.1%		5.16%	

Notes: This table shows the contribution of each firm type to the changes in total sanctioned product exports from neutral countries to Russia.

4.2 Effects of Compliance by Neutral Country Domestic Firms and Non-sanctioning Multinationals

In this section, we explore to what extent Russia's total imports of sanctioned products would decrease if domestic firms and non-sanctioning MNEs complied with extraterritorial export sanctions as strictly as sanctioning MNEs. This question highlights the critical role of neutral country domestic firm compliance in limiting Russia's war capacity and is highly relevant to the ongoing policy debate.

Similar to the empirical specification in Section 3, we first estimate the following regression: For products that belong to sanctioned products or non-sanctioned products, we compare the export changes by sanctioning MNEs versus domestic firms and non-sanctioning MNEs:

$$\begin{aligned} y_{mpt} =& \beta_P Post_t \times San\ MNE_m + \delta_{mp} + \delta_{pt} + \epsilon_{mpt}, \\ & p \in P, P \in \{\text{Sanctioned Products}, \text{Non-sanctioned Products}\} \end{aligned} \tag{4.1}$$

where $SanMNE_m$ is an indicator for sanctioning MNE.

Sanctioning Multinationals Decreased Exports to Russia More in Sanctioned Products But Not in Non-sanctioned Products. Table 6 shows that, compared to non-sanctioning MNEs and domestic firms, sanctioning MNEs significantly reduced their exports of sanctioned products but not non-sanctioned products. Consistent with Section 3, this finding proves that the reduction in exports by sanctioning MNEs to Russia was specifically due to their compliance with headquarters' sanctions on product exports, rather than a general decrease in exports.

Table 6: Sanctioning Multinationals Reduced Sanctioned Product Exports to Russia

	(1)	(2)
	IHS(Value of Export to Russia)	
$\text{Post}_t \times \text{Multi Sanc}_m$	-0.6602***	-0.0257
	(0.0623)	(0.0426)
R^2	0.802	0.842
Product x MNEs Status FE	✓	✓
Product x Quarter FE	✓	✓
Sample	Sanctioned Products	Non-sanctioned Products
N	58080	82467

Notes: Table reports the regression results of equation (4.1) where the dependent variable is the value of firm i's exports of products p in India, Mexico, Vietnam, or Pakistan to Russia. Robust standard errors in parentheses are clustered at the product (p) level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

If neutral country domestic firms and non-sanctioning MNEs complied to the same extent as sanctioning MNEs, Russia's imports of sanctioned products from non-sanctioning countries would decrease by 89%, total imports of sanctioned products by 76%, and overall imports by 53%. These estimates, presented in Table 7, are derived by multiplying the estimated difference in compliance

for sanctioned and non-sanctioned products (from Table 6) by the share of non-sanctioning MNEs and domestic firms in neutral countries' total exports to Russia, and further by the neutral countries' share of Russia's total imports, for the same product category (see equation (4.2)). The following assumptions are made: (1) the neutral countries in the study are representative of all neutral countries regarding the shares of non-sanctioning MNEs and domestic firms; (2) this first-order approximation is reasonably accurate. Although the numbers we obtained are approximations, they highlight the potential gains from improving compliance by neutral country domestic firms and non-sanctioning MNEs in restricting Russia's access to sanctioned products.

$$\frac{\Delta EX_P}{EX_P} = \beta_P \underbrace{\frac{EX_{P,IN+MX+VN+PK,Non\ San\ MNE+Domestic}}{EX_{P,IN+MX+VN+PK}}}_{\text{Non San MNE and Domestic Share in Neutral Countries}} \underbrace{\frac{EX_{P,All\ Non\ San\ Countries}}{EX_P}}_{\text{Neutral Country Share in RUS Import}}, \quad P \in \{\text{Sanctioned Products}, \text{Non-sanctioned Products}\}. \tag{4.2}$$

Table 7: Russia Trade Changes if Multinationals Headquartered in Non-sanctioning Countries and Domestic Firms Complied

	Non-sanctioning Countries			All Countries		
	Sanctioned Product	Non-sanctioned Product	All	Sanctioned Product	Non-sanctioned Product	All
Δ Exports (%)	-89.42%	-26.56%	-68.56%	-75.52%	-17.35%	-52.78%

Notes: This table presents the percentage changes in exports to Russia if MNEs headquartered in non-sanctioning countries and domestic firms complied with the export sanctions by the same magnitude as MNEs headquartered in sanctioning countries.

5 Improving Domestic Firm Compliance through Trade

Having established that domestic firms contributed the majority of sanctioned product exports from neutral countries to Russia, and highlighted the significant impact of reducing Russia's access to these products if compliance by domestic firms improved, we now explore policies to enhance compliance. Specifically, we focus on the influence of consumer markets: whether firms that depend more on sanctioning countries for their export markets and profits are more likely to comply.

5.1 Sanction Compliance and Trade with Sanctioning Countries

The current design of secondary sanctions incentivizes compliance among exporters to sanctioning countries but leaves gaps for non-compliance among importers from sanctioning countries. As discussed in Section 2.2, the SDN List poses risks for violators with substantial exports to sanctioning countries, as it freezes revenues and blocks market access. In contrast, domestic firms importing from sanctioning countries are less affected by the SDN List and are primarily targeted by the Entity List. However, the slow expansion of the Entity List enables violators to evade detection and continue accessing Western products and technologies through proxies.

To test this hypothesis, we consider an event study specification, where, compared to equation (3.6), we interact product sanctions with neutral country domestic firm-i's export shares to sanctioning countries and import shares from sanctioning countries in 2021:[46]

$$\begin{aligned} y_{ipt} &= \sum_{k=2021q1}^{2023q3} \beta_k \mathbb{I}\{t{=}k\} \times SanExpShare_{i,2021} \times SanProd_p + \delta_{ip} + \delta_{it} + \delta_{pt} + \epsilon_{ipt} \\ y_{ipt} &= \sum_{k=2021q1}^{2023q3} \beta_k \mathbb{I}\{t{=}k\} \times SanImpShare_{i,2021} \times SanProd_p + \delta_{ip} + \delta_{it} + \delta_{pt} + \epsilon_{ipt} \end{aligned} \tag{5.1}$$

We also consider a specification where the export and import shares with sanctioning countries are included simultaneously:

$$\begin{aligned} y_{ipt} = &\sum_{k=2021q1}^{2023q3} \beta_k \mathbb{I}\{t{=}k\} \times SanExpShare_{i,2021} \times SanProd_p \\ &+ \sum_{k=2021q1}^{2023q3} \theta_k \mathbb{I}\{t{=}k\} \times SanImpShare_{i,2021} \times SanProd_p \\ &+ \delta_{ip} + \delta_{it} + \delta_{pt} + \epsilon_{ipt}. \end{aligned} \tag{5.2}$$

Neutral Country Domestic Firms with Higher Export Shares to Sanctioning Countries Exported Less Sanctioned Products to Russia. Neutral country domestic firms are more likely to comply with sanctions if they export more to sanctioning countries. Figure 6 shows that if a domestic firm had a higher export share to sanctioning countries, it would export less sanctioned products to Russia. The pattern prevails if we include import and export shares with sanctioning countries on the right hand side separately as in equation (5.1) (left panel), or simultaneously as in equation (5.2) (right panel). The average treatment effect reported in Table E.1 further confirms this finding. These firms faced higher expected penalties under the SDN List, which freezes violators' revenues and assets and blocks future market access. Additionally, since they generate sales and profits in sanctioning countries, penalties against them are more enforceable.

Neutral Country Domestic Firms with Higher Import Shares from Sanctioning Countries Exported More Sanctioned Products to Russia. In contrast, firms that sourced a larger share of inputs from sanctioning countries are technically more constrained by the extraterritorial export sanctions, but in practice, they increased their sales of sanctioned products to Russia, potentially breaching the extraterritorial export sanction policy. For firms that relied on sanctioning countries for inputs rather than sales, penalties under the SDN List are less relevant. Although the Entity List

[46]The export share to sanctioning countries is defined as export to sanctioning countries divided by the firm's total export. The import share from sanctioning countries is defined as import from sanctioning countries divided by the firm's total import.

targets such imports and aims to enforce export controls, its slow expansion has left many potential violators unflagged and allowed firms to create proxies that import from sanctioning countries and export sanctioned products to Russia (see Section 2.2). As a result, these firms were undeterred by secondary sanctions and likely rerouted imports from sanctioning countries to Russia, boosting their Russian sales (further discussed in Section 6). Secondary sanctions should focus on monitoring firms importing from sanctioning countries that are also selling sanctioned products to Russia. The Entity List, which targets these importers, should be strengthened to address potential violators more swiftly.

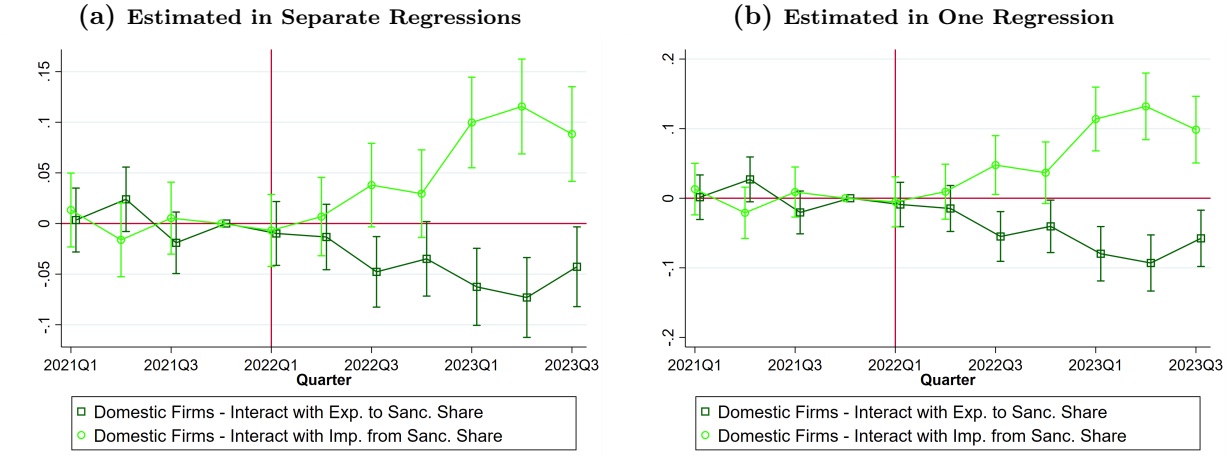

Figure 6: Domestic Firms Comply More if They Export More to Sanctioning Countries (Firm Level Trade Shares)

Notes: Figure displays the coefficients and 90% confidence interval from equation (5.1) (Panel (a)) and equation (5.2) (Panel (b)) for domestic firm sample. Panel (a) estimates the effects of import and export shares in separate regressions. Panel (b) estimates the effects of import and export shares in the same regression. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the firm-product (i, p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

5.2 Robustness

Interacting with Multinational Status. Table D.9 shows that our findings remain robust when domestic firms and MNEs are pooled together and the role of sanctioning MNEs in reducing sanctioned exports is accounted for. This table was previously used to show that export and import shares with sanctioning countries do not diminish the influence of MNEs on sanctioned exports to Russia. The analysis also confirms that the impact of trade linkages with sanctioning countries on sanctioned exports is consistent for the average firm and is not diminished by MNE status.

Firm-Product Level Trade Shares. Figure 7 confirms that the results remain robust when *firm level* export and import shares are replaced with *firm-product level* trade shares ($SanExpShare_{ip,2021}$ and $SanImpShare_{ip,2021}$) in equations (5.1) and (5.2). Specifically, the more a neutral country domestic firm relied on sanctioning countries for export markets for a particular product, the less

they sold that product to Russia. Conversely, the higher the expenditure share spent sourcing a product from sanctioning countries, the more they sold that product to Russia.

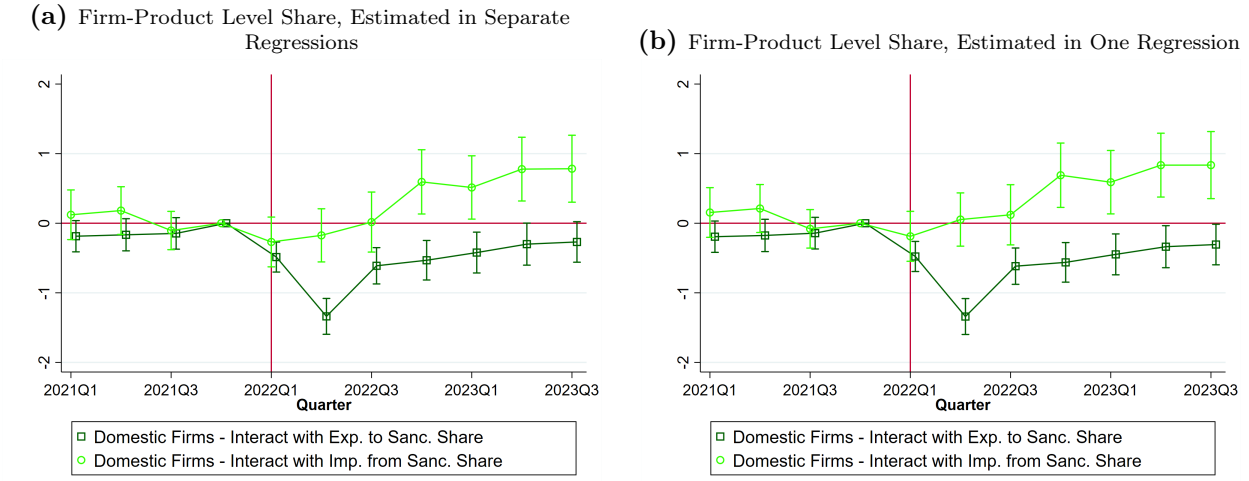

Figure 7: Domestic Firms Comply More if They Export More to Sanctioning Countries

Notes: Figure displays coefficients and 90% confidence for domestic firm sample where $SanExpShare_{i,2021}$ and $SanImpShare_{i,2021}$ in equations (5.1) and (5.2) are replaced with $SanExpShare_{ip,2021}$ and $SanImpShare_{ip,2021}$. Panel (a) estimates the effects of import and export shares in separate regressions. Panel (b) estimates the effects of import and export shares in the same regression. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the firm-product (i, p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

Controlling for Firm Size and Export Shares of High-Tech Products. We show that our estimates are not driven by potential effects of other firm characteristics that might be correlated with the share of exports to sanctioning countries. In equation (5.3), we include total firm exports and the share of advanced technology products in total firm exports in 2021 as additional controls. Figure 8 confirms that these additional controls do not affect our baseline findings: domestic firms more reliant on sanctioning countries for exports showed higher compliance, while those more dependent on sanctioning countries for imports were less compliant.

$$
\begin{aligned}
y_{ipt} = & \sum_{k=2021q1}^{2023q3} \beta_k \mathbb{I}\{t{=}k\} \times SanExpShare_{i,2021} \times SanProd_p \\
& + \sum_{k=2021q1}^{2023q3} \theta_k \mathbb{I}\{t{=}k\} \times SanImpShare_{i,2021} \times SanProd_p \\
& + \sum_{k=2021q1}^{2023q3} \gamma_k \mathbb{I}\{t{=}k\} \times Export_{i,2021}^{world} \times SanProd_p \\
& + \sum_{k=2021q1}^{2023q3} \lambda_k \mathbb{I}\{t{=}k\} \times ATPExpShare_{i,2021} \times SanProd_p \\
& + \delta_{ip} + \delta_{it} + \delta_{pt} + \epsilon_{ipt}.
\end{aligned}
\tag{5.3}
$$

Additionally, we check whether these additional controls appear to affect sanctioned exports to Russia by estimating the following equation:

$$y_{ipt} = \sum_{k=2021q1}^{2023q3} \gamma_k \mathbb{I}\{t{=}k\} \times Control_{i,2021} \times SanProd_p + \delta_{ip} + \delta_{it} + \delta_{pt} + \epsilon_{ipt}, \tag{5.4}$$

where $Control_{i,2021}$ is either $Export^{world}_{i,2021}$ or $ATPExpShare_{i,2021}$. Figures 9a and 9b show that neither factor affects sanctioned exports, highlighting the importance of trade linkages with sanctioning countries as key mechanisms driving domestic firm compliance.

Figure 8: Add Firm Size and Advanced Technology Export Share Controls

Notes: Figure displays coefficients and 90% confidence for domestic firm sample from equation (5.3) where we additionally control for $FirmSize_i \times SanProduct_p \times Time_t$ and $ATPExpShare_i \times SanProduct_p \times Time_t$. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the firm-product (i, p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

6 Trade Rerouting

We examine how neutral country firms reorganized their supply chains as sanctioning MNEs reduced sanctioned product exports to Russia and non-sanctioning MNEs and domestic firms increased them. We first document that domestic firms increased imports from sanctioning countries and exports to Russia for the same sanctioned products, suggesting potential trade rerouting from sanctioning countries to Russia through neutral countries. Next, we find that sanctioning MNEs increased sanctioned product exports to both sanctioning countries and countries close to Russia, while domestic firms did not increase sales to Russia-friendly countries.

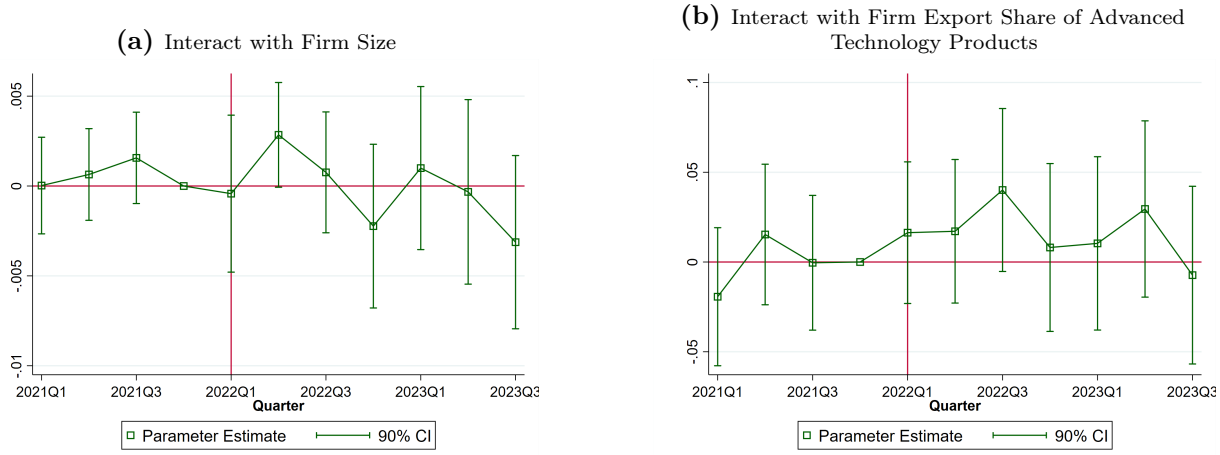

Figure 9: No Significant Effect of Firm Size or Advanced Technology Exports

Notes: Figure displays coefficients and 90% confidence for domestic firm sample from equation (5.4). $Control_{i,2021}$ is $Export^{world}_{i,2021}$ in Panel (a), and is $ATPExpShare_{i,2021}$ in Panel (b). The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the firm-product (i, p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

6.1 Trade Rerouting from Sanctioning Countries to Russia through Domestic Firms in Neutral Countries

As documented in Section 5, neutral country domestic firms that imported a larger share of inputs from sanctioning countries also exported more sanctioned products to Russia. Even more concerning is the possibility that these firms were importing from sanctioning countries and exporting to Russia the *same sanctioned products*. This "trade rerouting" likely allowed Russia to continue accessing components originally produced in sanctioning countries using Western technology. In this section, we first demonstrate that this pattern is significant across various margins. We then quantify the contribution of trade rerouting to the increase in sanctioned product exports to Russia.

