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July 2022

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Keywords: Economic sanctions; Trade; Russia; Ukraine

JEL classification: F15; F53

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The Trade Effect of Economic Sanctions: Evidence from the 2022 Russia–Ukraine Conflict

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Abstract: This study investigates the trade effects of the 2022 Russia–Ukraine war. We examine monthly data on bilateral trade between 40 countries and their 220 partner countries from January 2021 to May 2022. Estimating a gravity-type equation for this monthly dataset, we investigate how several key players, including the Western countries, China, and India, change their trade after February 2022. Our main findings are summarized as follows. On average, Western countries’ exports to and imports from Russia did not change significantly because some of them that have greater reliance on trade with Russia increased their trade with Russia. Nevertheless, the precision machinery industry found a significant decrease in the Western countries’ exports to Russia. Moreover, we found significant changes in the Western countries’ trade with Belarus and Ukraine in addition to those in Russia’s trade with China and India.

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1. Introduction

The Russian invasion of Ukraine in February 2020 created another source of negative shocks to the world economy during the COVID-19 pandemic. Russia and Ukraine went to war in 2014 over the status of Crimea and the Donbas. The conflict expanded dramatically after the full-scale Russian invasion of Ukraine in February 2022. As a result, the World Bank predicts that Ukraine’s economy will contract by 45.1% in 2022, whereas Russia’s economy will contract by 11.2%.¹ Similarly, the International Monetary Fund reported in its World Economic Outlook for April 2022 that global growth is projected to slow from 6.1% in 2021

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¹ <https://www.worldbank.org/en/news/press-release/2022/04/10/russian-invasion-to-shrink-ukraine-economy-by-45-percent-this-year>

to 3.6% in 2022, 0.8 percentage points lower than that projected in January 2022. The economic damage caused by the Russia–Ukraine conflict will contribute to a significant slowdown in global growth. Moreover, fuel and food prices have risen, disproportionately affecting vulnerable populations in low-income countries.²³

This study investigates the trade effects of the 2022 Russia–Ukraine war. Various effects will emerge on trade. First, since Ukraine’s land is the battlefield, most factories have been closed in Ukraine. This shutdown naturally decreases Ukraine’s trade with the world. Second, developed countries, including the U.S., the European Union (EU), the U.K., Japan, Australia, and others, imposed various sanctions against Russia. This study refers to the countries imposing sanctions on Russia as the “Western countries.” Sanctions range from financial to trade to other measures aimed at specific individuals associated with the Russian government. They also imposed similar sanctions on Belarus for its military assistance to Russia. These sanctions are expected to reduce their trade with Russia and Belarus. Third, China, India, and other countries do not support Ukraine or Western countries. These countries may substitute for Western countries and increase trade with Russia and Belarus. Lastly, airspace is closed in Russia and Ukraine due to the war. Also, railway transportation between China and Europe does not operate normally. These transport blockages would decrease international trade between the third countries.

Specifically, we examine monthly data on bilateral trade by 40 countries with their 220 partner countries from January 2021 to May 2022. We focus on the first three months of the 2022 Russia–Ukraine war on global trade. Estimating a gravity-type equation for this monthly dataset, we investigate how several key players, including Western countries, China, and India, change their exports to and imports from Russia after February 2022. We also introduce country pair, exporter-time, and importer-time fixed effects to control for various other factors that affect international trade (e.g., the COVID-19 pandemic). Then, we estimate this monthly gravity equation by the Poisson Pseudo Maximum Likelihood (PPML) method. We also examine the changes in trade with Belarus and Ukraine. Furthermore, we investigate the changes in trade between the countries connected by the air route over Russian airspace.

Our study is related to an extensive literature on the trade effects of political conflicts or economic sanctions. For example, the trade effects of political conflicts with China have been investigated by Fuchs and Klann (2013), Heilmann (2016), Du et al. (2017), Li et al.

² <https://www.imf.org/en/Publications/WEO/Issues/2022/04/19/world-economic-outlook-april-2022>

³ Other organizations have also issued forecasts. The International Food Policy Research Institute warned that excessive price volatility in wheat, maize, rice, and soybeans, and cotton had already been detected by its early warning system. According to IFPRI, this volatility is caused by Russia’s invasion of Ukraine, in addition to the effects of COVID-19. The OECD warned in its June 2022 Economic Outlook that the Ukraine crisis had triggered a global cost-of-living crisis. The war has slowed global economic growth, and rising inflation, primarily due to increases in energy and food prices, is causing hardship for low-income people. The OECD forecasted global growth of 3% in 2022, a reduction from 4.5% in December 2021. The forecasted inflation rate for the 38 member countries has nearly doubled to around 9%.

(2021), and Luo et al. (2021). Recent studies on the trade effects of economic sanctions mainly examine those sanctions against Iran around 2010 (e.g., Haidar, 2017; Felbermayr et al., 2020; Crozet et al., 2021; Larch et al., 2022) and Russia around 2014 (e.g., Crozet et al., 2020; 2021; Larch et al., 2021). The effects of Russian retaliation measures on the agri-food trade are also investigated by Cheptea and Gagné (2020). The sanction instruments examined in these studies include export restrictions, import restrictions, asset freezes, and travel bans. Moreover, Fuhrmann (2008) and Afesorgbor (2019) examined the effect of restrictions on exports. The former study found that democratic states received more dual-use exports from the U.S., whereas the latter examined global trade from 1962 to 2014 and showed no significant effects of export restrictions on trade.

Compared with the sanctions by the Western countries in the 2014 Russia–Ukraine conflict, those in the 2022 conflict are stronger and wider. The former sanctions mainly targeted financial dealings and travel bans. However, the latter sanctions included not only financial and travel restrictions but also strong trade restrictions. In particular, export control regulations have taken center stage among U.S. trade sanction measures since the administration of President Donald Trump. In August 2018, the U.S. tightened export controls for national security reasons and regulated key technology and component exports to China. Furthermore, since 2020, the U.S. government has required even firms outside the U.S. to obtain permission if products using U.S.-origin technology or software are exported directly or indirectly to specific Chinese firms. As a consequence of the following, the sanctions in 2022 are expected to have significant effects on international trade, with many countries revoking Russia and Belarus’ most favored nation (MFN) status, and this type of export regulation also being introduced in Russia and Belarus in 2022.