Event Study Analysis. Following Iyoha et al. (2024)'s study of trade rerouting from China to the US through Vietnam, we measure trade rerouting by $\min\{Exp^{Rus}_{mpt}, Imp^{Sanc}_{mpt}\}$, where Exp^{Rus}_{mpt} is the exports of product p to Russia from neutral country firms of type m in quarter t, and Imp^{Sanc}_{mpt} is imports of the same product from sanctioning countries to neutral country firms of type m in the same quarter. It equals zero if either import or export is zero, in which case product p is either imported for internal use or exported without using imports from sanctioning countries in the same quarter.[47] Two important caveats discussed in Iyoha et al. (2024) warrant attention here. First, since this measure can also include non-rerouted domestic consumption or exports, it should be considered as capturing the maximum possible value of rerouting. Second, even if HS product categories are granular, the neutral country might be adding value to the product. However, in our

[47]We do not divide this measure by exports because we are interested in the absolute value, rather than the share, of exports to Russia that are suspected of being rerouted from sanctioning countries through neutral countries.

context, such cases would still be considered violations of US sanctions. As detailed in Section 2.2, any sanctioned product requires an FDPR license for export to Russia if it is manufactured using inputs or technology from sanctioning countries.

Figure 10 shows that the rerouted trade values increased for domestic firms, decreased for sanctioning MNEs, and remained insignificant for non-sanctioning MNEs. This suggests a possibility that domestic firms engaged in rerouting sanctioned products from sanctioning countries to Russia.

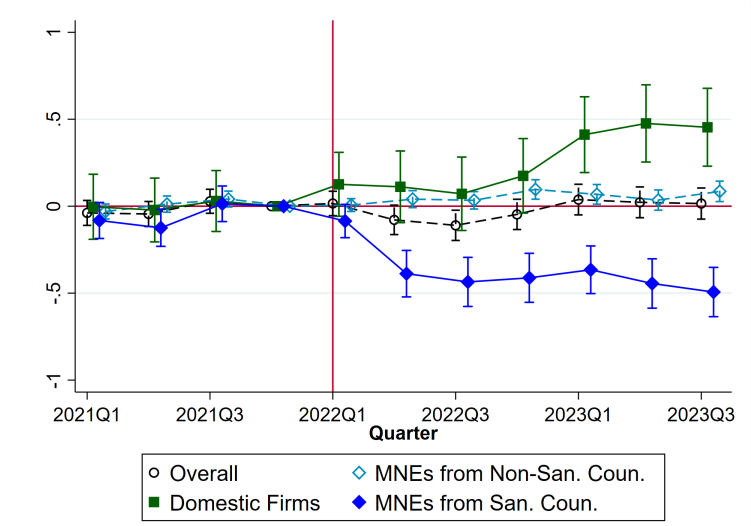

Figure 10: Trade Rerouting from Sanctioning Countries to Russia

Notes: This figure shows trade rerouting from sanctioning countries to Russia through domestic firms in neutral countries. The figure reports the product-level regression results of equation (3.1), where the dependent variable is defined as $IHS(\min\{Exp^{Rus}_{mpt}, Imp^{Sanc}_{mpt}\})$, inverse hyperbolic sine of the minimum of imports of product p from sanctioning countries in quarter t and exports of the same product to Russia in the same quarter. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the product p level. The quarter prior to the war (2021q4) is the omitted reference quarter.

In addition, we study trade rerouting on the extensive margins. The event study specification at the firm-product level follows equation (3.6), where the dependent variable y_{impt} is an indicator that equals 1 if firm i with MNE status m imports product p from sanctioning countries and sells the same product to Russia in quarter t. At the product level, the event study specification follows equation (3.1) where the dependent variable y_{mpt} is the number of m-type firms that import product p from sanctioning countries and export the same product to Russia in quarter t.

Figure 11a shows that the likelihood of domestic firms importing from sanctioning countries and exporting the same sanctioned products to Russia increased, while it decreased for both sanctioning and non-sanctioning MNEs. Figure 11b shows an increase in the number of domestic firms involved in trade rerouting, a decrease for sanctioning MNEs, and no significant change for non-sanctioning MNEs. These patterns suggest potential sanction violations by domestic firms and a reduction in trade rerouting for sanctioning and non-sanctioning MNEs.

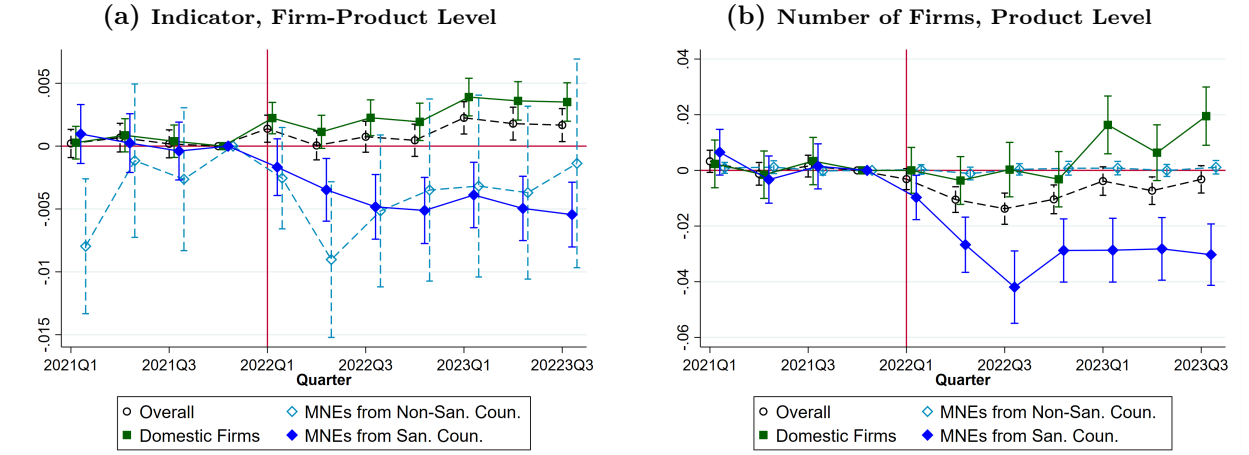

Figure 11: Trade Rerouting from Sanctioning Countries to Russia (Extensive Margins)

Notes: This figure shows trade rerouting from sanctioning countries to Russia through domestic firms in neutral countries. The left panel reports the firm-product level regression results of equation (3.6), where the dependent variable is an indicator that takes 1 if firm i imported product p from sanctioning countries in quarter t and exported the same product to Russia in the same quarter. The right panel reports the product-level regression results of equation (3.1), where the dependent variable is the number of firms that imported product p from sanctioning countries in quarter t and exported the same product to Russia in the same quarter. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the firm-product (i, p) level in the left panel, and at the product p level in the right panel. The quarter prior to the war (2021q4) is the omitted reference quarter.

Aggregate Implication of Trade Rerouting In Appendix Section F, we use a method similar to that in Section 4.1 to study the contribution of trade rerouting to the increase in sanctioned product exports from neutral countries to Russia. Table F.1 shows that trade rerouting accounted for a significant portion of the increase in sanctioned product exports to Russia – 69% for domestic firms and 51% for non-sanctioning MNEs. These findings indicate that more than half of the growth in sanctioned product exports from non-sanctioning countries to Russia by these firms can be traced back to the same products imported from sanctioning countries, a pattern that should raise concern among policymakers. In contrast, a substantial decline in trade rerouting contributed to over 90% of the decrease in sanctioned product exports by sanctioning MNEs, suggesting their strict compliance with sanctions.

6.2 Exports to Alternative Destinations

We investigate the extent to which sanctioning MNEs, non-sanctioning MNEs, and domestic firms in neutral countries diverted their trade to non-Russian countries in response to the export sanctions. In particular, we seek to understand the underlying motivations for sanctioning MNEs in their trade diversion efforts. If we observe a significant trade diversion to sanctioning countries, it may indicate that their primary motivation was to find alternative markets, as sales to these countries would be unlikely to be redirected to Russia ultimately. On the other hand, if we observe a substantial trade diversion to Russia-friendly countries, it may suggest that sanctioning MNEs are using these countries as a platform to continue serving the Russian market, thereby avoiding the sanctions.

In line with Section 2, we hypothesize that countries potentially serving as indirect export platforms to Russia include non-sanctioning countries that use Russia's System for Transfer of Financial Messages (SPFS), such as Armenia, Cuba, India, Iran, Kazakhstan, and Kyrgyzstan. Additional Russia-friendly countries are members of the Commonwealth of Independent States (CIS), which include Armenia, Azerbaijan, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, and Uzbekistan. Lastly, we consider non-sanctioning countries that share borders with Russia, such as China.

Sanctioning Multinationals Increased Sanctioned Exports to Russia-Friendly Countries. The trade diversion patterns are reported in Tables 8.[48] Panel A studies exports to both SPFS and CIS countries, Panel B focuses on SPFS members, and Panel C focuses on CIS members. In Panels A to C, the coefficients for the interaction between the post-war time dummy and the dummy indicating whether product p faced export sanctions are positive and significant for sanctioning MNEs. This suggests that, compared to non-sanctioned products, sanctioning MNEs substantially increased exports of sanctioned products to Russia-friendly countries. Given that sanctioning MNEs were most restricted from exporting sanctioned products to Russia, this pattern aligns with the motive of these MNEs seeking to avoid sanctions while adjusting trade. In contrast, domestic firms and non-sanctioning MNEs did not strongly increase their exports of sanctioned products to SPFS and CIS countries. As they increased sanctioned product exports to Russia directly, they had limited incentives to redirect trade through Russia-friendly countries.

Panel D focuses on China. Unlike SPFS and CIS countries, sanctioned exports to China did not grow significantly for sanctioning MNEs but increased mainly for non-sanctioning MNEs and domestic firms in neutral countries. One possibility is that many Chinese firms were already supplying sanctioned products to Russia, making the Chinese market more competitive and less profitable for sanctioning MNEs compared to exporting to Russia via SPFS and CIS countries. Another possibility is multi-step indirect exporting to Russia through Hong Kong headquartered MNEs or neutral country domestic firms. In an unreported regression, we find that most non-sanctioning MNEs that increased exports of sanctioned products to China were headquartered in Hong Kong. Sanctioning MNEs may have sold sanctioned products to Hong Kong affiliates in neutral countries or these countries' domestic firms, who then resold the products to China and subsequently to Russia. This strategy might reduce the likelihood of being detected by sanctioning country authorities.

Panel E shows that sanctioning MNEs significantly increased exports of sanctioned products to sanctioning countries, suggesting a genuine effort to switch to new customers. This result, in conjunction with Panels A-C, implies that sanctioning MNEs redirected their exports away from Russia due to a combination of sanction compliance and avoidance motivations.

Columns 2 and 4 of Table 8 show that domestic firms in neutral countries and non-sanctioning

[48]The regression specification we estimate is equations (3.2), where the regressor constitutes the inverse hyperbolic sine of product-level trade flows to other countries.

MNEs significantly increased exports of sanctioned products to China, sanctioning countries, and all non-Russian countries. This can be attributed to economies of scale and learning-by-doing. By capitalizing on the Russian market opportunities left by sanction-compliant firms, they would have gained experience in producing sanctioned products and become more efficient, which likely contributed to the growth of their exports of these products to all destinations.

In Figure G.1, we present the event study analysis for exports to alternative destination markets by sanctioning MNEs and non-sanctioning MNEs. The findings are consistent with what has been reported in Table 8. Table G.2 shows the effects on quantity, which is also consistent with previous results on trade values.

An alternative explanation for the increase in sales by sanctioning MNEs to Russia-friendly countries could be that, facing reduced demand from Russia, they shifted their supply to other markets, with the most viable options being countries similar to Russia, such as SPFS and CIS countries. However, Table G.1, which shows the effects on prices charged by different firm types in various markets, does not support this hypothesis. If the increase in sales to Russia-friendly countries were due to excess supply, prices should decrease. Instead, there is no significant price change in these markets, suggesting that the sales increase was more likely driven by demand reallocation from Russia rather than by excess supply.

7 Sanctioning Multinationals Reduce Imports from Russia More in Trade Finance Intensive Sectors

In this section, we explore potential policies to reduce sanctioning MNEs' imports from Russia. Could financial sanctions be effective? While we have demonstrated that export sanctions successfully reduced sanctioning MNEs' exports to Russia, no comparable extraterritorial sanctions exist for product imports. This gap prompts us to investigate alternative policies that reduce neutral countries' imports from Russia.

Financial sanctions, such as banning numerous Russian banks from SWIFT, heightened the risks associated with trading with Russia, particularly for sectors reliant on trade finance and for sanctioning MNEs. Compared to neutral country domestic firms and non-sanctioning MNEs, sanctioning MNEs are less likely to acquire financing from their headquarters' banks for trade with Russia. This increases the costs of importing from Russia, leading to further reductions in trade within sectors that are intensive in trade finance.

Our empirical strategy follows Manova et al. (2015). We collect ISIC 4-digit level external finance dependence, (the negative of) asset tangibility, (the negative of) trade credit intensity, and inventory ratio.[49] As in Manova et al. (2015), to derive a single trade finance index ($Trade\ Fin_p$), we

[49]We take the negative of asset tangibility and trade credit intensity so that a higher index value represents greater demand for trade finance.

Table 8: Effects of Sanctions on Exports Diversion (Product Level)

	(1)	(2)	(3)	(4)
Panel A. DV: IHS(Export to SPFS + CIS Countries)				
$\text{Post}_t \times \text{SP}_p$	0.0562**	0.0652	0.1218***	-0.0185
	(0.0223)	(0.0552)	(0.0337)	(0.0121)
R^2	0.262	0.632	0.592	0.527
Panel B. DV: IHS(Export to SPFS Countries)				
$\text{Post}_t \times \text{SP}_p$	0.0502**	0.0622	0.1148***	-0.0262*
	(0.0223)	(0.0576)	(0.0286)	(0.0138)
R^2	0.244	0.595	0.564	0.537
Panel C. DV: IHS(Export to CIS Countries)				
$\text{Post}_t \times \text{SP}_p$	0.0529**	0.0641	0.1099***	-0.0153
	(0.0221)	(0.0547)	(0.0358)	(0.0145)
R^2	0.272	0.636	0.612	0.530
Panel D. DV: IHS(Export to China)				
$\text{Post}_t \times \text{SP}_p$	0.0667*	0.2114***	-0.0371	0.0258
	(0.0353)	(0.0775)	(0.0525)	(0.0408)
R^2	0.395	0.785	0.798	0.685
Panel E. DV: IHS(Export to Sanctioning Countries)				
$\text{Post}_t \times \text{SP}_p$	0.1667***	0.2623***	0.1727**	0.0651
	(0.0439)	(0.0855)	(0.0701)	(0.0559)
R^2	0.372	0.842	0.872	0.822
Panel F. DV: IHS(Export to Countries other than Russia)				
$\text{Post}_t \times \text{SP}_p$	0.1491***	0.2013**	0.1460*	0.1000
	(0.0456)	(0.0809)	(0.0755)	(0.0621)
R^2	0.362	0.823	0.875	0.832
Product FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Sample	Full Sample	Domestic firms	MNEs from sanctioning countries	MNEs from non-sanctioning countries
Observations	130977	43659	43659	43659

Notes: Table reports the regression results of equation (3.2) where the dependent variable is the value of exports of products p in India, Pakistan, Mexico, or Vietnam to countries other than Russia. Controls include $\text{Post}_t \times$Capital Intensity_p, $\text{Post}_t \times$Skill Intensity_p, and $\text{Post}_t \times$Advanced Technology_p. Robust standard errors clustered at the product p level are displayed in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

compute the first principal component of the four measures of trade finance intensity, $FPC4_p$. Such a composite measure helps to consider various factors that influence the need for trade finance. As a robustness test, we calculate the mean of the standardized trade finance intensity measures, $AVG4_p$.