Some studies have explored the 2022 Russia–Ukraine conflict. For instance, Deng et al. (2022), Federle et al. (2022), and Huang and Lu (2022) investigated its effect on stock markets. In particular, several studies examined how the exit from the business in the Russian market affected stock markets at the firm level (Balyuk and Fedyk, 2022; Basnet et al., 2022; Berninger et al., 2022; Huang et al., 2022; Sonnenfeld et al., 2022; Tosun and Eshraghi, 2022). For example, Huang et al. (2022) examined 561 listed firms in 82 countries identified as withdrawing from Russia. They found that ESG (environmental, social, and governance) scores and internet freedom scores are the most important determinants of firms’ decision to exit Russia. However, firms with higher ESG scores withdraw at a slower pace, and their degree of cutoff from Russia is milder, leaving room for future re-entries. Furthermore, there is no difference in terms of the return pattern after firms’ exit announcement. Meanwhile, Itskhoki and Mukhin (2022) and Lorenzoni and Wrning (2022) discussed the effect of the conflict on exchange rates. A more comprehensive discussion of economic impacts was conducted by Astrov et al. (2022). Against this backdrop, our study is first to empirically examine the conflict’s effects on international trade.

Our findings can be summarized as follows. First, on average, the Western countries did not significantly change their exports to and imports from Russia after the invasion. This

unexpected result is because some Western countries with more dependence on trade with Russia have increased their trade with Russia. A relatively large decrease in trade with Russia was found in Canada, Singapore, and New Zealand. Also, the precision machinery industry found a significant decrease in the Western countries' exports to Russia. Second, the Western countries significantly decreased their exports to and imports from Belarus, whereas they increased their exports to Ukraine but did not change their imports from Ukraine. Third, China increased both exports to and imports from Russia, whereas India did not change exports to Russia but significantly increased imports from Russia. Lastly, international trade significantly decreased between countries along the flight corridors over Russian airspace.

The rest of this study is organized as follows. Section 2 provides an overview of the economic sanctions against Russia and Belarus. Section 3 then presents our empirical framework for examining the impact of those sanctions on trade, and Section 4 reports the estimation results. Finally, Section 5 concludes the paper.

2. Background

Following Russia's invasion of Ukraine, the U.S., the EU, the U.K., Japan, and Australia imposed various sanctions against Russia. Sanctions range from financial to trade to other measures aimed at specific individuals linked to the Russian government. This section discusses the economic sanctions imposed by Western countries during the 2022 Russia–Ukraine war. As of June 30, 2022, 14 countries⁴ and the EU joined in imposing sanctions against Russia.⁵ We do not conduct an exhaustive review of the sanctions but focus on some of the major ones, especially those relating to trade. Lastly, we also introduce some retaliation measures by Russia.

2.1. Financial Sanctions

The financial sanctions imposed on Russia by the Western countries are mainly of three types. The first one is the freezing of Russia's central bank assets. It has hindered the use of international reserves of the Central Bank of the Russian Federation (CBRF) in many countries and regions, including the U.S., the EU, the U.K., Japan, Canada, Australia, and Switzerland—the core reserve currency countries. On March 13, Russian Finance Minister Siluanov stated that the US\$300 billion in foreign currency reserves and gold held by the CBRF had been frozen due to economic sanctions imposed by the U.S., Europe, Japan, and

⁴ These 14 countries are the U.S., Canada, the U.K., Switzerland, Norway, Iceland, Liechtenstein, Ukraine, Japan, South Korea, Taiwan, Singapore, Australia, and New Zealand.

⁵ <https://www.piie.com/blogs/realtime-economic-issues-watch/russias-war-ukraine-sanctions-timeline>

other countries.⁶

The second type of sanction excludes Russia's banks and firms from the Society for Worldwide Interbank Financial Telecommunication (SWIFT) system. SWIFT connects 11,000 banks and institutions in over 200 countries to facilitate the smooth and rapid transfer of funds across borders. The U.S., the EU, the U.K., Canada, France, Germany, and Italy announced a joint statement on February 26, 2022, to remove some Russian banks from the SWIFT system. Similarly, Australia, Japan, and South Korea announced that selected Russian banks will be removed from the SWIFT system by the end of February 2022. The EU banned seven Russian commercial banks and three Belarus banks from using the SWIFT system in March. However, Sberbank, Russia's largest bank, was not excluded from SWIFT until May 2022, and Gazprom, Russia's state-owned gas company, was not excluded from SWIFT as of June 2022.

The third type of sanction targets Russian individuals called "oligarchs," who are considered to have connections to the Russian government and President Putin. More than 1,000 Russian individuals and entities, including President Putin himself and his family, had their offshore assets frozen by the U.S., EU, and the U.K. Moreover, EU imposed the same kind of sanction on more than 200 Belarus individuals and entities.⁷ Due to these financial sanctions, the Russian ruble fell from around 70 RUB/USD to 120 RUB/USD in the middle of March 2022. However, the Russian ruble recovered to pre-invasion levels and has been stable around 60 RUB/USD since June 2022. Despite various financial sanctions, many countries continue to purchase Russian natural gas, which may support the ruble.

2.2. Trade-related Sanctions

There are four trade-related sanctions by the Western countries. The first one is the prohibition of exports of specific goods, such as luxury and high-tech goods. The U.S. has banned semiconductors and other high-tech products, luxury goods, and construction machinery exports to Russia. It expanded the Foreign Direct Product (FDP) Rules to Russia and Belarus on February 24, 2022, requiring companies abroad that manufacture high-tech products incorporating parts and components made in the U.S. to obtain a U.S. government license before exporting these products to Russia and Belarus.⁸ The FDP Rules were first introduced as a sanction on Huawei, a Chinese manufacturer, under the Trump administration. The EU has banned the export of semiconductors and other high-tech and luxury goods to Russia. Additionally, exports of products that could be used for military purposes, such as telecommunications equipment and aviation-related components, are prohibited by the U.K. to Russia. In addition to semiconductors and luxury goods, Japan

⁶ <https://interfax.com/newsroom/top-stories/76603/>

⁷ <https://www.consilium.europa.eu/en/policies/sanctions/restrictive-measures-against-belarus/>

⁸ <https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/2913-2022-02-24-bis-russia-rule-fact-sheet-final>

has prohibited exports of diesel engines for trucks, communications equipment and centers, and 3D printers to Russia.

The prohibition of specific goods from being imported is the second type of sanction. In contrast to exports, many countries are reluctant to prohibit crude oil and gas imports, which bring the most foreign currency into the Russian economy. On March 8, 2020, the U.S. banned Russian oil, liquefied natural gas, and coal imports.⁹ On May 30, 2022, EU leaders agreed to block most Russian oil imports by the end of 2022. In particular, Poland and Germany declared to stop importing pipeline oil from Russia by the end of 2022, but Hungary, Slovakia, and the Czech Republic did not pledge to ban on imports. Japan joined the G7 declaration of a ban on imports of Russian oil on May 9, 2022, but no specific policy or timeline has been announced. Meanwhile, on natural gas, developed countries are less united on sanctions against Russia. Only the U.S. has banned the imports of natural gas from Russia to date among advanced countries against Russia's invasion of Ukraine. The EU has had more difficulty reaching an agreement on a ban on Russian natural gas imports than on crude oil. On June 7, 2022, the Japanese government approved its "Energy White Paper 2021," stating that it will maintain its concessions in the Sakhalin 1 and 2 natural gas development projects.

The third type of sanction is the revocation of the MFN status granted to Russia. On March 3, Canada revoked the MFN status of Russia and Belarus. The revocation of MFN status means Russia cannot enjoy market access following the MFN status under World Trade Organization (WTO) regulations. Unfavorable competitive conditions will likely reduce Russian exports. On March 15, 2022, the EU and 13 other WTO member countries withdrew from Russia's MFN in response to their invasion of Ukraine.¹⁰ Meanwhile, Australian Prime Minister Scott Morrison announced on March 31 that Australia would withdraw its MFN treatment for Russia and Belarus and imposes a 35% tariff on imports from both countries. With the imposition of tariffs by both countries scheduled to take effect on April 25, New Zealand similarly announced on April 6 that they would apply a 35% tariff on imports from Russia. On April 8, U.S. President Biden signed the law revoking the MFN status of Russia and Belarus.

The fourth type of sanction is restrictions on logistics from/to Russia. On February 27, the European Commission's president announced that EU member countries had imposed a flight ban on Russian-owned, Russian-registered, or Russian-controlled aircraft, including oligarchs' private jets.¹¹ The United Kingdom imposed a similar flight ban on Russian aircraft.¹² From April 16, 2022, the EU has prohibited Russian and Belarussian road hauling

⁹ <https://www.whitehouse.gov/briefing-room/statements-releases/2022/03/08/fact-sheet-united-states-bans-imports-of-russian-oil-liquefied-natural-gas-and-coal/>

¹⁰ <https://ec.europa.eu/commission/presscorner/detail/en/statement%2022%201724>

¹¹ https://ec.europa.eu/commission/presscorner/detail/en/statement_22_1441

¹² <https://www.gov.uk/government/speeches/uk-support-for-ukraine-following-russias-invasion-foreign-secretarys-statement>

transport operators from entering EU member countries, except to deliver essential products such as agricultural and food products, humanitarian aid, and energy. In terms of maritime transport, the EU has prohibited Russian-flagged vessels from entering EU ports, with exceptions for agricultural and food products, humanitarian aid, and energy.¹³

2.3. Retaliatory Sanction by Russia

In response to these sanctions, Russia issued a list of 48 unfriendly countries on March 7, 2022, which included all EU member countries, Ukraine, Albania, Andorra, Iceland, Lichtenstein, Monaco, Montenegro, Norway, North Macedonia, San Marino, Switzerland, the U.K., the U.S., Canada, Australia, New Zealand, Japan, South Korea, Singapore, Taiwan, and Micronesia. The Russian government, companies, and citizens will be able to pay creditors from the countries and regions on the list in Russian rubles.¹⁴

The Russian government has launched countermeasures against flight bans by mainly the EU member countries. On February 28, 2022, the Russian Federal Air Transport Agency (Rosaviation) issued a statement that 35 European countries and Canada have been prohibited from flights in the airspace over Russia by civil aircraft except when authorized by Rosaviation or the Russian Foreign Ministry.¹⁵ Although the U.S. and Japan are excluded in this retaliatory measure, the U.S.¹⁶ and Japanese¹⁷ airlines voluntarily avoid flying over Russian airspace.

Additionally, the Russian government has imposed export restrictions and increased export tariffs on strategic goods. On March 11, 2022, the Russian government announced a temporary export ban on over 200 products, including high-tech goods and heavy machinery industries, to all countries and regions except for the member countries of the Eurasian Economic Union, Abkhazia, and South Ossetia.¹⁸ On March 18, 2022, the Ministry of Agriculture of the Russian Federation announced increases in wheat and barley export duties¹⁹, and several rounds of export tariff increases have followed since then.²⁰

¹³ https://ec.europa.eu/commission/presscorner/detail/en/IP_22_2332

¹⁴ <https://tass.com/politics/1418197>

¹⁵ <https://www.trtworld.com/europe/russia-closes-airspace-to-36-countries-as-airlines-brace-for-chaos-55163>

¹⁶ <https://www.foxbusiness.com/lifestyle/airlines-suspend-flying-over-russia>

¹⁷ <https://www.nippon.com/en/news/reu20220303KBN2L009F/>

¹⁸ <https://www.globaltradealert.org/state-act/62491/russian-federation-temporary-export-ban-on-multiple-products>

¹⁹ <https://www.globaltradealert.org/state-act/64418/russian-federation-changes-to-export-duties-on-certain-agricultural-products-22-to-28-june-2022>

²⁰ Aside from these retaliatory measures, President Putin signed a decree on May 3, 2022, authorizing the use of new special retaliatory economic measures against unfriendly countries, including the U.S., and international organizations. It forbids the performance of obligations and the completion of transactions with specific foreign individuals and legal entities, as well as the export of raw materials and products from Russia to these individuals. See <https://tass.com/politics/1446445>.

3. Empirical Framework

This section presents the empirical framework we used to investigate the trade effects of the Russia–Ukraine conflict. As discussed in the previous section, the Western countries have imposed an export ban on high-tech or luxury goods against Russia and Belarus, which will decrease their exports to Russia and Belarus. In sanctions that will decrease the Western countries' imports from Russia and Belarus, these Western countries also revoked their MFN status against Russia and Belarus. Additionally, Russia imposed export restrictions and additional export tariffs. Western countries' financial sanctions may raise transaction costs, reducing trade with Russia and Belarus. We examine these changes empirically using monthly bilateral trade data from January 2021 to May 2022.