To generate firm-sector level variations, we interact the sectoral trade finance index with whether firm i is a sanctioning MNE ($Multi\ San_i$) or a non-sanctioning MNE ($Multi\ No\text{-}San_i$). Additionally, we interact the trade finance index with firm-level financial health measures, such as the firm's financial profit rate, liquidity ratio, leverage ratio, and firm age, all measured using the average value during the pre-war period.[50]

[50]A firm's financial profit rate is defined as the ratio of financial profit to the firm's financial expenditure. The liquidity ratio is calculated as the difference between the firm's current assets and stocks, divided by the firm's current

Table 9: Effects on Import from Russia: Trade Finance Intensity

	(1)	(2)	(3)
	IHS(Value of Import from Russia)		
$\text{Post}_t \times \text{Multinational Sanc}_i \times \text{FPC4}_p$	-0.0049***	-0.0048**	-0.0074***
	(0.0018)	(0.0019)	(0.0021)
$\text{Post}_t \times \text{Multinational Non-Sanc}_i \times \text{FPC4}_p$	0.0040	0.0038	0.0028
	(0.0066)	(0.0065)	(0.0068)
$\text{Post}_t \times \text{Profit Rate}_i \times \text{FPC4}_p$		0.0000	0.0000
		(0.0000)	(0.0000)
$\text{Post}_t \times \text{Liquidity Ratio}_i \times \text{FPC4}_p$		0.0360	0.0355
		(0.0838)	(0.0849)
$\text{Post}_t \times \text{Age}_i \times \text{FPC4}_p$		0.0039	0.0025
		(0.0032)	(0.0031)
$\text{Post}_t \times \text{Leverage}_i \times \text{FPC4}_p$		-0.0006	-0.0002
		(0.0006)	(0.0006)
$\text{Post}_t \times \text{Import}_{ip}^{world}$		-0.0051***	-0.0066***
		(0.0003)	(0.0003)
$\text{Post}_t \times \text{FPC4}_p$			0.0003
			(0.0129)
$\text{Post}_t \times \text{SP}_p$			-0.0014
			(0.0023)
R^2	0.537	0.537	0.504
Firm x Product FE	✓	✓	✓
Firm x Quarter FE	✓	✓	✓
Product x Quarter FE	✓	✓	
Observations	2540252	2540252	2543860

Notes: The table presents the regression estimations of equation (7.1) where the dependent variable is the value of imports of products p by neutral country firm i from Russia. Following Manova et al. (2015), FPC4_p is constructed as the first principal component of external finance dependence, inventory ratio, (the negative of) trade credit intensity and (the negative of) asset tangibility. Profit Rate_i is firm i's financial profit divided by its financial expenditure in 2021. Liquidity Ratio_i equals ($\textit{Current assets}_i - \textit{Stocks}_i$) divided by $\textit{Current liabilities}_i$ in 2021. Leverage_i equals ($\textit{Non current liabilities}_i + \textit{Loans}_i$) divided by $\textit{Shareholders funds}_i$ in 2021. Firm Age_i is the log value of firm i's age. Robust standard errors in parentheses are clustered at firm-product (i, p) level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Our regression equation is the following:

$$\begin{aligned} y_{ipt} = {} & \beta^1 \textit{Post}_t \times \textit{Trade Fin}_p \times \textit{Multi San}_i + \beta^2 \textit{Post}_t \times \textit{Trade Fin}_p \times \textit{Multi No-San}_i \\ & + \gamma \textit{Post}_t \times \textit{Trade Fin}_p \times \textit{Firm Fin Health}_i + \lambda \textit{Post}_t \times \textit{Trade}_{ip,pre}^{World} + \delta_{pt} + \delta_{ip} + \delta_{it} + \epsilon_{ipt}. \end{aligned} \tag{7.1}$$

y_{ipt} denotes import from Russia by firm i in product p time t. On the right-hand side, in addition to the interactions between the post-war time dummy, sectoral trade finance intensity index, and

liabilities. The leverage ratio is calculated as the sum of the firm's non-current liabilities and loans, divided by the firm's shareholder funds. Firm age is measured by the number of years the firm has been continuously operating in the Russian market.

firm-level multinational indicators/financial health, we include product-time, firm-product, and firm-time fixed effects. Furthermore, we control for the effect of firm size, measured by the firm's total imports or exports in product p during the pre-war period.

Table 9 shows that sanctioning MNEs reduced their imports from Russia more in industries that are more intensive in trade finance.[51] Column 1 includes only the effects of multinational status without accounting for the effects of firm financial health. Column 2 incorporates these effects. Column 3, in addition to Column 2, removes the product-time fixed effect but includes interactions between the post-war time dummy and sectoral trade finance intensity, as well as between the post-war time dummy and whether product p is on the export sanctions list.

Robustness As a robustness test, we use the standardized mean of the four trade finance intensity indices, ($AVG4_p$), as a measure of sectoral trade finance intensity in Table H.1. The observed pattern – sanctioning MNEs reducing trade with Russia in sectors more intensive in trade finance, conditional on firm financial health – remains robust.

Event Studies To understand the dynamic effects of trade finance intensity on sanctioning MNE imports and to demonstrate that sectors with different levels of trade finance intensity have parallel trends before the war, we consider the following event study specification:

$$\begin{aligned} y_{ipt} = &\sum_{k=2021q1}^{2023q3} \beta_k \mathbb{I}\{t{=}k\} \times \textit{Multi Sanc}_i \times \textit{Trade Fin}_p \\ &+ \sum_{k=2021q1}^{2023q3} \gamma_k \mathbb{I}\{t{=}k\} \times X_i \times \textit{Trade Fin}_p + \delta_{pt} + \delta_{ip} + \delta_{it} + \epsilon_{ipt}, \end{aligned} \tag{7.2}$$

where, on the right-hand side, we interact time dummies with MNE status and trade finance index. We also interact time dummies with pre-war firm characteristics and sectoral financial risks. Additionally, we control for product-time, firm-product, and firm-time fixed effects.

[51] On the other hand, in an unreported regression (available upon request), we also show that sanctioning MNEs did not significantly reduce exports to Russia more in financially intensive sectors. This pattern suggests that extraterritorial export controls, instead of financial sanctions, played the dominant role in influencing sanctioning MNEs' exports to Russia.

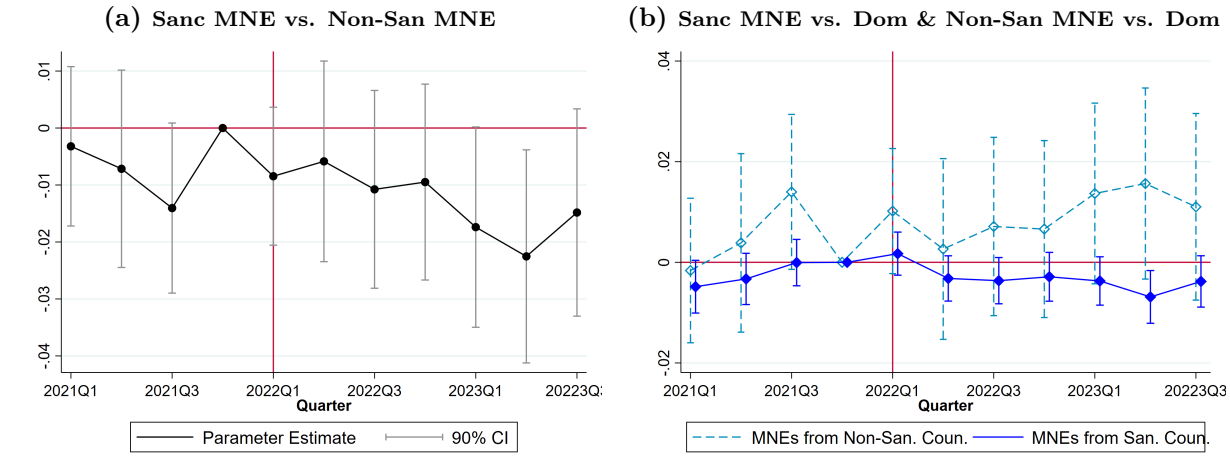

Figure 12: Effects on Import from Russia (Trade Value): Trade Finance Intensity

Notes: Figure displays the coefficients and 90% confidence interval from equation (7.2). The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. The dependent variable is the value of firm i's import of product p from Russia. We control for $Post_t \times X_i \times Multi_m$ and $Post_t \times X_i \times Multi\ Sanc_m$, where X_i includes firm's financial profit rate, liquidity ratio, leverage ratio, and firm age. Standard errors are clustered at the firm-product (i, p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

Figures 12a and 12b show that sanctioning MNEs significantly reduced imports from Russia in trade finance-intensive sectors compared to non-sanctioning MNEs and domestic firms, respectively. In contrast, non-sanctioning MNEs did not significantly reduce imports from Russia in trade finance-intensive sectors, highlighting the role of sanctioning headquarters in driving MNE import decisions.

8 Conclusion

Sanctioning countries have made significant progress in restricting trade with Russia, cutting sanctioned product exports by 80%, non-sanctioned product exports by 40%, and imports from Russia by 80%. However, neutral countries remain a major loophole, enabling Russia to acquire critical supplies and sustain revenue from abroad.

In this paper, we show that while MNEs from sanctioning countries strongly reduced exports of sanctioned products to Russia, complying with their headquarters' sanctions and extending geopolitical influence to the host countries, domestic firms in neutral countries significantly increased these exports on average. In the aggregate, domestic firms were the primary drivers of sanctioned product export growth from neutral countries to Russia. Their compliance could lead to a substantial reduction in Russia's total imports of sanctioned products.

Consumer markets significantly influence compliance. Firms with a larger share of exports to sanctioning countries reduced their sanctioned exports to Russia, motivated by the higher expected penalties for sanction violations, such as revenue freezes and loss of future market access through the SDN List. In contrast, firms with higher imports from sanctioning countries increased their

exports to Russia. This highlights the urgent need to strengthen the Entity List by imposing more immediate restrictions on importers that re-export sanctioned products to Russia.

We document substantial trade rerouting, where neutral country domestic firms increased imports from Russia and exports to sanctioning countries for the same sanctioned products. Trade rerouting accounted for more than half of the growth in sanctioned product exports from neutral country domestic firms to Russia, a finding that should raise concerns among policymakers. Sanctioning MNEs increased exports to both sanctioning and Russia-friendly countries, suggesting a mix of compliance and avoidance.

Sanctioning MNEs reduced their imports from Russia more in trade finance intensive sectors compared to firms with similar financial performances. This implies that sanctioning MNEs faced higher cost of financing for their Russian trade from headquarters banks and reallocated their input sourcing further away from Russia, in particular in sectors that require greater trade finance.

We argue that effective sanctions should mobilize MNEs in neutral countries, as they are more likely to comply with export sanctions and respond to financial sanctions. The success of future sanctions depends on discouraging neutral country domestic firms and non-sanctioning MNEs from trading with sanctioned countries. This could be achieved through strengthened secondary sanctions that swiftly restrict violators importing from sanctioning countries and limit their market access. To further isolate Russia, additional policies incentivizing neutral countries to reduce imports from Russia are crucial. Our findings underscore the importance of MNEs and the extraterritorial reach of sanctions in geopolitical conflicts beyond the Russia-Ukraine war.

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Online Appendix

Appendix A Trends of Russian Trade

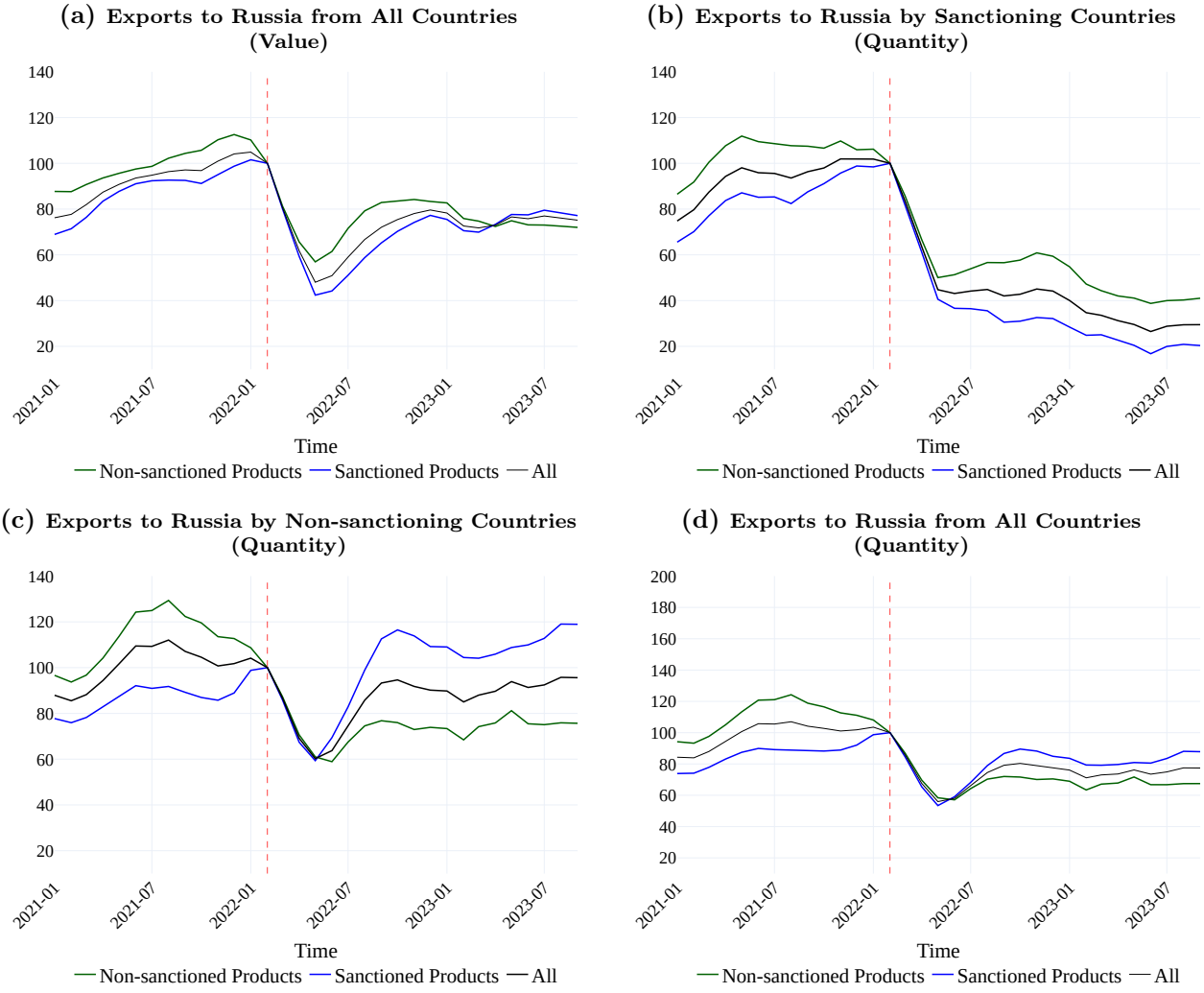

Figure A.1: Trends of Trade with Russia

Notes: Figure A.1a presents the 3-month moving average of the monthly value of exports to Russia from all countries. Figures A.1b, A.1c, and A.1d present the 3-month moving average of the monthly quantity of exports to Russia from sanctioning countries, non-sanctioning countries, and all countries, respectively. Green, blue, and black lines refer to non-sanctioned products, sanctioned products, and all products, respectively. Each line is normalized to a value of 100 in February 2022. The analogous figures for the value of exports from sanctioning countries and non-sanctioning countries are presented in Figure 1. Data source: UN Comtrade.

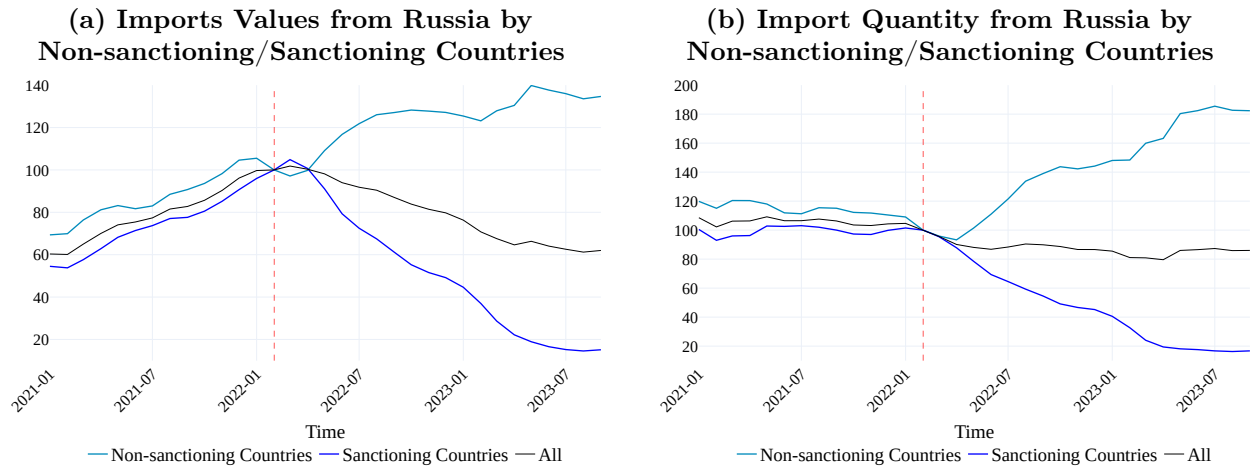

Figure A.2: Imports from Russia by Non-sanctioning/Sanctioning Countries

Notes: Figure presents the 3-month moving average of monthly import value in Figure A.2a, and quantity in Figure A.2b from Russia. Light blue, blue, and grey lines refer to non-sanctioning countries, sanctioning countries, and all countries. The vertical dotted red line refers to the onset of the Russo-Ukrainian War. Each line is normalized to a value of 100 in February 2022. Data source: UN Comtrade.

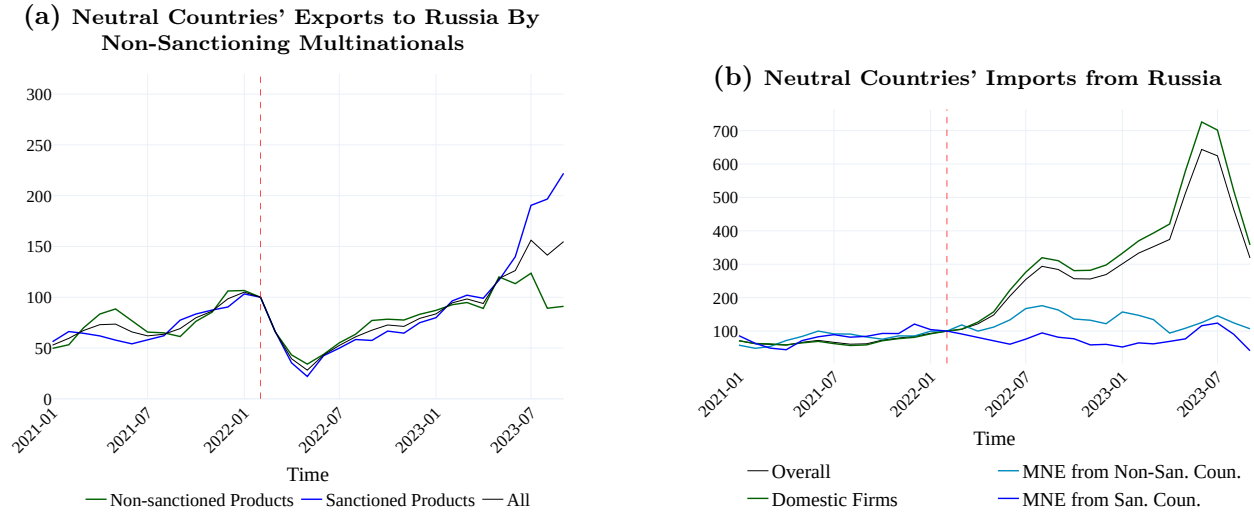

Figure A.3: Trade Value with Russia by Product Sanction Status and Firm Type

Notes: Figures present the 3-month moving average of export and import value between the four non-sanctioning countries (Mexico, Vietnam, India, and Pakistan) with Russia. Figure A.3a depicts multinational subsidiaries headquartered in non-sanctioning countries (non-sanctioning MNEs), and A.3b depicts the total import from Russia by the four non-sanctioning countries. Each line is normalized to a value of 100 in February 2022. The analogous trend for the quantity of exports is presented in Figure A.4. Data source: S&P Panjiva.

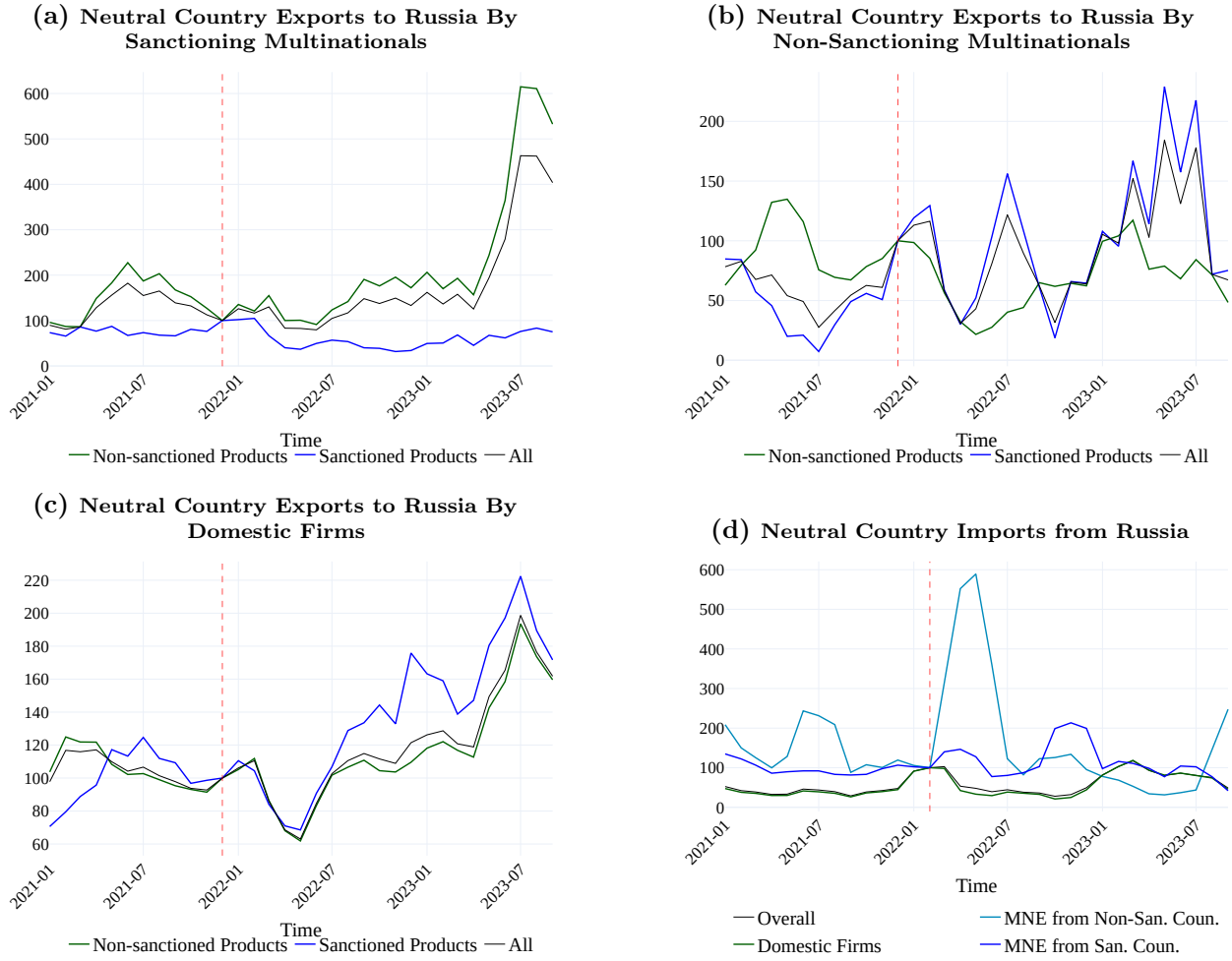

Figure A.4: Combined Export Quantity from Mexico, Vietnam, India, and Pakistan to Russia by Product Sanction Statuses and Multinational Types

Notes: Figures present the 3-month moving average of export and import quantity from the four non-sanctioning countries we study (Mexico, Vietnam, India, and Pakistan) to Russia. Figure A.4a displays the exports to Russia by multinational subsidiaries headquartered in sanctioning countries (sanctioning MNEs), whereas Figure A.4b depicts multinational subsidiaries headquartered in non-sanctioning countries (non-sanctioning MNEs), and A.4c depicts those by domestic firms. A.4d depicts the total import from Russia into the four non-sanctioning countries. Each line is normalized to a value of 100 in February 2022. The analogous trend for the value of exports is presented in Figure 2 and Figure A.3. Data source: S&P Panjiva.

Appendix B Comparison between Panjiva and Comtrade

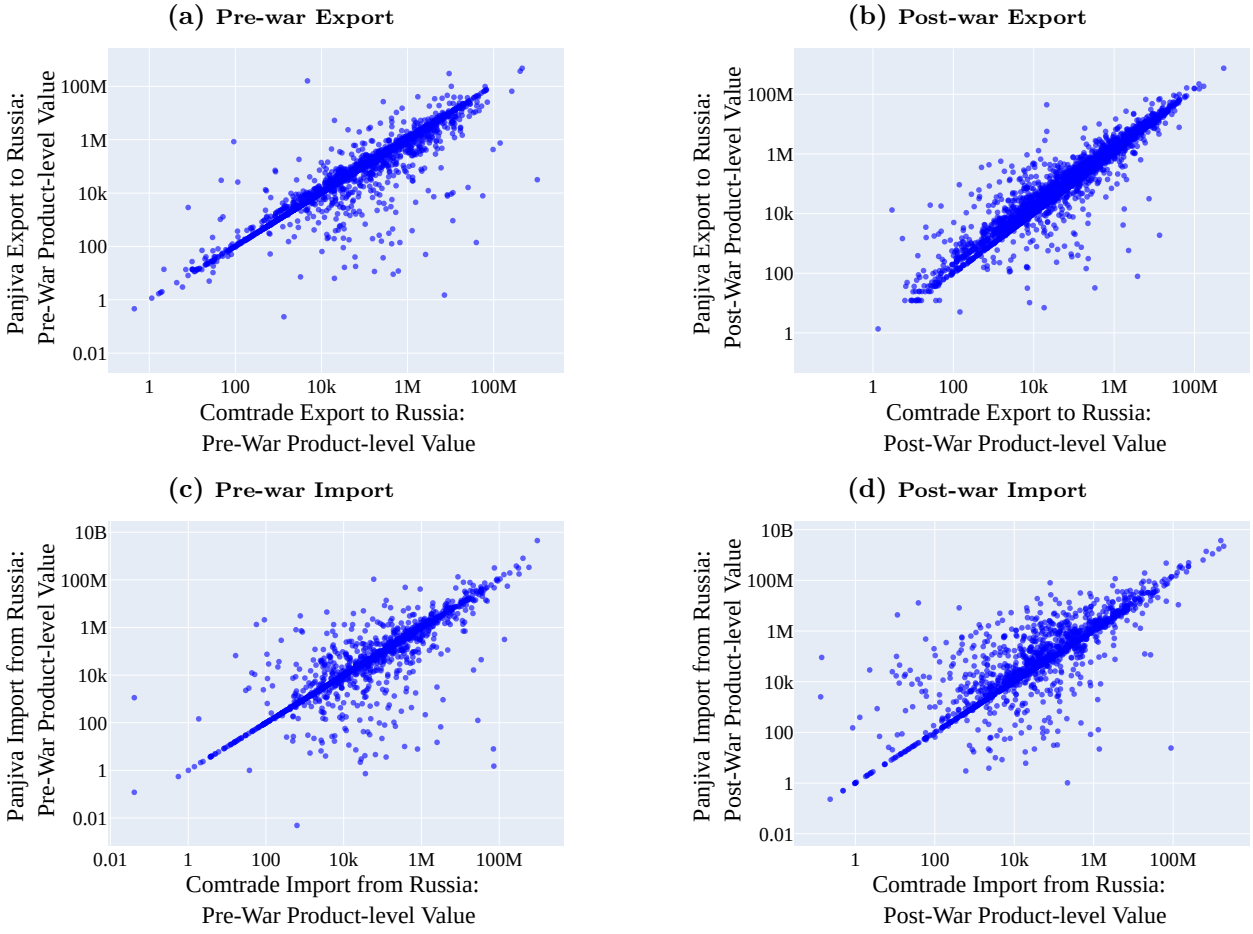

Figure B.1: Comparing Trade Values between Panjiva and Comtrade

Notes: These figures present trade values from S&P Panjiva (y-axis) and UN Comtrade (x-axis) at the 6-digit HS Code level, covering both pre-war and post-war periods. The pre-war period includes 2021Q1-2021Q4, and post-war period includes 2022Q1-2023Q3. Each data point refers to the trade value of a product between the developing countries (Mexico, Vietnam, India, and Pakistan) and Russia as calculated by S&P Panjiva and reported in UN Comtrade. Data for Mexico, Vietnam, India, and Pakistan are pooled together. The correlation coefficients for these figures are as follows. B.1a: corr=0.914; B.1b: corr= 0.944; B.1c: corr = 0.838; B.1d: corr = 0.815.

Appendix C Summary Statistics

Table C.1: Post-war Exports Summary Statistics by Multinational Status

Country	Type	# Firms	# Products per Firm	# Partners per Firm	# SCs per Firm	# SCs per Firm-Product	# SCs per Firm-Partner	Value per Firm	Value per SC
Mexico	All	61	4.1	1.8	6.1	1.5	3.3	493,973	81,439
	Non-santioning MNE	15	2.0	1.9	2.8	1.4	1.5	501,744	179,194
	Sanctioning MNE	9	2.8	1.2	3.1	1.1	2.5	219,060	70,412
	Domestic	37	5.4	1.9	8.1	1.5	4.2	557,694	68,782
Vietnam	All	820	3.4	2.1	4.9	1.4	2.4	1,063,129	216,265
	Non-santioning MNE	67	3.0	2.7	5.3	1.8	1.9	1,926,920	365,733
	Sanctioning MNE	51	5.4	2.6	7.2	1.3	2.8	1,043,215	144,576
	Domestic	702	3.4	2.0	4.7	1.4	2.4	982,134	208,296
India	All	5,700	3.6	2.5	6.4	1.8	2.5	1,080,563	169,853
	Non-santioning MNE	160	2.6	2.6	4.5	1.7	1.7	1,217,446	271,297
	Sanctioning MNE	239	3.1	2.3	5.5	1.8	2.4	1,205,172	220,043
	Domestic	5,301	3.7	2.5	6.5	1.8	2.6	1,070,814	165,806
Pakistan	All	206	2.2	1.6	2.9	1.3	1.8	245,970	85,591
	Non-santioning MNE	2	6.0	1.5	9.5	1.6	6.3	1,614,543	169,952
	Sanctioning MNE	1	2.0	1.0	2.0	1.0	2.0	235,357	117,679
	Domestic	203	2.1	1.6	2.8	1.3	1.8	232,538	82,671

Notes: This table presents the number of firms, the number of products, partners, and supply chains per firm, and trade value with Russia per firm and per supply chain within each MNE type for exports in the post-war periods. A firm's MNE type is based on its global ultimate owner country.

Table C.2: Pre-war Imports Summary Statistics by Multinational Status

Country	Type	# Firms	# Products per Firm	# Partners per Firm	# SCs per Firm	# SCs per Firm-Product	# SCs per Firm-Partner	Value per Firm	Value per SC
Mexico	All	346	2.9	2.0	3.9	1.3	2.0	6,111,308	1,560,526
	Non-santioning MNE	60	1.8	2.0	2.8	1.5	1.4	5,306,341	1,929,578
	Sanctioning MNE	78	2.2	2.2	3.3	1.5	1.5	17,271,104	5,282,926
	Domestic	208	3.5	1.9	4.5	1.3	2.4	2,158,587	480,199
Vietnam	All	1,400	2.3	2.0	3.4	1.5	1.6	1,260,984	375,772
	Non-santioning MNE	105	2.8	2.4	4.0	1.4	1.7	949,682	237,987
	Sanctioning MNE	87	1.5	1.7	2.3	1.5	1.4	643,560	282,776
	Domestic	1,208	2.3	2.0	3.4	1.5	1.7	1,332,510	394,431
India	All	2,800	1.8	2.8	3.6	2.0	1.3	3,445,397	953,460
	Non-santioning MNE	84	2.3	2.0	3.5	1.5	1.8	9,589,962	2,758,756
	Sanctioning MNE	170	2.1	1.8	2.9	1.4	1.6	1,651,726	561,587
	Domestic	2,546	1.8	2.9	3.7	2.1	1.3	3,362,436	917,946
Pakistan	All	370	1.4	1.4	1.8	1.2	1.2	367,117	208,974
	Non-santioning MNE	1	1.0	1.0	1.0	1.0	1.0	14,770	14,770
	Sanctioning MNE	11	1.6	1.6	2.5	1.5	1.5	448,260	182,624
	Domestic	358	1.4	1.4	1.7	1.2	1.2	365,608	210,430

Notes: This table presents the number of firms, the number of products, partners, and supply chains per firm, and trade value with Russia per firm and per supply chain within each MNE type for imports in the pre-war periods. A firm's MNE type is based on its global ultimate owner country.

Table C.3: Post-war Imports Summary Statistics by Multinational Status

Country	Type	# Firms	# Products per Firm	# Partners per Firm	# SCs per Firm	# SCs per Firm-Product	# SCs per Firm-Partner	Value per Firm	Value per SC
Mexico	All	260	2.9	2.3	4.4	1.5	1.9	8,063,162	1,827,744
	Non-santioning MNE	41	2.1	2.6	3.7	1.8	1.4	6,580,665	1,763,446
	Sanctioning MNE	65	2.8	2.9	4.5	1.6	1.6	17,768,222	3,915,032
	Domestic	154	3.1	2.0	4.5	1.4	2.2	4,361,561	960,916
Vietnam	All	952	2.5	1.8	3.5	1.4	2.0	1,025,796	289,093
	Non-santioning MNE	67	2.7	1.8	3.4	1.3	2.0	498,606	144,617
	Sanctioning MNE	64	1.6	1.7	2.2	1.4	1.3	637,093	291,242
	Domestic	821	2.6	1.8	3.7	1.4	2.0	1,099,119	300,092
India	All	2,010	2.2	2.4	3.8	1.7	1.6	8,100,192	2,134,424
	Non-santioning MNE	68	3.2	2.7	5.3	1.7	2.0	25,382,263	4,754,804
	Sanctioning MNE	98	3.4	1.8	4.7	1.4	2.6	2,224,886	468,901
	Domestic	1,844	2.1	2.4	3.7	1.7	1.5	7,775,137	2,108,434
Pakistan	All	146	1.2	1.5	1.7	1.4	1.1	329,784	198,142
	Non-santioning MNE	0							
	Sanctioning MNE	6	1.8	2.0	3.0	1.6	1.5	384,148	128,049
	Domestic	140	1.2	1.4	1.6	1.3	1.1	327,454	203,749

Notes: This table presents the number of firms, the number of products, partners, and supply chains per firm, and trade value with Russia per firm and per supply chain within each MNE type for imports in the post-war periods. A firm's MNE type is based on its global ultimate owner country.

Table C.4: Post-War Summary of Sanctioned Products

	# Sanctioned Products (Share in Sectoral Product #)	Sanctioned Product Share in Sectoral Trade Value							
		Export				Import			
Sector		Mexico	Vietnam	India	Pakistan	Mexico	Vietnam	India	Pakistan
Agriculture	33 (3.34%)	49.11%	0.12%	9.34%	91.91%	0.91%	0.38%	0.03%	0.00%
Mining and Energy	39 (26.53%)	0	88.82%	77.54%	0.09%	93.19%	93.04%	13.86%	35.16%
Durables	1495 (64.58%)	19.20%	51.69%	75.36%	45.89%	74.61%	65.77%	31.33%	9.86%
Nondurables	564 (26.07%)	1.67%	29.26%	17.75%	18.11%	86.46%	24.64%	22.06%	33.22%
All	2131 (37.97%)	23.24%	23.42%	38.14%	31.89%	47.38%	40.90%	13.58%	8.74%

Notes: This table presents the number and share of 6-digit HS code products subject to sanctions across various sectors, as well as the percentage of post-war trade with Russia that these sanctioned products accounted for. The sanctioned product lists are derived from Supplements No. 2, No. 4, No. 5, and No. 7 of Part 746 of the Export Administration Regulations (EAR) (https://www.bis.doc.gov/index.php/regulations/export-administration-regulations-ear. Products included in these supplements require licenses for export to Russia.

C.1 Sales Growth, Entry, and Exit by Firm Type

Observation 1. *MNEs headquartered in sanctioning countries exhibited a greater export decline, a higher supply chain exit rate, and a lower supply chain entry rate compared to non-sanctioning MNEs and domestic firms within the same host country.*

Table C.5 shows that, except for Pakistan, exports by MNEs headquartered in sanctioning countries significantly decreased compared to those from non-sanctioning countries and domestic firms in neutral countries. Pakistan was an exception due to the limited presence of sanctioning MNEs. For other countries, compared to the other two groups of firms, sanctioning MNEs contributed the most to the overall decrease in neutral country exports to Russia.

Supply chains through which developing countries export to Russia were significantly disrupted by the war and ensuing sanctions, featuring high exits and turnovers, particularly for sanctioning MNEs.[52] Table C.5 further shows that sanctioning MNEs displayed higher exit rates and lower entry rates at both the supply chain level and firm-product level. Regardless of MNE status, firms in these neutral countries experienced higher exit rates and turnovers, compared to other developing and advanced countries during normal times (see Kasahara and Tang 2019 for China, Alvarez and López 2005, 2008 for Chile, Bernard and Wagner 2001 for Germany, and Bernard et al. 2009 for US). These findings suggest that the conflict and sanctions considerably amplified the destruction and creation of supply chains.