Our equation for exports from 40 countries to their 220 partner countries is as follows:

$$\begin{aligned}
 Export_{ijt} = \exp\{ & \alpha_1 \cdot West_i \cdot RUS_j \cdot Mar22_t + \alpha_2 \cdot West_i \cdot BLR_j \cdot Mar22_t + \alpha_3 \cdot West_i \cdot UKR_j \\
 & \cdot Mar22_t + \alpha_4 \cdot CHN_i \cdot RUS_j \cdot Mar22_t + \alpha_5 \cdot IND_i \cdot RUS_j \cdot Mar22_t + \beta \cdot Air_{ij} \\
 & \cdot Mar22_t + \gamma \cdot RTA_{ijt} + \delta_{ij} + \delta_{it} + \delta_{jt}\} \cdot \epsilon_{ipt} \quad (1)
 \end{aligned}$$

$Export_{ijt}$ represents country i 's total exports to country j at time t . Time is defined at a monthly level. $West_i$ is a dummy variable that takes a value of 1 if exporting country i is one of the Western countries that imposed an export ban. RUS_j takes a value of 1 if importing country j is Russia, whereas $Mar22_t$ does so if time t is after February 2022. Thus, the coefficient for $West_i \cdot RUS_j \cdot Mar22_t$ (i.e., α_1) indicates how the Western countries change their exports to Russia after February 2022. Because of the imposition of the export ban on some specific goods, we expect a significant decrease in their exports.

Similarly, interacting various variables with $Mar22_t$, we further investigate the trade changes in some other country pairs. BLR_j and UKR_j take a value of 1 if importing country j is Belarus and Ukraine, respectively. Thus, the coefficients for $West_i \cdot BLR_j \cdot Mar22_t$ and $West_i \cdot UKR_j \cdot Mar22_t$ indicate the export changes of the Western countries to Belarus and Ukraine, respectively. CHN_i and IND_i take a value of 1 if the exporting country j is China and India, respectively. We investigate how China and India behave differently from other countries in terms of exports to Russia by examining $CHN_i \cdot RUS_j \cdot Mar22_t$ and $IND_i \cdot RUS_j \cdot Mar22_t$. Air_{ij} takes the value of 1 if trading countries i and j are originally connected by the air route over Russian airspace. Thus we examine the effects of blockages of flight corridors over Russian airspace by investigating the coefficient for $Air_{ij} \cdot Mar22_t$.

Other control variables are as follows. RTA_{ijt} is a dummy variable on the existence of any regional trade agreements (RTAs) between countries i and j at time t . Unlike the RTA dummy in the standard gravity analyses, this variable is defined at a monthly level. We introduce three kinds of fixed effects: country pair-fixed effects, exporter-time fixed effects,

and importer-time fixed effects. The first one controls for standard gravity factors such as geographical distance and linguistic similarity. In addition to their multilateral resistance effects, the latter two control for demand sizes in importing countries and supply capacity in exporting countries. Furthermore, these country-time fixed effects are critical in controlling for the ongoing COVID-19 pandemic. Moreover, the fluctuation of the world commodity prices (e.g., prices in maize, wheat, or oils) is absorbed in these country-time fixed effects. The time component of these fixed effects also controls for the global shortage of semiconductors and the global rise of oil prices. Lastly, ϵ_{ijt} is the error term. We estimated this export equation using the PPML method.

Using the data on imports from 40 countries to their 220 partner countries, we also estimate the following import equation.

$$\begin{aligned} Import_{ijt} = \exp\{ & \alpha_1 \cdot West_i \cdot RUS_j \cdot Mar22_t + \alpha_2 \cdot West_i \cdot BLR_j \cdot Mar22_t + \alpha_3 \cdot West_i \cdot UKR_j \\ & \cdot Mar22_t + \alpha_4 \cdot CHN_i \cdot RUS_j \cdot Mar22_t + \alpha_5 \cdot IND_i \cdot RUS_j \cdot Mar22_t + \beta \cdot Air_{ij} \\ & \cdot Mar22_t + \gamma \cdot RTA_{ijt} + \delta_{ij} + \delta_{it} + \delta_{jt}\} \cdot \epsilon_{ipt} \quad (2) \end{aligned}$$

$Import_{ijt}$ represents country i 's total imports from country j at time t . The explanatory variables are defined similarly to those in Eq. (1). For example, the coefficient for $West_i \cdot RUS_j \cdot Mar22_t$ indicates how the Western countries change their imports from Russia after February 2022. We anticipate a significant decrease in their imports as a result of the Western countries' revocation of MFN status and Russia's export restrictions. The PPML method also estimates this equation.

The following are the data sources for our variables. We obtain the monthly trade data from the Global Trade Atlas managed by S&P Global. We can obtain data reported by 40 countries.²¹ Among them, 24 countries are categorized as the Western countries in our study; AUS, AUT, BEL, CAN, CHE, DEU, DNK, ESP, FIN, FRA, GBR, GRC, IRL, ITA, JPN, KOR, LUX, NLD, NZL, PRT, SGP, SWE, TWN, and USA. The RTA dummy variable is constructed using the database updated by Egger and Larch (2008) and the Regional Trade Agreements Database available on the WTO website. *Air* takes the value of 1 if the great circle route between the two countries' capitals passes clearly through Russian airspace. With the dummy also virtually covering the country pairs that could not use the Trans-Eurasia Logistics connecting China and Europe by railway, it was constructed by using the Geographic Information System software drawing the great circle route of every combination of countries on a map and visually checking it.

Before reporting our estimation results, we overview the changes in trade with Russia and Ukraine (Fig. 1). The upper panel depicts monthly exports from Western countries,

²¹ Those include ARG, AUS, AUT, BEL, BRA, CAN, CHE, CHN, CIV, DEU, DNK, ESP, FIN, FRA, GBR, GRC, HKG, IDN, IND, IRL, ISR, ITA, JPN, KEN, KOR, LUX, MEX, MYS, NLD, NZL, PHL, PRT, RUS, SGP, SWE, THA, TWN, USA, VNM, and ZAF. The latest month in the data, which is not necessarily May, differs by country.

China, and India to Russia and Ukraine, while the lower panel depicts imports. All export and import values are normalized so that those in January 2021 take a value of 1. Exports from the Western countries and India to Russia decreased to a level of less than 50% of those in January 2021. Those from China to Russia had also decreased since around the end of 2021 but were about to return to a similar level in May 2022. In particular, those exports from China and India saw a significant drop, falling to around 10% of those in January 2021, while all three types of countries reduced their exports to Ukraine as well. The three groups' imports from Ukraine show similar changes to their exports to Ukraine, although they kept decreasing in May. In contrast, we can see a clear difference in imports from Russia. The Western countries have gradually decreased their imports from Russia, whereas China and India continue to increase their imports. In particular, India's imports from Russia increased explosively from April 2022.