Table C.5: Export Entry and Exit Rates by Multinational Status

Country	Type	Value Growth	Contribution	Exit rate			Entry rate		
				Supply Chain	Firm-Product	Firm	Supply Chain	Firm-Product	Firm
Mexico	All	-76.30%	100.00%	0.95	0.81	0.75	0.86	0.58	0.38
	Sanctioning MNE	-97.60%	82.80%	0.99	0.96	0.88	0.75	0.64	0.44
	Non-sanctioning MNE	-39.30%	5.02%	0.80	0.71	0.58	0.45	0.23	0.07
	Domestic	-36.40%	12.17%	0.92	0.68	0.76	0.92	0.63	0.49
Vietnam	All	-6.14%	100.00%	0.68	0.60	0.44	0.67	0.58	0.39
	Sanctioning MNE	-67.35%	192.43%	0.57	0.52	0.38	0.45	0.32	0.20
	Non-sanctioning MNE	68.86%	-92.33%	0.75	0.65	0.47	0.73	0.56	0.39
	Domestic	0.01%	-0.10%	0.69	0.61	0.44	0.68	0.61	0.41
India	All	23.81%	100.00%	0.78	0.57	0.41	0.89	0.77	0.57
	Sanctioning MNE	-75.69%	-75.71%	0.88	0.75	0.57	0.83	0.65	0.46
	Non-sanctioning MNE	24.21%	3.20%	0.83	0.68	0.46	0.89	0.78	0.56
	Domestic	56.25%	172.50%	0.76	0.55	0.40	0.89	0.77	0.58
Pakistan	All	-63.82%	100.00%	0.91	0.80	0.70	0.85	0.68	0.51
	Sanctioning MNE	432.12%	-0.21%	1.00	1.00	1.00	1.00	1.00	1.00
	Non-sanctioning MNE	-75.47%	11.12%	0.97	0.71	0.50	0.95	0.08	0.00
	Domestic	-62.78%	89.10%	0.91	0.80	0.70	0.84	0.70	0.51

Notes: This table presents the changes in export values to Russia for each country and by MNE status, from pre-war to post-war periods. It also shows sectoral contributions to country-level export changes and the exit-entry rates at various levels, including supply chain, firm-product, and trading firm. Trade growth is computed with the method discussed in Section 2.4, taking into account the different time window lengths between the pre-war and post-war periods.

[52] In line with Broda and Weinstein (2010) and other, we define the exit rate as the ratio of the number of exiters to the sum of exiters and continuers, while the entry rate is defined as the ratio of the number of entrants to the sum of entrants and continuers.

Table C.6: Import Entry and Exit Rates by Multinational Status

Country	Type	Value Growth	Contribution	Exit rate			Entry rate		
				Supply Chain	Firm-Product	Firm	Supply Chain	Firm-Product	Firm
Mexico	All	-17.38%	100.00%	0.78	0.67	0.47	0.74	0.55	0.29
	Sanctioning MNE	-28.56%	104.68%	0.62	0.49	0.32	0.67	0.52	0.18
	Non-sanctioning MNE	-29.38%	25.45%	0.78	0.57	0.50	0.76	0.47	0.27
	Domestic	24.67%	-30.14%	0.83	0.73	0.51	0.77	0.58	0.34
Vietnam	All	-53.90%	100.00%	0.82	0.66	0.56	0.75	0.55	0.35
	Sanctioning MNE	-39.31%	2.31%	0.69	0.56	0.48	0.56	0.41	0.30
	Non-sanctioning MNE	-72.08%	7.55%	0.79	0.66	0.50	0.62	0.43	0.22
	Domestic	-53.28%	90.13%	0.83	0.66	0.57	0.76	0.56	0.36
India	All	40.64%	100.00%	0.89	0.71	0.64	0.86	0.67	0.49
	Sanctioning MNE	-35.29%	-2.53%	0.87	0.78	0.65	0.86	0.77	0.39
	Non-sanctioning MNE	78.55%	16.14%	0.79	0.58	0.51	0.83	0.62	0.40
	Domestic	39.56%	86.39%	0.90	0.72	0.64	0.86	0.67	0.50
Pakistan	All	-70.46%	100.00%	0.93	0.86	0.81	0.81	0.59	0.51
	Sanctioning MNE	-61.05%	3.15%	0.70	0.56	0.64	0.56	0.27	0.33
	Non-sanctioning MNE	-100.00%	0.02%	1.00	1.00	1.00	0.00	0.00	0.00
	Domestic	-70.81%	96.84%	0.94	0.87	0.81	0.83	0.61	0.52

Notes: This table presents the changes in export values to Russia for each country and by MNE status, from pre-war to post-war periods. It also shows sectoral contributions to country-level export changes and the exit-entry rates at various levels, including supply chain, firm-product, and trading firm. Trade growth is computed with the method discussed in Section 2.4, taking into account the different time window lengths between the pre-war and post-war periods.

Observation 2. *MNEs headquartered in sanctioning countries did not display a more pronounced import decline from Russia compared to non-sanctioning MNEs and domestic firms.*

Table C.6 shows that the reduction in imports by sanctioning MNEs was not significantly greater than that of non-sanctioning MNEs or domestic firms. This aligns with Western export sanctions, which impose extraterritorial restrictions on products utilizing Western technologies, software, or components, but not on imports.

Unlike exports, sanctioning MNEs did not have significantly higher exit rates or lower entry rates in their import supply chains. Import supply chains from Russia were significantly disrupted across all firm types, with high exit rates and turnover. For instance, 78% of Mexican pre-war import supply chains from Russia disappeared after the war, while new entrants made up 74% of the post-war supply chains.

These observations prompt us to explore alternative policies to reduce neutral country firms' imports from Russia. We find that financial sanctions may decrease imports by sanctioning MNEs from Russia in financially dependent sectors.

C.2 Decomposing Trade Changes with Russia

We decompose the change of non-sanctioning countries' trade with Russia into several components: (1) firm entry/exit from trade, (2) trade partner entry/exit for continuing trading firms, (3) product entry/exit for continuing trading firm-partner relationship, and (4) continuing supply chains.

We use the term "trading firm" to refer to a neutral country firm engaged in exports or imports with Russia. A Russian firm trading with a neutral country firm is called a "trade partner", while a trading firm-partner-product relationship is referred to as a "supply chain". We define an entrant trading firm/trade partner/supply chain as one that appeared between Q2 2022 and Q3 2023 but did not exist between Q1 2021 and Q1 2022. An exited trading firm/trade partner/supply chain is one that was present between Q1 2021 and Q1 2022 but disappeared during Q2 2022 and Q3 2023. A continuing trading firm/trade partner/supply chain is one that appears in the data during both Q1 2021 to Q1 2022 and Q2 2022 to Q3 2023 periods.

The change in a country's total trade with Russia, ΔX, can be decomposed into three components: changes in trade by continuing firms in the country, adding trade by firms who entered Russia since the war, and subtracting trade by trading firms that exited following the onset of the war:[53]

$$\Delta X = \sum_{i \in \text{Cont}} \Delta x_i + \sum_{i \in \text{Entry}} x_i - \sum_{i \in \text{Exit}} x_i \tag{C.1}$$

The change in trade by a continuing firm can be broken down into changes with ongoing Russian trade partners, the addition of new trade partners, and the subtraction of trade from exited partners:

$$\Delta x_i = \sum_{j \in \text{Cont Partner}_i} \Delta x_{ij} + \sum_{j \in \text{Enter Partner}_i} x_{ij} - \sum_{j \in \text{Exit Partner}_i} x_{ij} \tag{C.2}$$

The change in trade with a continuing partner can be further decomposed into changes within continuing products/supply chains, the addition of new products, and the subtraction of discontinued products:

$$\Delta x_{ij} = \sum_{p \in \text{Cont Supply Chain}_{ij}} \Delta x_{ijp} + \sum_{p \in \text{Enter Product}_{ij}} x_{ijp} - \sum_{p \in \text{Exit Product}_{ij}} x_{ijp} \tag{C.3}$$

To calculate the contribution share of each component, we divide it by the total change in trade.

Figure C.1 shows that extensive margins, where firms enter and exit trade and add or drop Russian partners, substantially contributed to trade changes with Russia for all developing countries. As Section C.1 indicates, war and subsequent sanctions greatly disrupted supply chains between Russia and other developing countries, leading to high exits and turnovers of trade partners. Consequently, Table C.7 shows that partner exit accounted for 227% and 152% of the export changes from Vietnam

[53] Bernard et al. (2009) and Flaaen et al. (2023) use similar decomposition formulas.

and India to Russia, and partner entry accounted for 178% of the import increase in India from Russia. Trading firm exit also contributed 101% to the change in Mexican exports and 370% to the change in Vietnamese exports from Russia. In contrast, the intensive margin – trade changes within ongoing supply chains – had, at most, a moderate impact on total trade changes. This differs from findings by Bernard et al. (2009) and Flaaen et al. (2020), who report that in the US, during normal times and the Covid-19 pandemic, the intensive margin – continuing supply chains – contributed most to the change in total trade. These patterns imply that conflict and sanctions disrupt supply chains to an extent unmatched by regular economic shocks or natural disasters.

Table C.7: Decomposition of a Country's Total Trade Change with Russia

Trading Firm Status	Partner Status	Product Status	Export				Import			
			Mexico	Vietnam	India	Pakistan	Mexico	Vietnam	India	Pakistan
Trading Firm Entry			-7.34%	-312.53%	140.53%	-7.28%	-10.68%	-15.55%	101.53%	-6.64%
Trading Firm Exit			101.46%	370.16%	-62.89%	68.40%	25.53%	98.39%	-65.93%	68.45%
Continuing Trading Firms			5.87%	42.37%	22.36%	38.88%	85.15%	17.17%	64.40%	38.19%
Continuing Trading Firms	Partner Entry		-11.79%	-308.38%	147.45%	-27.31%	-259.01%	-36.15%	177.85%	-14.68%
Continuing Trading Firms	Partner Exit		13.76%	226.73%	-152.82%	52.12%	60.41%	35.45%	-94.64%	42.09%
Continuing Trading Firms	Continuing Partners		3.90%	124.01%	27.73%	14.06%	283.75%	17.87%	-18.82%	10.78%
Continuing Trading Firms	Continuing Partners	Product Entry	-0.52%	-91.32%	21.95%	-3.48%	-20.70%	-2.44%	13.72%	-1.10%
Continuing Trading Firms	Continuing Partners	Product Exit	2.82%	85.14%	-15.39%	3.54%	24.47%	5.37%	-6.58%	1.45%
Continuing Trading Firms	Continuing Partners	Continuing Products	1.60%	130.19%	21.17%	14.01%	279.98%	14.94%	-25.96%	10.43%

Notes: This table displays the various margins that contributed to Mexico, Vietnam, India and Pakistan's trade changes with Russia. Based on equations (C.1)-(C.3), a country's total trade change with Russia is decomposed into contributions by (1) trading firm entry/exit, (2) trade partner entry/exit for continuing trading firms, (3) product entry/exit for continuing trading firm-partner relationship, and (4) continuing supply chains.

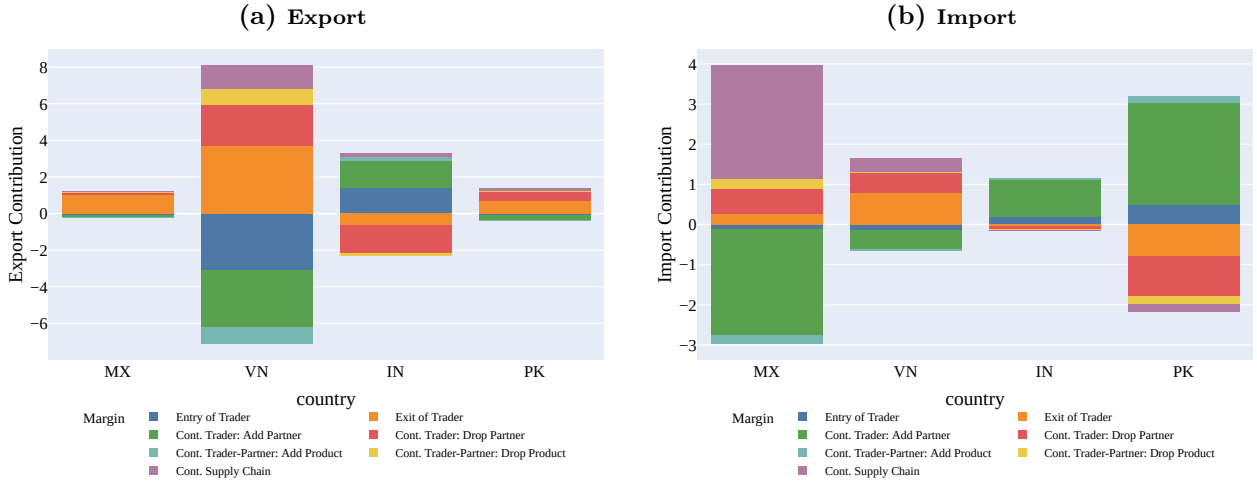

Figure C.1: Contributions to Non-Sanctioning Countries' Trade with Russia

Notes: This figure displays the various margins that contributed to Mexico, Vietnam, India, and Pakistan's trade changes with Russia. A country's total trade change with Russia is decomposed into contributions by (1) trading firm entry/exit, (2) trade partner entry/exit for continuing trading firms, (3) product entry/exit for continuing trading firm-partner relationship, and (4) continuing supply chains.

Appendix D Extensions and Robustness Tests

D.1 Triple Differences with Multinational Statuses

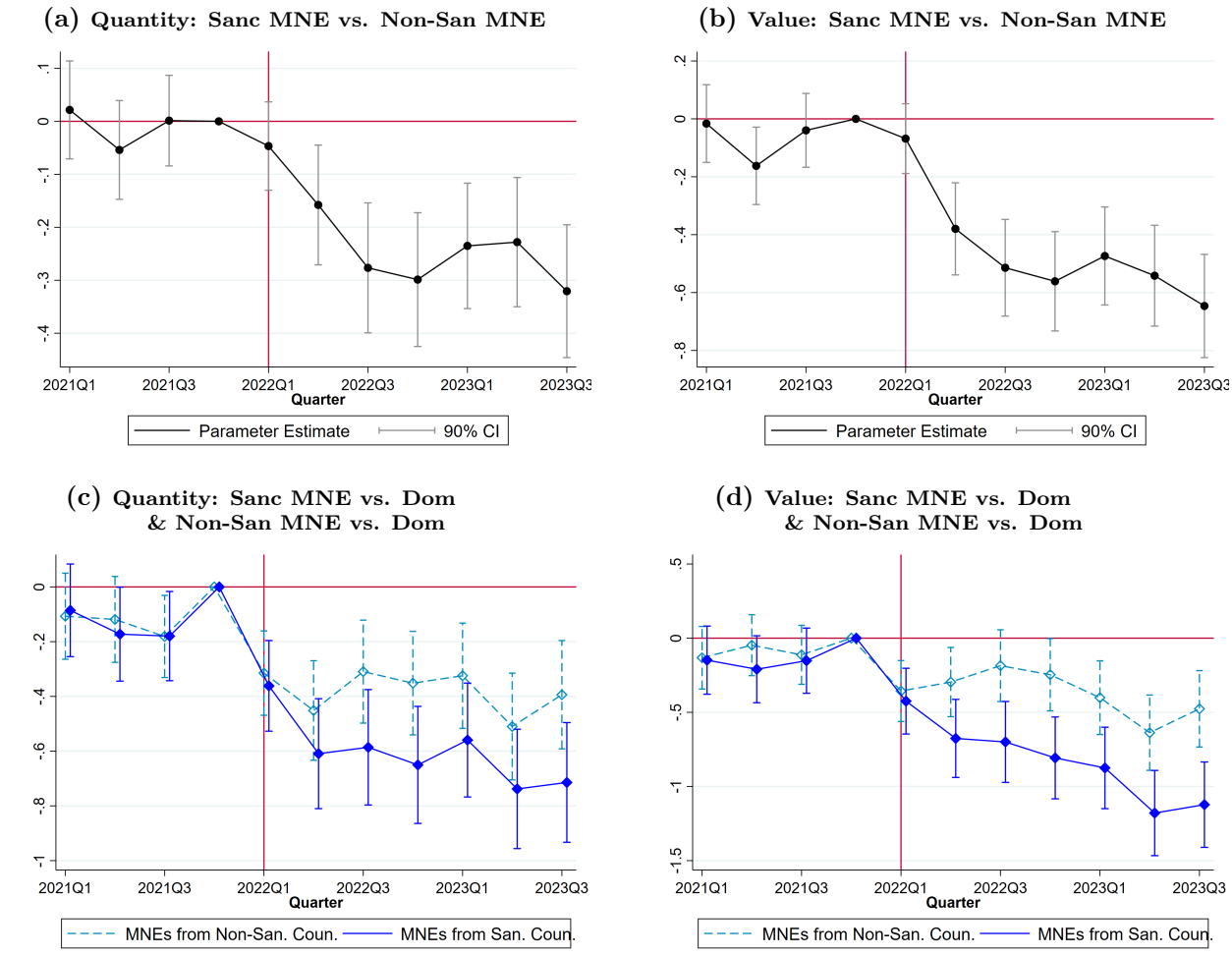

Figure D.1: Effects of Sanctions on Exporting Sanctioned Products to Russia: (Triple Differences - Product Level)

Notes: Figure displays the coefficients and 90% confidence interval from equation (3.3). The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Controls for $Post_t \times X_p \times Multi_m$ and $Post_t \times X_p \times Multi\ Sanc_m$, where X_p includes skill intensity, capital intensity, and advanced technology usage, are included. Standard errors are clustered at the product (p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

D.2 Firm-Product Level Analysis

We implement the following event study specification at firm-product level to understand the dynamic effects of sanctioning MNEs relative to non-sanctioning MNEs or domestic firms in reducing sanctioned product exports:

$$y_{ipt} = \sum_{k=2021q1}^{2023q3} \beta_k \mathbb{I}\{t{=}k\} \times SanProd_p \times Multi_i + \sum_{k=2021q1}^{2023q3} \gamma_k \mathbb{I}\{t{=}k\} \times X_p \times Multi_i + \delta_{pt} + \delta_{ip} + \delta_{it} + \epsilon_{ipt}. \tag{D.1}$$

We estimate the average treatment effect using the following specification:

$$y_{impt} = \beta_m Post_t \times SanProd_p + \gamma_m Post_t \times X_p + \delta_{imp} + \delta_{imt} + \epsilon_{impt}, \quad i \in \Omega(m), m \in \{\text{Domestic, Sanctioning MNE, Non-sanctioning MNE, All}\}, \tag{D.2}$$

$$y_{ipt} = \beta Post_t \times SanProd_p \times Multi_i + \gamma Post_t \times X_p \times Multi_i + \delta_{pt} + \delta_{ip} + \delta_{it} + \epsilon_{ipt}. \tag{D.3}$$

Figure D.2 shows that, consistent with product-level findings, sanctioning MNEs experienced the largest decrease in exports of sanctioned products, while domestic firms adjusted in the opposite direction, increasing sanctioned product exports. These results demonstrate how MNEs transmit sanctions from their headquarters to subsidiaries and affected trade in host countries. Meanwhile, domestic firms in neutral countries exploit sanctions by expanding sanctioned product exports to Russia, filling the gaps left by sanctioning MNEs.