=== Figure 1 ===

4. Empirical Results

This section reports our estimation results of Eqs. (1) and (2). The standard errors are clustered by country pairs. Table 1 displays the results of Eq. (1), which examines exports. In column (I), we only include the variable for Western countries' exports to Russia, and the RTA dummy and fixed effects. The coefficient for exports from Western countries is estimated to be significantly negative. Specifically, their exports to Russia decreased by 40% ($=\exp(-0.516)-1$) after the outbreak of the Russia-Ukraine conflict in 2022. The coefficient for the RTA dummy is estimated insignificantly.

=== Table 1 ===

In columns (II)-(V), we add more variables step-by-step. Column (II) shows the significant decrease in the Western countries to not only Russia but also Belarus. The decreased magnitude is almost the same. In column (III), we introduce the variable for the Western countries' exports to Ukraine. Its coefficient is significant and positive, indicating the increase in exports from the Western countries to Ukraine by more than 300%. Column (IV) includes the variables of exports from China and India to Russia. Although the coefficient for India's exports is insignificant, China significantly increased its exports to Russia by around 123%. Another important result is that the coefficient for Western countries' exports to Russia is insignificant after controlling for China's explosive growth in exports. We introduce the *Air* dummy in column (V), which has a significantly negative coefficient. The blockages of flight corridors over Russian airspace reduce trade by approximately 5%. Lastly, in column (VI), we introduce all variables simultaneously and

obtain similar results. In particular, exports from the Western countries and India to Russia do not change significantly, while China's exports to Russia significantly increase.

Table 2 shows the corresponding results for Eq. (2) (i.e., the import equation). Column (VI) results suggest the following. Western countries' imports from Russia did not change significantly, whereas their imports from Belarus significantly decreased by 52%. Moreover, their imports from Ukraine have not changed significantly, but their exports to Ukraine have increased significantly, as shown in Table 1. China's and India's imports from Russia increased significantly, by 39% and 137%, respectively. Thus, India's exports to Russia did not change significantly, but its imports from Russia increased significantly. Flight corridor closures over Russian airspace do not have insignificant effects. All coefficients for the RTA dummy are estimated to be significantly negative, which is inconsistent with our expectations.

=== Table 2 ===

Next, we examine the heterogeneous effects of trade with Russia among the Western countries. We introduce the interaction term between the variable of the Western countries' trade with Russia and the share of trade with Russia out of total trade in 2019 (i.e., the year before our study period and the COVID-19 period) in columns (I) and (II) in Table 3. The shares are evaluated in terms of exports and imports, respectively. The non-interacted terms have insignificant coefficients in both exports and imports. The coefficient for the interaction term is significantly positive in exports but insignificant in imports. The former result indicates that the Western countries with more dependence on exports to Russia increase their exports to Russia. This increase leads to an insignificant coefficient for the variables in the Western countries in Table 1.

=== Table 3 ===

In columns (III) and (IV), we decompose the Western countries and interact with each country/region dummy. This analysis is important because our results in the sign of coefficients depend heavily on trade in the "control group." We found significant negative coefficients in Western countries' trade with Russia when we did not control for Russia's trade with China and India in Tables 1 and 2. Indeed, more than half (24 countries) of all reporting countries in our study (i.e., 40 countries) are classified as "Western countries." Because of the relatively small number of reporting countries in the control group, the sign of the coefficients is likely to change depending on the set of countries in the control group. As a result, displaying the *relative* order of trade changes across countries may be more valuable. According to the estimates, Canada's exports to Russia decreased the most, followed by Singapore and New Zealand. The imports from Russia decreased most greatly in New Zealand, followed by Singapore and Canada.

We also estimate Eq. (1) and (2) by industries, which are defined by the tariff section of Harmonized System classification. The results for exports are shown in Table 4. Western countries have significantly decreased their exports of precision machinery. However, while exports from the Western countries to Belarus decreased significantly in most manufacturing industries, especially the machinery industry, in some industries, the Western countries significantly increase exports, including paper products, footwear, and general or electronic machinery industries. In contrast to Western exports to Belarus, the export of Western countries to Ukraine increased significantly in the majority of industries, particularly agriculture, footwear, and miscellaneous industries (including arms). In most industries, India reduced its exports to Russia, while the significant increase in Chinese exports to Russia can be found in many industries, particularly mineral products, paper products, and precision metals. The significant export decrease over Russian airspace was found in plastics, rubber, and wood products.

=== Table 4 ===

The results of imports are presented in Table 5. Western countries have increased significantly increased imports from Russia of agricultural goods, leather products, base metals, and transport equipment. Chemical products have shown a significant decrease. Agricultural goods, food products, mineral products, footwear, ceramic or glass products, and transportation equipment are also some industries where Western countries are increasing imports from Belarus. Moreover, chemical products have seen a significant decrease, similar to Russian imports. The imports of the Western countries from Ukraine increase significantly in plastic and rubber, wood products, paper products, textiles, footwear, and miscellaneous industries. China and India increased their imports of agricultural goods, leather goods, and precision metals from Russia. Mineral products, which include petroleum oils, have also seen an increase.

=== Table 5 ===

Lastly, we briefly check the relationship of trade effects in the Western countries with those in China and India. We look specifically at whether China and India increased their exports to or imports from Russia in industries where Western countries reduced their exports or imports. To observe this, we simply plot the estimates of Table 4 in Figure 2 and those of Table 5 in Figure 3. The vertical axis represents an industry-level estimate of China's or India's trade with Russia, while the horizontal axis represents trade with Western countries. We can expect negative correlations if China and India replace the Western countries in terms of trade with Russia. However, as shown in Figures 2 and 3, we cannot see such relationships in both export and imports. Rather, the fitted lines for both China and India have positive slopes.

5. Concluding Remarks

Using monthly trade data from January 2021 to May 2022, we investigated the trade effects of the 2022 Russia–Ukraine war. We investigated how several key players, including Western countries, China, and India, changed their trade after February 2022 by estimating gravity-type equations. Our main finding is that, on average, Western countries' exports to and imports from Russia did not change significantly after the invasion because some Western countries with greater reliance on trade with Russia increased their trade with Russia. Although the Western countries have imposed several trade restrictions, their effects do not necessarily appear immediately. However, the precision machinery industry found a significant decrease of in the Western countries' exports to Russia. Thus, the export restriction of high-tech goods seemed to work immediately.