Figure D.3 presents the estimates for the "triple-difference" analysis where we compare sanctioning MNEs to firms of other ownership types. Consistent with the product-level results, sanctioning MNEs significantly reduce their exports of sanctioned products to Russia more than domestic firms and non-sanctioning MNEs.

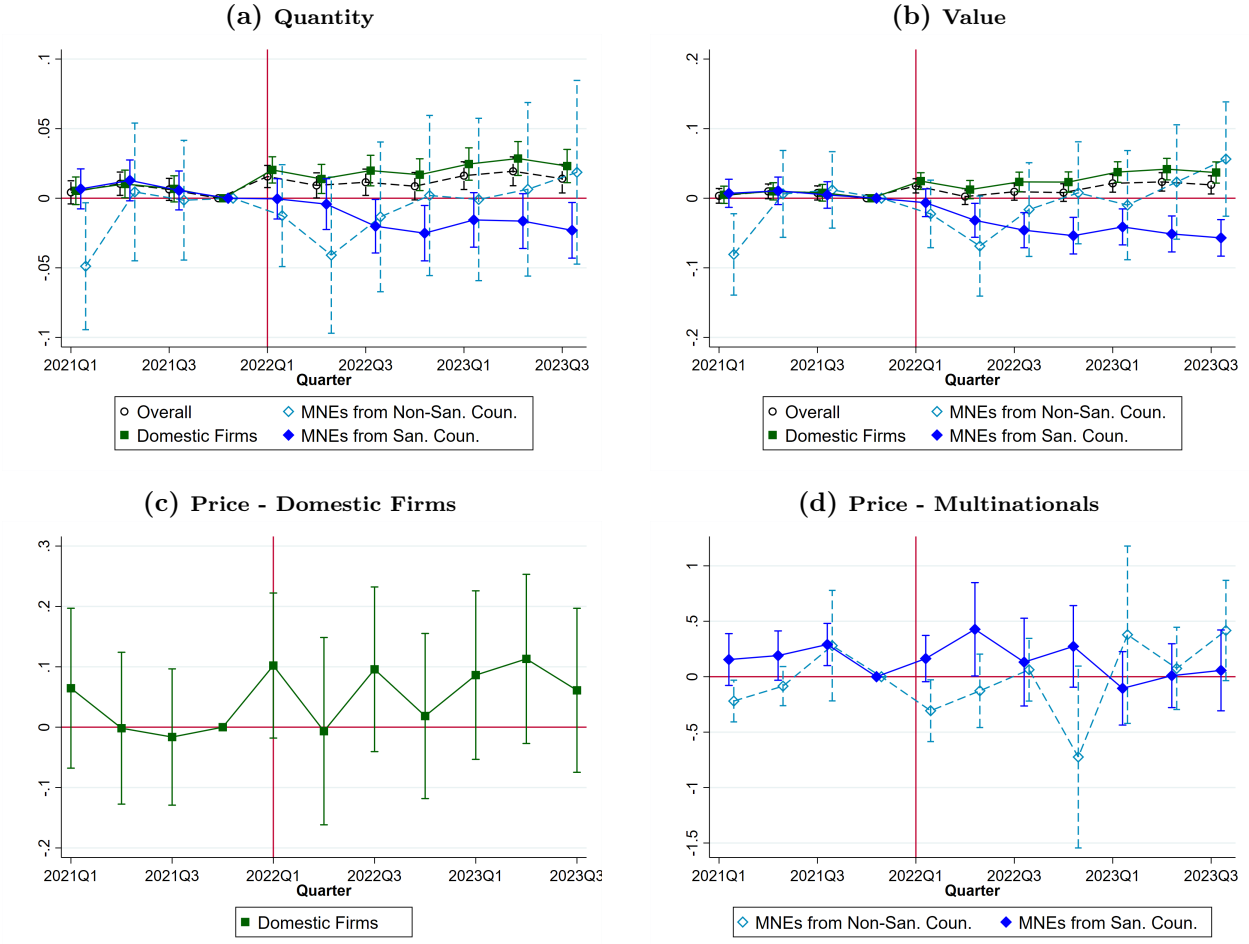

Figure D.2: Effects of Export Sanctions on Exporting Sanctioned Products to Russia by Multinational Status (Firm-Product Level)

Notes: Figure displays the coefficients and 90% confidence interval from equation (3.6) for each sample indicated by the legend. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the firm-product (i, p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

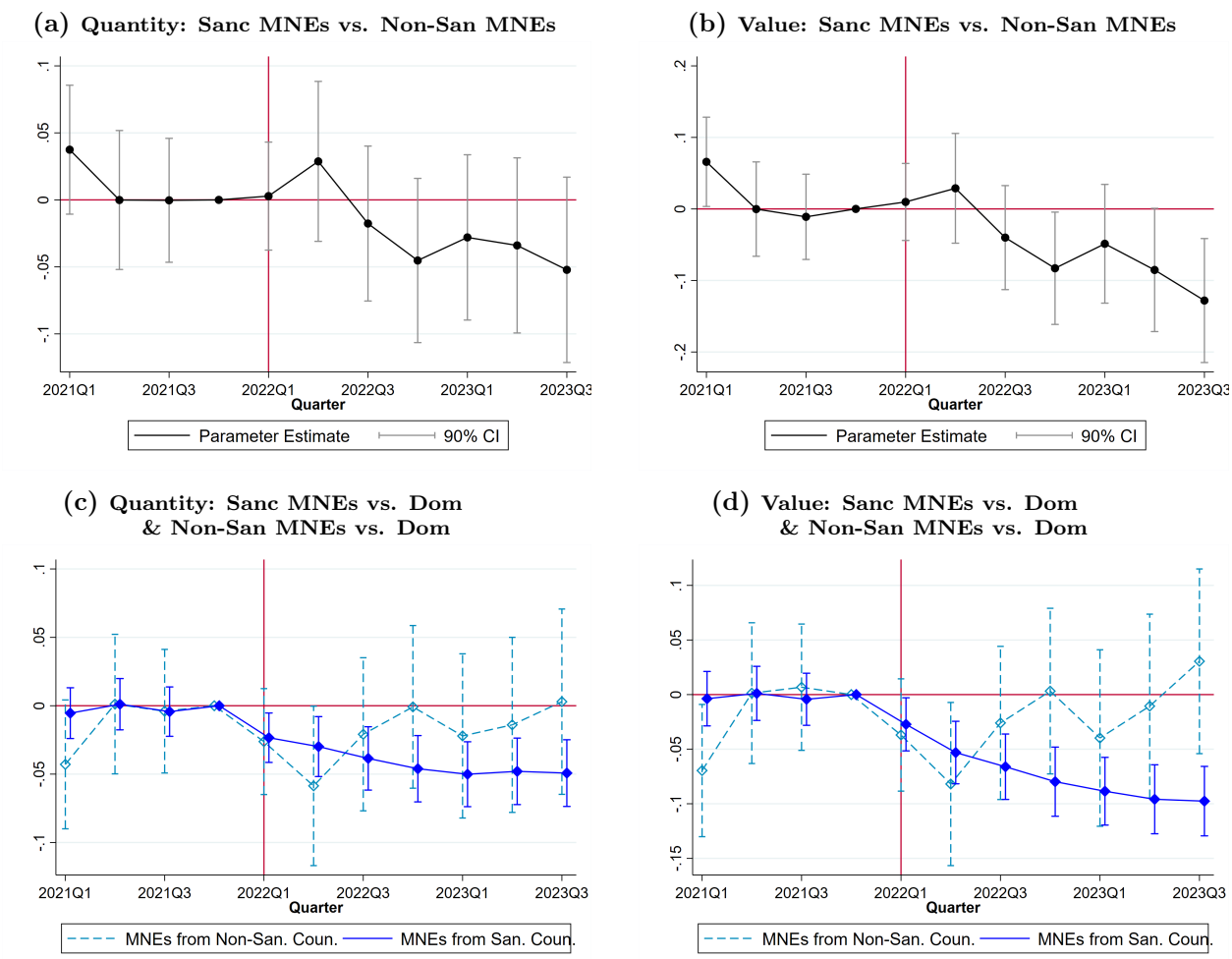

Figure D.3: Effects of Sanctions on Exporting Sanctioned Products to Russia: (Triple Differences with Firm Types, Firm-Product Level)

Notes: Figure displays the coefficients and 90% confidence interval from equation (D.1). The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Controls include $Post_t \times X_p \times Multi_m$ and $Post_t \times X_p \times Multi\ Sanc_m$, where X_p encompasses skill intensity, capital intensity, and advanced technology usage. Standard errors are clustered at the firm-product (i, p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

Table D.1: Effects of Sanctions on Exports to Russia (Triple Differences with Firm Types, Firm-Product Level)

	(1)	(2)	(3)	(4)	(5)
	IHS(Value of Export to Russia)				
$\text{Post}_t \times \text{Multi}_i \times \text{SP}_p$	-0.0639***	-0.0077			
	(0.0119)	(0.0306)			
$\text{Post}_t \times \text{Multi San}_i \times \text{SP}_p$		-0.0632**	-0.1008***	-0.0696***	-0.0709***
		(0.0318)	(0.0124)	(0.0123)	(0.0125)
$\text{Post}_t \times \text{Multi No-Sanc}_i \times \text{SP}_p$			0.0586*	-0.0116	-0.0077
			(0.0352)	(0.0307)	(0.0306)
$\text{Post}_t \times \text{Multi San}_i$			-0.0130		
			(0.0483)		
$\text{Post}_t \times \text{Multi No-Sanc}_i$			-0.2095		
			(0.1431)		
$\text{Post}_t \times \text{SP}_p$				0.0229***	
				(0.0053)	
$\text{Post}_t \times \text{Capital Intensity}_p$				0.0296***	
				(0.0032)	
$\text{Post}_t \times \text{Skill Intensity}_p$				0.0249***	
				(0.0077)	
$\text{Post}_t \times \text{Advanced Technology}_p$				0.0168**	
				(0.0068)	
R^2	0.597	0.597	0.499	0.588	0.597
Firm x Product FE	✓	✓	✓	✓	✓
Firm x Quarter FE	✓	✓		✓	✓
Country x Quarter FE			✓		
Product x Quarter FE	✓	✓	✓		✓
Controls	✓	✓	✓	✓	✓
Observations	2479983	2479983	2495944	2482722	2479983

Notes: Table reports the regression results of equation (D.3) where the dependent variable is the value of exports of products p in India, Mexico, or Vietnam to Russia. Firm x Quarter controls absorb $\text{Post}_t \times \text{Multi}_i$ and $\text{Post}_t \times \text{Multi Sanction}_i$. Column (1) controls for $Post_t \times X_p \times Multi_i$. Column (2) controls for $Post_t \times X_p \times Multi_i$ and $Post_t \times X_p \times Multi\ Sanc_i$. Column (3)-(5) control for $Post_t \times X_p \times Multi\ Sanc_i$ and $Post_t \times X_p \times Multi\ No\text{-}Sanc_i$. X_p includes skill intensity, capital intensity, and advanced technology usage. Robust standard errors in parentheses are clustered at the firm-product (i, p) level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

D.3 Instrumenting Export Sanctions on Russia

Table D.2: Effects of Sanctions on Value of Exports to Russia (IV, Product Level)

	(1)	(2)	(3)	(4)
	Panel A: IHS(Quantity of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	-0.1207	0.5688*	-1.1155***	0.1847**
	(0.1354)	(0.3028)	(0.2720)	(0.0926)
R^2	0.001	0.013	-0.030	-0.000
F-stat	187.5	187.4	187.4	187.4
N	140547	46849	46849	46849
	Panel B: IHS(Value of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	-0.3552*	0.6902*	-2.0430***	0.2871**
	(0.1856)	(0.4019)	(0.3788)	(0.1238)
R^2	0.001	0.012	-0.052	-0.001
F-stat	187.5	187.4	187.4	187.4
N	140547	46849	46849	46849
	Panel C: Log(Price of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.2842	0.4990*	-0.2342	-0.5786
	(0.2453)	(0.2620)	(0.7587)	(1.1302)
R^2	-0.000	-0.003	-0.002	0.021
F-stat	136.2	147.5	30.5	5.4
N	18445	14604	2759	764
Product FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Sample	Full Sample	Domestic Firms	MNEs from Sanctioning Countries	MNEs from Non-Sanctioning Countries

Notes: Table reports the regression results of equation (3.2) where the dependent variable is the quantity (Panel A), value (Panel B), and price (Panel C) of exports of products p in India, Mexico, Vietnam or Pakistan to Russia. Controls include $\text{Post}_t \times \text{Capital Intensity}_p$, $\text{Post}_t \times \text{Skill Intensity}_p$, and $\text{Post}_t \times \text{Advanced Technology}_p$. Robust standard errors in parentheses are clustered at the product (p) level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

D.4 Extensive and Intensive Margins, and PPML Estimations

In this section, we separately examine the extensive and intensive margins. For the extensive margin, we perform analogous regressions with the dependent variable being an indicator of trading a non-zero amount. The results are reported in Tables D.3 and D.4. For the intensive margin, we use the log trade value as the dependent variable, where we drop zero trade observations. The outcomes are presented in Tables D.5 and D.6 .

Overall, we find that the extensive margin dominates the aggregate outcome although intensive margin adjustment also points to the same direction, a pattern consistent with the summary statistics presented in Section C.2 which shows that the extensive margin is more important in driving neutral countries' trade changes with Russia from pre-war to post-war periods. When we analyze the extensive margin adjustment, the main qualitative patterns are maintained: the

likelihood of engaging in exporting sanctioned products to Russia decreased for sanctioning MNEs but increased for domestic firms. This is true whether the analysis is conducted at product level (Table D.3) or at firm-product level (Table D.4). The intensive margin adjustment points in the same direction. The significant increase in exports to Russia among domestic firms is observed at product level, but not at firm-product level.

Figure D.4 presents the results of the Poisson Pseudo Maximum Likelihood (PPML) estimations. Consistent with the baseline, both the signs and magnitudes of the coefficients indicate that, in terms of quantity and value, domestic firms increased their exports of sanctioned products to Russia, while sanctioning MNEs significantly decreased theirs.

Table D.3: Extensive Margin Effects of Sanctions on Exports to Russia (Product Level)

	(1)	(2)	(3)	(4)
	Panel A: I(Quantity of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	-0.0004	0.0204***	-0.0283***	0.0067**
	(0.0033)	(0.0077)	(0.0055)	(0.0028)
R^2	0.251	0.648	0.578	0.512
N	140547	46849	46849	46849
	Panel B: I(Value of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.0013	0.0248***	-0.0279***	0.0069**
	(0.0033)	(0.0076)	(0.0055)	(0.0028)
R^2	0.251	0.647	0.579	0.515
N	140547	46849	46849	46849
Product FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Sample	Full Sample	Domestic Firms	MNEs from Sanctioning Countries	MNEs from Non-Sanctioning Countries

Notes: Table reports the regression results of equation (3.2) where the dependent variable is the indicator of exporting non-zero amount of product p to Russia. Controls include $\text{Post}_t \times \text{Capital Intensity}_p$, $\text{Post}_t \times \text{Skill Intensity}_p$, and $\text{Post}_t \times \text{Advanced Technology}_p$. Robust standard errors in parentheses are clustered at the product (p) level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table D.4: Extensive Margin Effects of Sanctions on Exports to Russia (Firm-Product)

	(1)	(2)	(3)	(4)
	Panel A: I(Quantity of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.0007	0.0019***	-0.0046***	0.0009
	(0.0005)	(0.0005)	(0.0011)	(0.0027)
R^2	0.545	0.548	0.514	0.542
N	2482722	2023472	407154	52096
	Panel B: I(Value of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.0008*	0.0021***	-0.0044***	0.0013
	(0.0005)	(0.0005)	(0.0011)	(0.0027)
R^2	0.544	0.547	0.515	0.545
N	2482722	2023472	407154	52096
Firm x Product FE	✓	✓	✓	✓
Firm x Quarter FE	✓	✓	✓	✓
Sample	Full Sample	Domestic Firms	Multinational Sanc Firms	Multinational Non-Sanc Firms

Notes: Table reports the regression results of equation (D.2) where the dependent variable is the indicator of exporting non-zero amount of product p to Russia. Controls include $\text{Post}_t \times$Capital Intensity_p, $\text{Post}_t \times$Skill Intensity_p, and $\text{Post}_t \times$Advanced Technology_p. Robust standard errors in parentheses are clustered at the firm-product (i, p) level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table D.5: Intensive Margin Effects of Sanctions on Exports to Russia (Product Level)

	(1)	(2)	(3)	(4)
	Panel A: Log(Quantity of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.0132	0.1909*	-0.5707**	0.6026*
	(0.1082)	(0.1058)	(0.2700)	(0.3551)
R^2	0.649	0.775	0.775	0.872
N	18445	14604	2759	764
	Panel B: Log(Value of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.0883	0.3150***	-0.4234	0.4591
	(0.0912)	(0.0846)	(0.2748)	(0.2839)
R^2	0.586	0.723	0.735	0.821
N	18445	14604	2759	764
Product FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Sample	Full Sample	Domestic Firms	MNEs from Sanctioning Countries	MNEs from Non-Sanctioning Countries

Notes: Table reports the regression results of equation (3.2) where the dependent variable is the log quantity (Penal A) and log value (Panel B) of exports of product p to Russia. By taking logs, we focus on the intensive margin, and zero-trade observations are dropped from the sample. Controls include $\text{Post}_t \times$Capital Intensity_p, $\text{Post}_t \times$Skill Intensity_p, and $\text{Post}_t \times$Advanced Technology_p. Robust standard errors in parentheses are clustered at the product (p) level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Table D.6: Intensive Margin Effects of Sanctions on Exports to Russia (Firm-Product)

	(1)	(2)	(3)	(4)
	Panel A: Log(Quantity of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	-0.0018	0.0268	-0.1121	-0.4102
	(0.0649)	(0.0740)	(0.1415)	(0.3068)
R^2	0.929	0.929	0.927	0.940
N	34226	29991	3645	590
	Panel B: Log(Value of Export to Russia)			
$\text{Post}_t \times \text{SP}_p$	0.0452	0.0932	-0.1241	-0.5823**
	(0.0645)	(0.0710)	(0.1604)	(0.2670)
R^2	0.904	0.897	0.927	0.916
N	34226	29991	3645	590
Firm x Product FE	✓	✓	✓	✓
Firm x Quarter FE	✓	✓	✓	✓
Sample	Full Sample	Domestic Firms	Multinational Sanc Firms	Multinational Non-Sanc Firms

Notes: Table reports the regression results of equation (D.2) where the dependent variable is the log quantity (Penal A) and log value (Panel B) of exports of product p to Russia. By taking logs, we focus on the intensive margin, and zero-trade observations are dropped from the sample. Controls include $\text{Post}_t \times$Capital Intensity$_p$, $\text{Post}_t \times$Skill Intensity$_p$, and $\text{Post}_t \times$Advanced Technology$_p$. Robust standard errors in parentheses are clustered at the firm-product (i, p) level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

D.5 Controlling Additional Product Characteristics

Regardless of whether the analysis is conducted at the product level (Table D.7), or firm-product level (Table D.8), we obtain reassuringly consistent results as we control for additional product characteristics, including pre-war total product-level or firm-product-level trade value, contract intensity, external finance dependence, asset tangibility, trade credit intensity, and inventory ratio.