Other findings include the following. First, Western countries reduced their exports to and imports from Belarus significantly. These results, which differ from those in trade with Russia, could be explained by the fact that Belarus is not a significant trade partner for Western countries. The decrease in trade with Belarus is harmless to the Western countries' economies. Second, the Western countries increased their exports to Ukraine but did not change their imports from Ukraine. The former increase could include an increase in military supplies. Third, China increased both exports to and imports from Russia, whereas India increased imports from Russia but decreased exports to Russia. However, it is also demonstrated that these two countries do not always replace Western countries in terms of trade with Russia. Lastly, international trade significantly decreased between countries along the flight corridors over Russian airspace. In other words, the war had significant effects on trade between the third countries through the blockage of transportation routes.

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Table 1. Impacts on Total Exports

	(I)	(II)	(III)	(IV)	(V)	(VI)
West * RUS * Mar22	-0.516*** [0.142]	-0.516*** [0.142]	-0.515*** [0.142]	0.145 [0.229]	-0.501*** [0.140]	0.149 [0.229]
West * BLR * Mar22		-0.524*** [0.197]				-0.555*** [0.197]
West * UKR * Mar22			1.514*** [0.162]			1.529*** [0.162]
CHN * RUS * Mar22				0.801*** [0.221]		0.787*** [0.220]
IND * RUS * Mar22				-0.038 [0.222]		-0.046 [0.221]
Air * Mar22					-0.053*** [0.012]	-0.053*** [0.012]
RTA dummy	-0.031 [0.022]	-0.031 [0.022]	-0.032 [0.022]	-0.031 [0.022]	-0.048** [0.022]	-0.047** [0.022]
Number of observations	226,590	226,590	226,590	226,590	226,590	226,590
Pseudo R-squared	0.995	0.995	0.995	0.995	0.995	0.995

Source: Authors' estimation.

Notes: Estimation results were obtained using the Poisson pseudo maximum likelihood method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by country pairs are shown in brackets.

Table 2. Impacts on Total Imports

	(I)	(II)	(III)	(IV)	(V)	(VI)
West * RUS * Mar22	-0.425*** [0.158]	-0.426*** [0.158]	-0.425*** [0.158]	-0.079 [0.223]	-0.425*** [0.159]	-0.082 [0.223]
West * BLR * Mar22		-0.729*** [0.239]				-0.739*** [0.240]
West * UKR * Mar22			0.005 [0.230]			0.003 [0.228]
CHN * RUS * Mar22				0.333* [0.176]		0.328* [0.175]
IND * RUS * Mar22				0.864*** [0.177]		0.861*** [0.176]
Air * Mar22					-0.016 [0.013]	-0.016 [0.013]
RTA dummy	-0.069*** [0.024]	-0.069*** [0.024]	-0.069*** [0.024]	-0.069*** [0.024]	-0.074*** [0.024]	-0.074*** [0.024]
Number of observations	230,983	230,983	230,983	230,983	230,983	230,983
Pseudo R-squared	0.993	0.993	0.993	0.993	0.993	0.993

Source: Authors' estimation.

Notes: Estimation results were obtained using the Poisson pseudo maximum likelihood method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Standard errors clustered by country pairs are shown in brackets.

Table 3. Heterogeneous Impacts among the Western Countries

Flow	(I)	(II)	(III)	(IV)
	Export	Import	Export	Import
West * RUS * Mar22	-0.014	-0.155		
West * RUS * Mar22 * RUS Share	10.625*	2.828		
USA * RUS * Mar22			-0.763***	-0.332*
CAN * RUS * Mar22			-1.471***	-0.673***
EU * RUS * Mar22			0.198	-0.026
CHE * RUS * Mar22			0.655***	-0.454**
JPN * RUS * Mar22			0.296	0.064
KOR * RUS * Mar22			0.034	-0.15
SGP * RUS * Mar22			-1.239***	-1.460***
AUS * RUS * Mar22			-0.302	0.949***
NZL * RUS * Mar22			-0.934***	-2.134***
TWN * RUS * Mar22			-0.053	0.043
West * BLR * Mar22	-0.555***	-0.739***	-0.555***	-0.739***
West * UKR * Mar22	1.530***	0.003	1.530***	0.004
CHN * RUS * Mar22	0.786***	0.328*	0.786***	0.328*
IND * RUS * Mar22	-0.046	0.861***	-0.046	0.861***
Air * Mar22	-0.053***	-0.016	-0.053***	-0.016
RTA dummy	-0.047**	-0.074***	-0.047**	-0.073***
Number of observations	226,590	230,983	226,590	230,983
Pseudo R-squared	0.995	0.993	0.995	0.993

Source: Authors' estimation.

Notes: Estimation results were obtained using the Poisson pseudo maximum likelihood method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The significance is based on the standard errors clustered by country pairs. To save space, we do not report the standard errors.

Table 4. Impacts on Exports by Industry

Origin Destination	West RUS	West BLR	West UKR	CHN RUS	IND RUS	Air
Live animals	0.41	-0.19	1.945**	0.486*	-0.491*	-0.024
Vegetable products	0.19	1.660***	2.161***	0.574***	-0.669***	-0.022
Animal/vegetable fats & oils	-0.914***	8.813***	5.000***	-0.519***	-1.394***	-0.123
Food products	-0.4	0.115	0.715***	-0.043	-0.705*	0.004
Mineral products	1.272	-1.067*	-0.253	2.704***	0.744	0.032
Chemical products	0.737	0.361**	1.447**	1.113**	0.407	0.017
Plastics and rubber	-0.036	-0.647***	0.518*	0.788***	-0.537**	-0.039***
Leather products	-0.111	-0.915***	1.887***	0.413	0.026	-0.006
Wood products	-0.036	-0.111	0.949***	0.042	-1.186***	-0.140***
Paper products	2.242***	-1.918***	1.337***	3.037***	0.288	-0.003
Textiles	-0.241	-0.211	2.634***	0.32	-0.720***	-0.006
Footwear	0.878***	0.860***	3.728***	1.526***	0.509**	0.018
Ceramic or glass products	0.339	-0.417**	2.749***	1.094***	0.731*	-0.02
Precision metals	0.573	-8.403***	-1.329***	3.105***	1.341***	-0.092
Base Metal	0.634	-0.343***	2.411***	1.063**	0.26	-0.016
General/electric machinery	0.817***	-0.817***	0.991***	1.590***	0.756***	-0.01
Transport equipment	-0.027	-0.602**	0.989***	1.762***	-0.581**	-0.037
Precision machinery	-0.317**	-0.642***	0.828**	0.307***	-0.205**	0.016
Miscellaneous	0.384	-0.460*	3.690***	1.083***	-0.344	-0.066***

Source: Authors' estimation.

Notes: Estimation results were obtained using the Poisson pseudo maximum likelihood method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The significance is based on the standard errors clustered by country pairs. To save space, we do not report the standard errors.

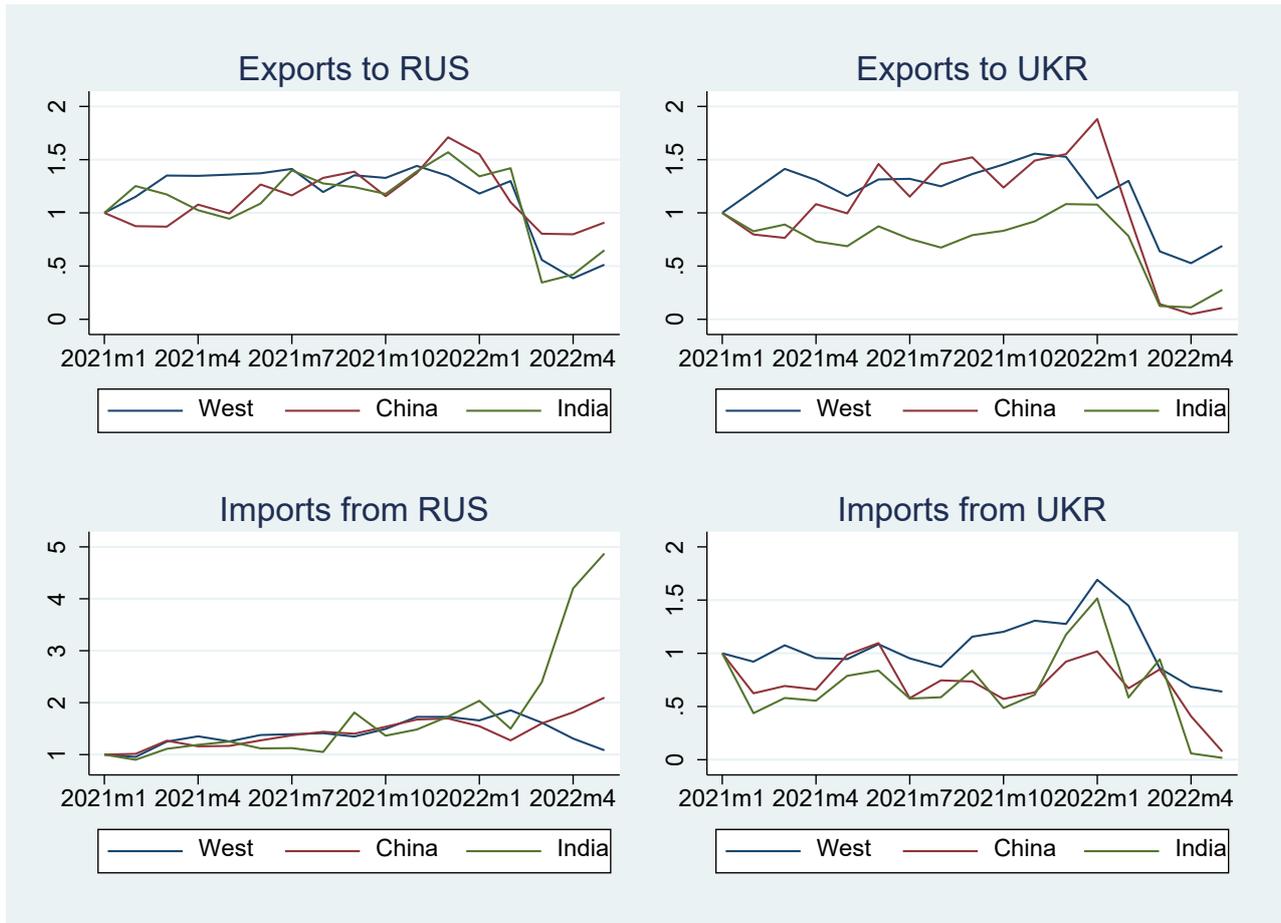
Table 5. Impacts on Imports by Industry

Destination Origin	West RUS	West BLR	West UKR	CHN RUS	IND RUS	Air
Live animals	0.429***	-0.024	0.438*	0.386***	0.839***	-0.051
Vegetable products	1.052***	1.412**	-0.377	1.563***	1.151***	0.037
Animal/vegetable fats & oils	1.815***	-0.860***	0.433	0.680**	1.303***	-0.04
Food products	-0.372*	1.985***	-0.021	0.16	-0.550***	0.001
Mineral products	-0.112	1.046**	-0.411*	0.439**	1.314***	-0.136**
Chemical products	-0.480***	-2.587***	0.385	0.141	0.116	0.105*
Plastics and rubber	-0.015	-0.097	1.313***	-0.076	-0.455**	-0.026*
Leather products	2.018***	-0.106	0.252	2.107***	1.248*	0.119***
Wood products	-0.075	-0.344**	1.098***	0.134	0.306*	0.029
Paper products	-0.089	0.119	1.944***	0.700***	-0.288*	0.031
Textiles	-0.187	-0.330*	0.686**	0.065	-0.713***	0.057**
Footwear	-0.412	3.091***	0.930***	-0.912***		0.158***
Ceramic or glass products	-0.575	0.624***	-0.821***	-0.617*	-0.962**	0.065***
Precision metals	-0.029		0.234	1.105***	0.311**	-0.099
Base Metal	0.548***	-1.030*	0.091	0.318*	0.228	0.049**
General/electric machinery	0.05	0.209	0.526	0.285	0.812***	-0.001
Transport equipment	1.263***	2.306***	0.731	-0.077	0.262	0.009
Precision machinery	0.255	0.292	-0.276	0.581***	0.169	0.078***
Miscellaneous	0.597	-0.379	1.917**	-2.004***	-0.915	0.124***

Source: Authors' estimation.