Table D.7: Effects of Sanctions on Exports to Russia (Product Level with Controls)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	IHS(Value of Export to Russia)									
$\text{Post}_t \times \text{Multi San}_m \times \text{SP}_p$	-0.6437***	-0.6224***	-0.8761***	-0.7878***	-0.8752***	-0.7639***	-0.8856***	-0.8183***	-0.9704***	-0.5603***
	(0.1044)	(0.1024)	(0.1042)	(0.1037)	(0.1088)	(0.1050)	(0.1061)	(0.1048)	(0.1107)	(0.1139)
$\text{Post}_t \times \text{Multi No-Sanc}_m \times \text{SP}_p$	-0.3000***	-0.1956**	-0.4172***	-0.3249***	-0.5081***	-0.3211***	-0.4662***	-0.3512***	-0.5425***	-0.3439***
	(0.0886)	(0.0882)	(0.0888)	(0.0887)	(0.0945)	(0.0904)	(0.0920)	(0.0893)	(0.0972)	(0.0993)
R^2	0.828	0.828	0.828	0.827	0.827	0.825	0.825	0.825	0.825	0.827
Product x MNEs Status FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
MNEs Status x Quarter FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Product x Quarter FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Additional Controls	$\text{Export}^{World}_{p,2021}$	Skill Intensity	Capital Intensity	Advanced Technology	Contract Intensity	External Finance Dependence	Asset Tangibility	Trade Credit Intensity	Inventory Ratio	All
Observations	140547	140547	140547	140547	140547	139161	139161	139161	139161	139161

Notes: Table reports the regression results of equation (3.4) where the dependent variable is the value of exports of products p in India, Mexico, Vietnam, or Pakistan to Russia. Additional product-level controls (interacted with $Post_t$ and multinational statuses) are indicated in each column, where the last column includes all controls. Robust standard errors in parentheses are clustered at the product (p) level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

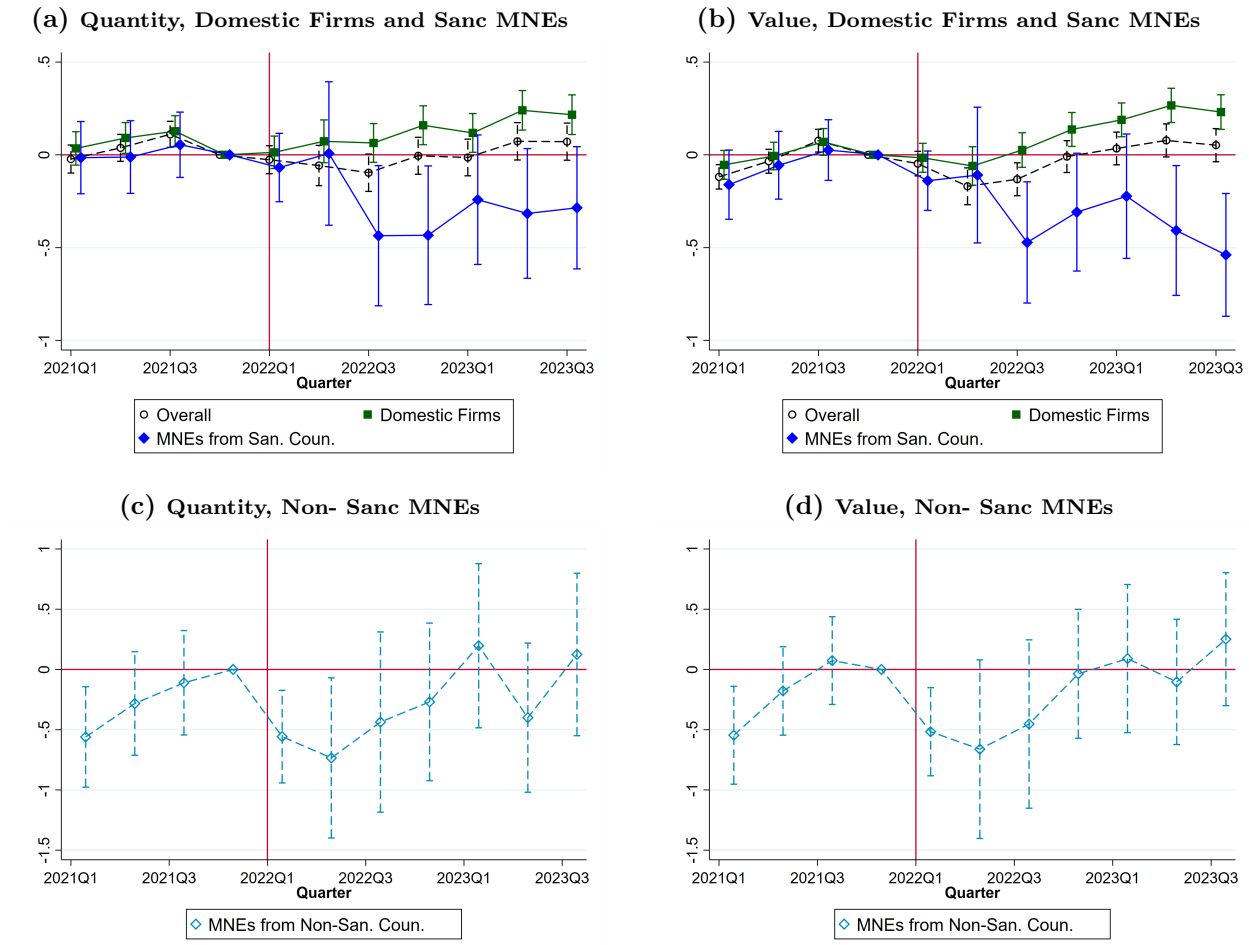

Figure D.4: Effects of Export Sanctions on Exporting Sanctioned Products to Russia by Multinational Status (Product Level, PPML)

Notes: Figure displays the coefficients and 90% confidence interval from equation (3.1) for each sample indicated by the legend. PPML regression results are reported. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the product (p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

Table D.8: Effects of Sanctions on Exports to Russia (Firm-Product Level with Controls)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	IHS(Value of Export to Russia)									
$\text{Post}_t \times \text{Multi San}_i \times \text{SP}_p$	-0.0559***	-0.0671***	-0.0716***	-0.0754***	-0.0600***	-0.0723***	-0.0666***	-0.0705***	-0.0742***	-0.0483***
	(0.0117)	(0.0123)	(0.0119)	(0.0125)	(0.0125)	(0.0129)	(0.0125)	(0.0119)	(0.0129)	(0.0136)
$\text{Post}_t \times \text{Multi No-Sanc}_i \times \text{SP}_p$	-0.0042	-0.0091	-0.0037	-0.0076	0.0054	-0.0125	0.0010	-0.0042	0.0029	-0.0039
	(0.0294)	(0.0297)	(0.0300)	(0.0307)	(0.0315)	(0.0307)	(0.0311)	(0.0295)	(0.0321)	(0.0320)
R^2	0.598	0.597	0.597	0.597	0.597	0.592	0.592	0.592	0.592	0.592
Firm x Product FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Firm x Quarter FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Product x Quarter FE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Additional Controls	$\text{Export}^{World}_{ip,2021}$	Skill Intensity	Capital Intensity	Advanced Technology	Contract Intensity	External Finance Dependence	Asset Tangibility	Trade Credit Intensity	Inventory Ratio	All
Observations	2479983	2479983	2479983	2479983	2479983	2445201	2445201	2445201	2445201	2445201

Notes: Table reports the regression results of equation (D.3) where the dependent variable is the value of exports of products p from firm i in India, Mexico, Vietnam or Pakistan to Russia. Additional product-level controls (interacted with $Post_t$ and $Multi_i$) are indicated in each column, where the last column includes all controls. Robust standard errors in parentheses are clustered at the firm-product (i, p) level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

D.6 Controlling Additional Headquarters Country Characteristics

Our baseline findings remain robust when accounting for various other headquarters country characteristics. For example, the observed patterns could be attributed to the economic development stage of the headquarters countries rather than their status as sanctioning countries. To address this concern, we control for whether the headquarters countries are advanced economies and whether they have above-median GDP per capita among all headquarters countries (Table D.9).

Our baseline finding is not affected by neutral country firms' trade ties with sanctioning countries. Trade with sanctioning countries could be a confounding factor, as firms importing more inputs from them may be more bound by extraterritorial export sanctions, while those exporting more to them may face greater penalties for violations. Sanctioning MNEs, headquartered in sanctioning countries, naturally have stronger trade ties with them.[54] To account for this, we control for firms' export and import shares with sanctioning countries. Table D.9 confirms our earlier finding: Sanctioning MNEs show a sharper decline in sanctioned exports to Russia compared to domestic firms and non-sanctioning MNEs. We will explore the role of trade linkages in compliance in Section 5.

Finally, considering the involvement of financial sanctions following the war, the financial stability of sanctioning countries might also influence the effectiveness of sanctions. To account for this, we include controls for the headquarters countries' liquidity liabilities to GDP ratio, central bank assets to GDP ratio, and deposit money bank assets to GDP ratio. Table D.10 presents the results with these additional controls, reaffirming the robustness of our main findings from Table D.1.

[54] See Li (2023).

Table D.9: Effects of Sanctions on Exports to Russia (Firm-Product Level - Trade Share and Advanced Economy Controls)

	(1)	(2)	(3)	(4)	(5)
	IHS(Value of Export to Russia)				
$\text{Post}_t \times \text{Multi San}_i \times \text{SP}_p$	-0.0676***	-0.0799***	-0.0867**	-0.0989*	-0.1176*
	(0.0128)	(0.0130)	(0.0423)	(0.0590)	(0.0608)
$\text{Post}_t \times \text{Multi No-Sanc}_i \times \text{SP}_p$	-0.0062	-0.0096	-0.0141	-0.0133	-0.0181
	(0.0306)	(0.0307)	(0.0349)	(0.0353)	(0.0368)
$\text{Post}_t \times \text{San Exp Share}_{i,2021} \times \text{SP}_p$	-0.0231*				-0.0280**
	(0.0123)				(0.0124)
$\text{Post}_t \times \text{San Imp Share}_{i,2021} \times \text{SP}_p$		0.0379***			0.0421***
		(0.0143)			(0.0145)
$\text{Post}_t \times \text{HQ Above Median}_{i,2021} \times \text{SP}_p$			0.0170		0.0108
			(0.0416)		(0.0458)
$\text{Post}_t \times \text{HQ Advance Economy}_i \times \text{SP}_p$				0.0281	0.0307
				(0.0578)	(0.0667)
R^2	0.597	0.597	0.597	0.597	0.597
Firm x Product FE	✓	✓	✓	✓	✓
Firm x Quarter FE	✓	✓	✓	✓	✓
Product x Quarter FE	✓	✓	✓	✓	✓
Observations	2479983	2479983	2479983	2479983	2479983

Notes: Table reports the regression results of equation (D.3) where the dependent variable is the value of exports of products p in India, Mexico, Vietnam, or Pakistan to Russia. *San Exp Share*$_{i,2021}$ measures firm i's export share from sanctioning countries in 2021. *San Imp Share*$_{i,2021}$ measures firm i's import share from sanctioning countries in 2021. *HQ Advanced Economy*$_i$ is an indicator that equals 1 if the headquarters of the firm is in an advanced economy. *HQ Above Median*$_i$ is an indicator that equals 1 if the headquarters' GDP per capita is above the median of all headquarters countries in the sample. All columns control for *Post*$_t \times X_p \times$ *Multi Sanc*$_i$ and *Post*$_t \times X_p \times$ *Multi No-Sanc*$_i$, where X_p includes skill intensity, capital intensity, and advanced technology usage. Robust standard errors in parentheses are clustered at the firm-product (i, p) level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table D.10: Effects of Sanctions on Exports to Russia (Firm-Product Level - Headquarters Finance System Development Controls)

	(1)	(2)	(3)	(4)
	IHS(Value of Export to Russia)			
$\text{Post}_t \times \text{Multi San}_i \times \text{SP}_p$	-0.0725***	-0.0643***	-0.0661***	-0.0712***
	(0.0157)	(0.0149)	(0.0159)	(0.0152)
$\text{Post}_t \times \text{Multi No-Sanc}_i \times \text{SP}_p$	-0.0073	-0.0127	-0.0035	-0.0173
	(0.0429)	(0.0467)	(0.0442)	(0.0476)
$\text{Post}_t \times$ Private Credit $\text{Ratio}_{i,2021} \times \text{SP}_p$	0.0182			0.0012
	(0.0142)			(0.0944)
$\text{Post}_t \times$ Debt $\text{Ratio}_{i,2021} \times \text{SP}_p$		0.0034		-0.0114
		(0.0125)		(0.0216)
$\text{Post}_t \times$ DM Asset $\text{Ratio}_{i,2021} \times \text{SP}_p$			0.0125	0.0290
			(0.0161)	(0.1115)
R^2	0.601	0.601	0.601	0.601
Firm x Product FE	✓	✓	✓	✓
Firm x Quarter FE	✓	✓	✓	✓
Product x Quarter FE	✓	✓	✓	✓
Observations	2314191	2301761	2314895	2301761

Notes: Table reports the regression results of equation (D.3) where the dependent variable is the value of exports of products p in India, Mexico, Vietnam, or Pakistan to Russia. *Private Credit Ratio*$_i$ measures firm i's headquarter country's private credit by deposit money banks to GDP in 2021. *Debt Ratio*$_i$ measures firm i's headquarter country's liquidity liabilities to GDP ratio in 2021. *DM Asset Ratio*$_i$ measures firm i's headquarter country's deposit money bank assets to GDP ratio in 2021. All columns control for *Post*$_t \times X_p \times$ *Multi Sanc*$_i$ and *Post*$_t \times X_p \times$ *Multi No-Sanc*$_i$. X_p includes skill intensity, capital intensity, and advanced technology usage. Robust standard errors in parentheses are clustered at the firm-product (i, p) level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

D.7 Results by Individual Neutral Countries

While sanctioning MNEs reduced their exports of sanctioned products to Russia in both countries, domestic firms in India increased these exports more significantly and consistently (Figures D.5a and D.5b). In contrast, domestic firms in Mexico only increased their sanctioned exports to Russia during the first two quarters after the war began (Figures D.5c and D.5d). One possible explanation for this difference is that the US, a major sanctioning country, may have leveraged its strong trade ties with Mexico to enhance compliance among Mexican domestic firms. We will explore this further in Section 5.