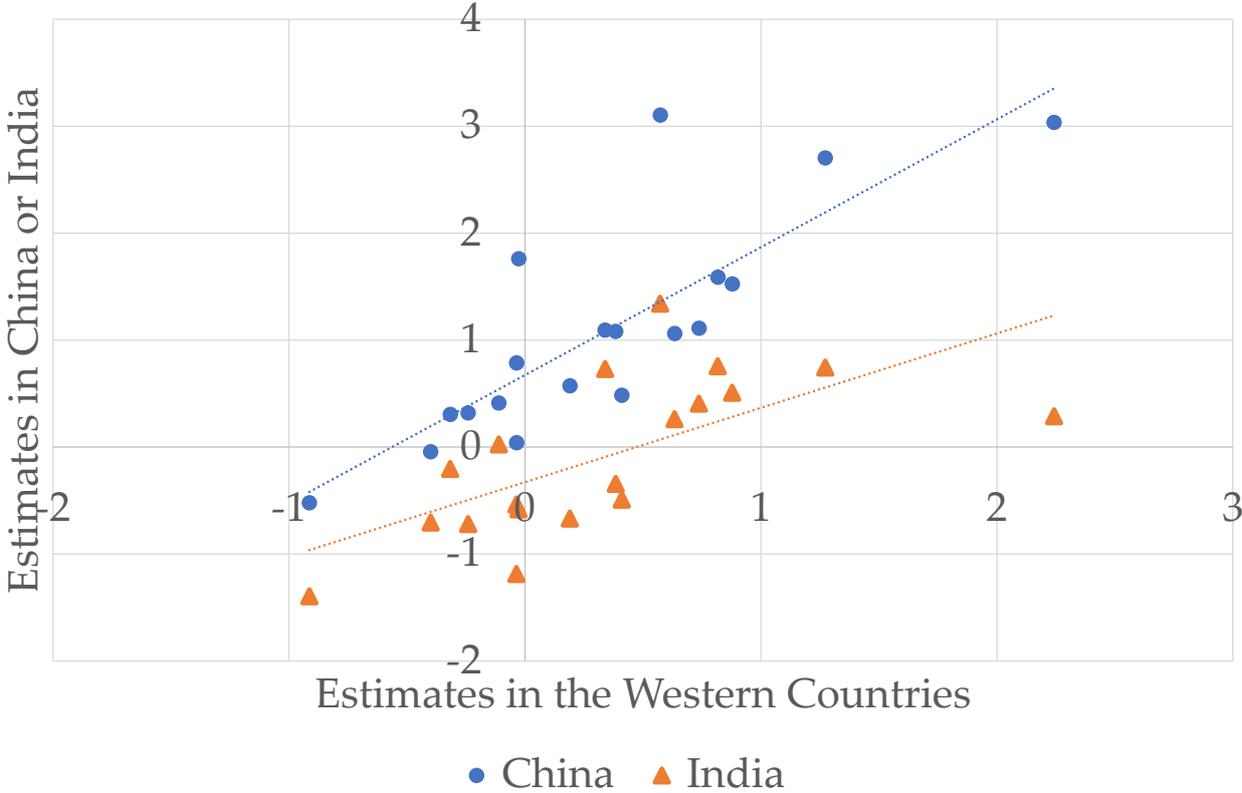
Notes: Estimation results were obtained using the Poisson pseudo maximum likelihood method. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. The significance is based on the standard errors clustered by country pairs. To save space, we do not report the standard errors.

Figure 1. Overview of Monthly Trade (January 2021 = 1)



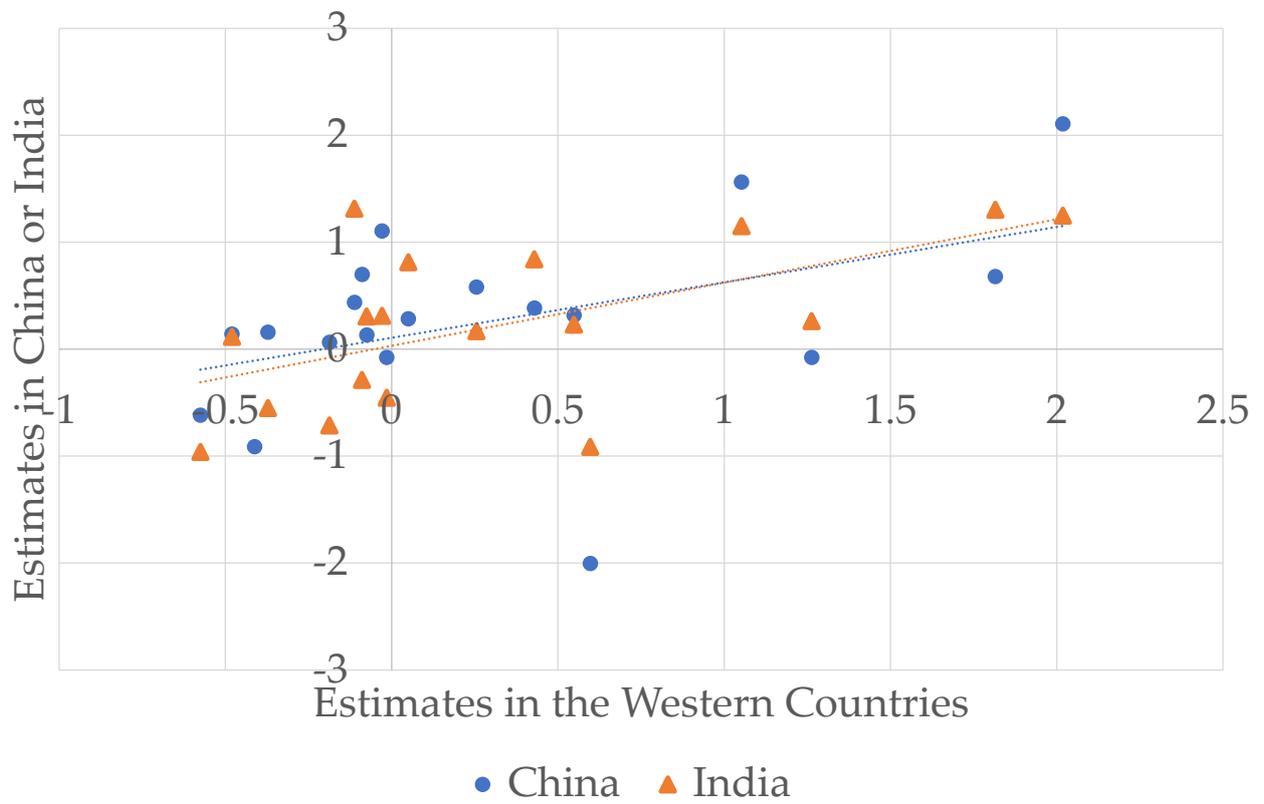
Source: Global Trade Atlas

Figure 2. Correlation of Export Effects in the Western Countries with Those in China and India



Source: Drawn using the estimates in Table 4.

Figure 3. Correlation of Import Effects in the Western Countries with Those in China and India



Source: Drawn using the estimates in Table 5.