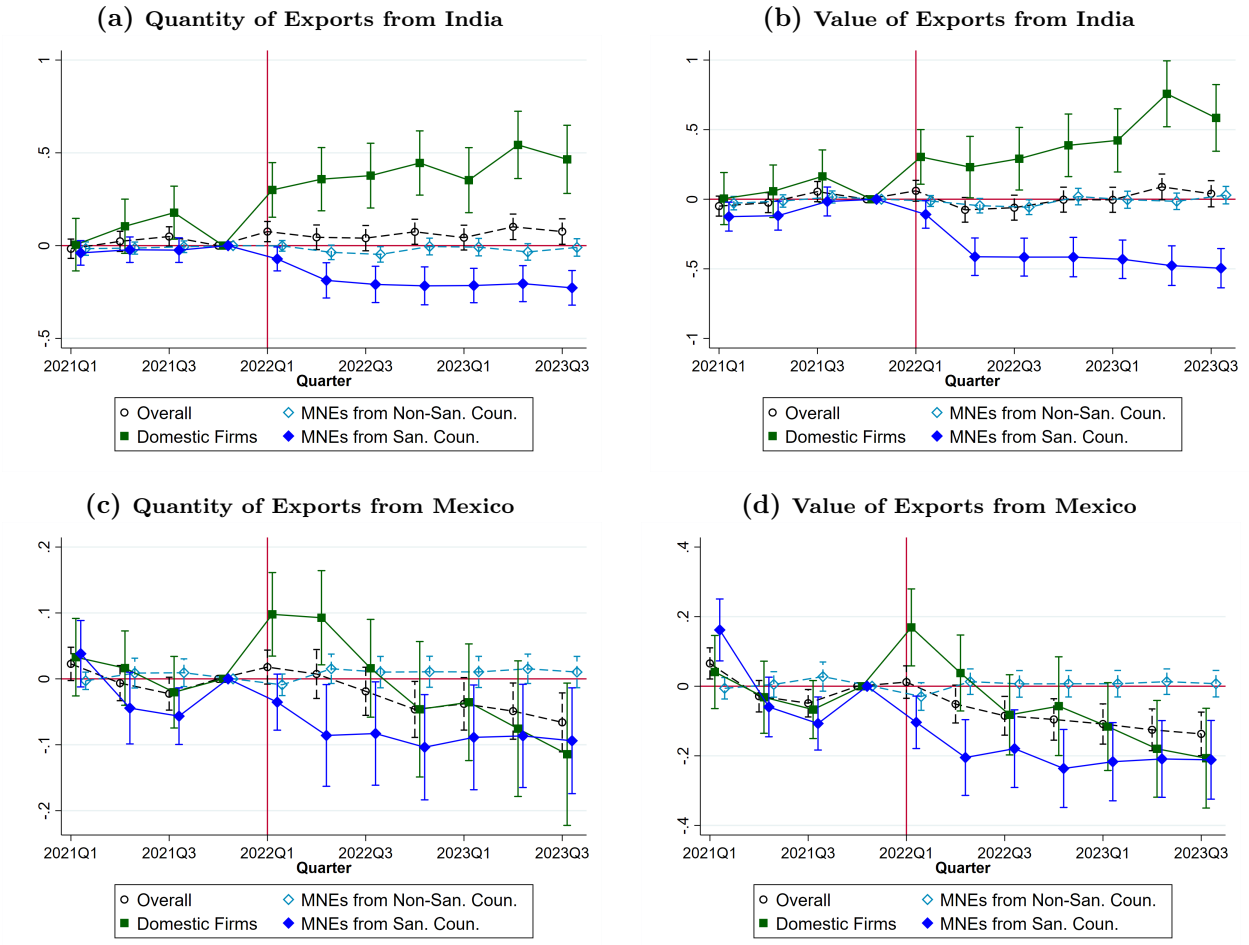

Figure D.5: Effects of Export Sanctions on Exports of Sanctioned Products to Russia by Multinational Status (Product Level) (Contrast India and Mexico)

Notes: Figure displays the coefficients and 90% confidence interval from equation (3.1) for each sample indicated by the legend. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the product (p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

Appendix E Improving Domestic Firm Compliance Through Trade

Table E.1: Domestic Firms Comply More if They Export More to Sanctioning Countries (Firm Level Trade Shares)

	(1)	(2)	(3)	(4)
	IHS(Value of Export to Russia)			
$\text{Post}_t \times \text{Sanc Exp Share}_i \times \text{SP}_p$	-0.0371***	-0.0479***	0.0082	0.0208
	(0.0121)	(0.0136)	(0.0360)	(0.0888)
$\text{Post}_t \times \text{Sanc Imp Share}_i \times \text{SP}_p$	0.0178	0.0637***	-0.0457	0.0909
	(0.0141)	(0.0159)	(0.0449)	(0.1008)
R^2	0.597	0.601	0.585	0.716
Firm x Product FE	✓	✓	✓	✓
Firm x Quarter FE	✓	✓	✓	✓
Product x Quarter FE	✓	✓	✓	✓
Sample	Full Sample	Domestic Firms	MNEs from Sanctioning Countries	MNEs from Non-Sanctioning Countries
Observations	2479983	2020392	399553	43923

Notes: Table reports the regression results of equation (5.2) where the dependent variable is the value of exports of products p in India, Mexico, Vietnam, or Pakistan to Russia. *Sanc Exp Share*$_i$ measures firm i's export share to sanctioning countries in 2021. *Sanc Imp Share*$_i$ measures firm i's import share from sanctioning countries in 2021. All columns control for $Post_t \times X_p \times$ *Multi Sanc*$_i$ and $Post_t \times X_p \times$ *Multi No-Sanc*$_i$. X_p includes skill intensity, capital intensity, and advanced technology usage. Robust standard errors in parentheses are clustered at the firm-product (i, p) level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Appendix F Contribution of Trade Rerouting to Sanctioned Product Export Growth to Russia.

Using a method similar to Section 4.1, we study the contribution of trade rerouting to the increase in sanctioned product exports from neutral countries to Russia. In the first step, we calculate the weights of rerouted and non-rerouted trade in total exports for each ownership type:

$$\begin{aligned} IHS(Export_{mpt}) =& \hat{\alpha}_{1m} IHS(\min\{Export^{rus}_{mpt}, Import^{sanc}_{mpt}\}) \\ &+ \hat{\alpha}_{2m} IHS(Export_{mpt} - \min\{Export^{rus}_{mpt}, Import^{sanc}_{mpt}\}) + \epsilon_{mpt}, \\ & m \in \{\text{Domestic}, \text{Sanctioning MNE}, \text{Non-sanctioning MNE}\}. \end{aligned}$$

If a product p has similar import values from sanctioning countries and export values to Russia, the rerouting index will carry significant weight in total trade. Otherwise, non-rerouted trade, $Export_{mpt} - \min\{Export^{rus}_{mpt}, Import^{sanc}_{mpt}\}$, will play a greater role.

In the next step, we use the following difference-in-differences specifications to separately analyze the impact of export sanctions on rerouted and non-rerouted trade:

$$\begin{aligned} IHS(\min\{Export^{rus}_{mpt}, Import^{sanc}_{mpt}\}) =& \hat{\beta}_{1m} Post_t \times SanProd_p + \gamma_{1m} Post_t \times X_p + \delta_{1mp} + \delta_{1mt} + \epsilon_{1mpt}, \\ IHS(Export_{mpt} - \min\{Export^{rus}_{mpt}, Import^{sanc}_{mpt}\}) =& \hat{\beta}_{2m} Post_t \times SanProd_p + \gamma_{2m} Post_t \times X_p + \delta_{2mp} + \delta_{2mt} + \epsilon_{2mpt}, \\ & m \in \{\text{Domestic}, \text{Sanctioning MNE}, \text{Non-sanctioning MNE}\}. \end{aligned} \tag{F.1}$$

$\hat{\beta}_{1m}$ captures the effect of sanctions on the rerouted trade of sanctioned products (relative to non-sanctioned products) for MNE type m, while $\hat{\beta}_{2m}$ captures the effect on non-rerouted trade of sanctioned products. Since rerouted and non-rerouted trade have weights $\hat{\alpha}_{1m}$ and $\hat{\alpha}_{2m}$, the contribution of trade rerouting to sanctioned exports for MNE type m is given by:

$$Contrib_m = \frac{\hat{\alpha}_{1m}\hat{\beta}_{1m}}{\hat{\alpha}_{1m}\hat{\beta}_{1m} + \hat{\alpha}_{2m}\hat{\beta}_{2m}}$$

Table F.1 presents the results described in the main text.

Table F.1: Contribution of Trade Rerouting to Sanctioned Exports to Russia

Estimates	Domestic Firms	Sanc MNEs	No Sanc MNEs
$\hat{\alpha}_1$	0.8915	0.9563	0.6860
$\hat{\alpha}_2$	0.4405	0.5041	0.7876
$\hat{\beta}_1$	0.2595	-0.3267	0.0466
$\hat{\beta}_2$	0.2310	-0.0605	0.0386
Contribution of Trade Rerouting	69.46%	91.10%	51.23%

Notes: Table shows the contribution of trade rerouting to the changes in sanctioned exports to Russia for each firm type.

Appendix G Exports to Alternative Destinations

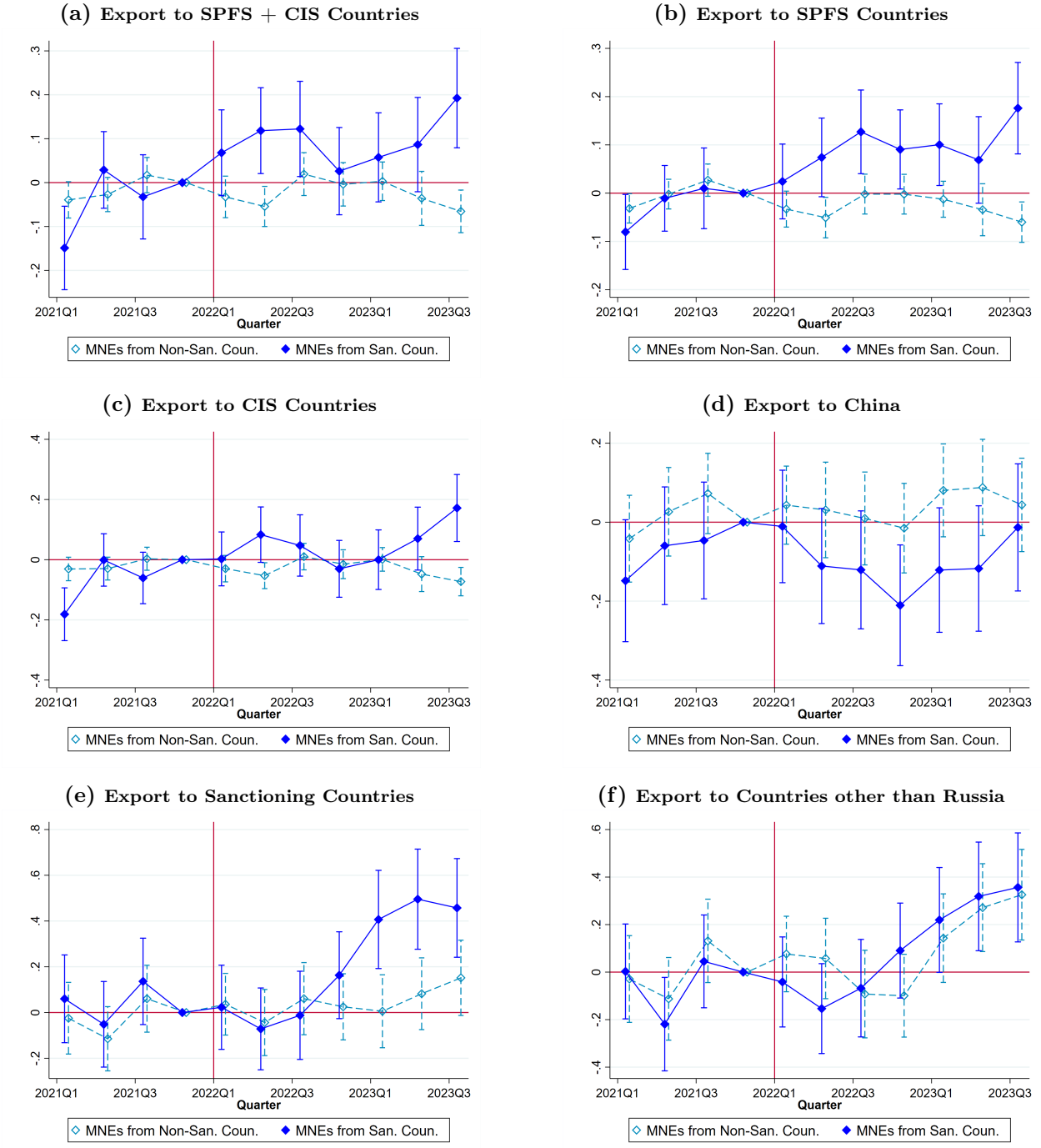

Figure G.1: Effects of Sanctions on Exports of Diversion (Product Level)

Notes: Figure displays the coefficients and 90% confidence interval from equation (3.1) for each sample indicated by the legend. The dependent variable is the value of exports of products p in India, Pakistan, Mexico, or Vietnam to countries other than Russia. The vertical red line refers to the first quarter of 2022 when the Russo-Ukrainian war broke out. Standard errors are clustered at the product (p) level. The quarter prior to the war (2021q4) is the omitted reference quarter.

Table G.1: Effects of Sanctions on Exports Diversion (Product Level, Price)

	(1)	(2)	(3)	(4)
Panel A. DV: Log(Price of Export to SPFS + CIS Countries)				
$\text{Post}_t \times \text{SP}_p$	0.0414	0.0168	0.1574	0.3738
	(0.1094)	(0.1174)	(0.3032)	(0.3038)
R^2	0.714	0.746	0.829	0.925
Observations	8801	7152	1192	278
Panel B. DV: Log(Price of Export to SPFS Countries)				
$\text{Post}_t \times \text{SP}_p$	-0.0482	-0.0399	-0.1349	0.0564
	(0.1331)	(0.1578)	(0.2874)	(0.2117)
R^2	0.720	0.742	0.868	0.929
Observations	5891	4828	713	201
Panel C. DV: Log(Price of Export to CIS Countries)				
$\text{Post}_t \times \text{SP}_p$	-0.0978	-0.0740	0.0809	0.4904
	(0.1158)	(0.1227)	(0.3603)	(0.3763)
R^2	0.726	0.755	0.845	0.935
Observations	7141	5691	1045	250
Panel D. DV: Log(Price of Export to China)				
$\text{Post}_t \times \text{SP}_p$	-0.0136	0.0272	0.0731	-0.6439***
	(0.0561)	(0.0717)	(0.0964)	(0.1999)
R^2	0.733	0.814	0.844	0.843
Observations	22017	13300	6228	2064
Panel E. DV: Log(Price of Export to Sanctioning Countries)				
$\text{Post}_t \times \text{SP}_p$	0.0621*	0.1004***	0.0345	-0.1104
	(0.0331)	(0.0376)	(0.0538)	(0.1293)
R^2	0.738	0.859	0.880	0.835
Observations	55710	32358	16902	5812
Panel F. DV: Log(Price of Export to Countries other than Russia)				
$\text{Post}_t \times \text{SP}_p$	0.0322	0.1488***	-0.0219	-0.2187***
	(0.0281)	(0.0338)	(0.0464)	(0.0829)
R^2	0.745	0.872	0.875	0.857
Observations	69485	37533	22136	9267
Product FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Sample	Full Sample	Domestic firms	MNEs from sanctioning countries	MNEs from non-sanctioning countries

Notes: Table reports the regression results of equation (3.2) where the dependent variable is the price of exports of products p in India, Pakistan, Mexico, or Vietnam to countries other than Russia. Controls include $\text{Post}_t \times$Capital Intensity$_p$, $\text{Post}_t \times$Skill Intensity$_p$, and $\text{Post}_t \times$Advanced Technology$_p$. Robust standard errors clustered at the product p level are displayed in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table G.2: Effects of Sanctions on Exports Diversion (Product Level, Quantity)

	(1)	(2)	(3)	(4)
Panel A. DV: IHS(Quantity of Export to SPFS + CIS Countries)				
$\text{Post}_t \times \text{SP}_p$	0.0501***	0.0787*	0.0911***	-0.0195*
	(0.0184)	(0.0470)	(0.0268)	(0.0106)
R^2	0.281	0.670	0.634	0.602
Panel B. DV: IHS(Quantity of Export to SPFS Countries)				
$\text{Post}_t \times \text{SP}_p$	0.0403**	0.0693	0.0725***	-0.0209**
	(0.0164)	(0.0436)	(0.0191)	(0.0097)
R^2	0.259	0.620	0.595	0.593
Panel C. DV: IHS(Quantity of Export to CIS Countries)				
$\text{Post}_t \times \text{SP}_p$	0.0373**	0.0541	0.0791***	-0.0211**
	(0.0167)	(0.0422)	(0.0263)	(0.0101)
R^2	0.287	0.652	0.644	0.604
Panel D. DV: IHS(Quantity of Export to China)				
$\text{Post}_t \times \text{SP}_p$	0.0667*	0.2114***	-0.0371	0.0258
	(0.0353)	(0.0775)	(0.0525)	(0.0408)
R^2	0.395	0.785	0.798	0.685
Panel E. DV: IHS(Quantity of Export to Sanctioning Countries)				
$\text{Post}_t \times \text{SP}_p$	0.1443***	0.1990***	0.1698***	0.0640
	(0.0360)	(0.0686)	(0.0567)	(0.0470)
R^2	0.406	0.888	0.896	0.823
Panel F. DV: IHS(Quantity of Export to Countries other than Russia)				
$\text{Post}_t \times \text{SP}_p$	0.1756***	0.1286*	0.2013***	0.1969***
	(0.0382)	(0.0677)	(0.0618)	(0.0529)
R^2	0.409	0.879	0.899	0.842
Product FE	✓	✓	✓	✓
Quarter FE	✓	✓	✓	✓
Controls	✓	✓	✓	✓
Sample	Full Sample	Domestic firms	MNEs from sanctioning countries	MNEs from non-sanctioning countries
Observations	130977	43659	43659	43659

Notes: Table reports the regression results of equation (3.2) where the dependent variable is the quantity of exports of products p in India, Pakistan, Mexico, or Vietnam to countries other than Russia. Controls include $\text{Post}_t \times \text{Capital Intensity}_p$, $\text{Post}_t \times \text{Skill Intensity}_p$, and $\text{Post}_t \times \text{Advanced Technology}_p$. Robust standard errors clustered at the product p level are displayed in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

Appendix H Effects on Import from Russia: Trade Finance Intensity

Table H.1: Imports from Russia and Trade Finance Intensity - Standardized Mean

	(1)	(2)	(3)
	IHS(Value of Import from Russia)		
$\text{Post}_t \times \text{Multinational Sanc}_i \times \text{AVG}_p$	-0.0071**	-0.0063*	-0.0083**
	(0.0033)	(0.0036)	(0.0038)
$\text{Post}_t \times \text{Multinational Non-Sanc}_i \times \text{AVG}_p$	0.0071	0.0068	0.0062
	(0.0115)	(0.0113)	(0.0118)
$\text{Post}_t \times \text{Profit Rate}_i \times \text{AVG}_p$		0.0000*	0.0000
		(0.0000)	(0.0000)
$\text{Post}_t \times \text{Liquidity Ratio}_i \times \text{AVG}_p$		0.1529	0.1304
		(0.1360)	(0.1336)
$\text{Post}_t \times \text{Age}_i \times \text{AVG}_p$		0.0078	0.0068
		(0.0058)	(0.0058)
$\text{Post}_t \times \text{Leverage}_i \times \text{AVG}_p$		-0.0003	0.0006
		(0.0011)	(0.0011)
$\text{Post}_t \times \text{Import}_{ip}^{world}$		-0.0051***	-0.0067***
		(0.0003)	(0.0003)
$\text{Post}_t \times \text{Avg}_p$			-0.0176
			(0.0243)
$\text{Post}_t \times \text{SP}_p$			-0.0002
			(0.0024)
R^2	0.537	0.537	0.504
Firm x Product FE	✓	✓	✓
Firm x Quarter FE	✓	✓	✓
Product x Quarter FE	✓	✓	
Observations	2540252	2540252	2543860

Notes: Table reports the regression results of equation (7.1) where the dependent variable is the value of imports of products p by neutral country firm i from Russia. Following Manova et al. (2015), AVG_p is constructed as the standardized mean of external finance dependence, inventory ratio, (the negative of) trade credit intensity and (the negative of) asset tangibility. Profit Rate_i is firm i's financial profit divided by its financial expenditure in 2021. Liquidity Ratio_i equals ($\textit{Current assets}_i - \textit{Stocks}_i$) divided by $\textit{Current liabilities}_i$ in 2021. Leverage_i equals ($\textit{Non current liabilities}_i + \textit{Loans}_i$) divided by $\textit{Shareholders funds}_i$ in 2021. Firm Age_i is the log value of firm i's age. Robust standard errors in parentheses are clustered at firm-product (i, p) level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.