World Trade Review (2024), **23**, 433–447
doi:10.1017/S1474745623000484

ORIGINAL ARTICLE

The Real-Time Impact of the War on Russian Imports: A Synthetic Control Method Approach

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(Received 17 November 2022; revised 4 October 2023; accepted 6 November 2023; first published online 17 May 2024)

Abstract
In response to the invasion of Ukraine, the EU and most other advanced economies imposed extensive sanctions on Russia, intending to harm its production capabilities and hinder its economic activities by restricting its access to international trade and financial markets. This paper develops an empirical framework based on the synthetic control method to assess the impact of the war and the following sanctions on bilateral and sectoral exports to Russia almost in real time. The war and the following sanctions reduced aggregate exports to Russia by a third between March and December 2022, with the effects being stronger for sanctioning countries than for non-sanctioning ones, albeit with substantial country-level heterogeneity within each group. Exports to Russia in high-tech sectors – relatively more targeted by trade sanctions – have been disproportionately affected.

Keywords: synthetic control; Russia; Sanctions; International trade; War

JEL Classification: F51; C54; F13

1. Introduction

Following the Russian invasion of Ukraine in February 2022, the EU and several countries (the USA, the UK, Japan, Canada, and Australia, among others) imposed extensive sanctions on Russia.[1] The restrictions restrained trade in goods and services, affected the financial sector (e.g., exclusion of most local banks from SWIFT), and even targeted specific individuals related to the Russian government, military, or state-owned enterprises. Moreover, several multinationals, including large transport and logistic firms, exited the Russian market or curtailed local operations.

Providing a credible quantitative assessment of the impact of the war and sanctions on the Russian economy remains complex because local institutions have discontinued the publication of several official statistics (including on monthly bilateral merchandise trade). Available figures and anecdotal information point to a significant blow to the Russian economy (Sonnenfeld et al., 2022), with some sectors recording dramatic contractions in activity (e.g., car production dropped 77% in September 2022 with respect to the previous year). The IMF projections before the conflict indicated Russia's GDP would expand by 3.8% in 2022, whereas actual data revealed a contraction of 2.1%. Despite the significant negative revision, it was milder than the initial estimates

[†]Bank of Italy. The authors are grateful to Rinalds Gerinovics for his excellent research assistance and thank Riccardo Cristadoro and Giovanni Veronese, the editor Hylke Vandenbussche, and two anonymous referees for their useful comments and suggestions. The views expressed in this paper are solely those of the authors and do not necessarily reflect those of the Bank of Italy. The usual disclaimer applies.

[1]See Bown (2022) for a comprehensive timeline of the provisions adopted in the context of the war.

reported following the war outbreak and the first sanction packages. This evidence fueled the debate surrounding the effectiveness of the sanctions.

In this context, the evolution of Russia's imports provides a valuable metric to glean the implications of the conflict and sanctions on its economy as they relate tightly to short- and long-run growth.[2] Russian domestic production relies on foreign intermediate and capital goods in many sectors (Grzegorczyk et al., 2022). In addition, reducing available foreign goods may decrease consumer welfare as it will increase prices (Broda and Weinstein, 2004). However, evaluating the changes in nominal trade flows requires an appropriate counterfactual to account for the prevailing dynamics of international trade. This aspect becomes particularly crucial when examining the period following the outbreak of the conflict, which was marked by high inflation and still-growing trade volumes at the global level.

This paper contributes to the debate on the real consequences of the war and the following sanctions by developing an empirical framework to assess their impact on Russian imports almost in real time.[3] This prompt and easy-to-update assessment could inform the debate among policymakers concerning the design of optimal sanctioning policies.

To the best of our knowledge, this paper is the first one evaluating the impact of the war and the following sanctions on exports *to* Russia.[4] Another recent contribution, closely related to this paper, focuses instead on the impact of the war on exports *from* Russia and Ukraine using an event-study approach (Steinbach, 2023).

We find that the war and the following sanctions caused a substantial drop in exports to Russia from March to December 2022. Initially, both shipments from sanctioning and non-sanctioning countries were considerably affected. Then, when export bans and restrictions became more binding,[5] exports from sanctioning countries did not rebound and stood below 50% of the corresponding benchmark. Conversely, exports from non-sanctioning countries bounced back, substantially exceeding the no-war counterfactual. Sectoral decomposition of exports shows that high-tech imports – such as motor vehicles and electronics industries, relatively more targeted by trade sanctions than other sectors – have been impacted the most (−60% compared to their counterfactual). Considering a naive counterfactual, such as the pre-war level of Russian imports, instead of the synthetic control, would lead to severely underestimating the drop in Russian imports by about two-thirds.

The rest of this paper is structured as follows. Section 2 describes the synthetic control method in more detail. Section 3 describes our data. Section 4 presents the main results concerning the impact of the war and following sanctions on Russian imports. Section 5 concludes.

2. The Synthetic Control Method

This section provides an overview of the synthetic control method. In subsection 2.1, we summarize in a non-technical way the features of such a methodology and highlight the main differences using a standard gravity framework. In subsection 2.2, we detail the methodology, especially the construction of the synthetic counterfactual.

2.1 Overview of the Methodology

We use the synthetic control method (Abadie and Gardeazabal, 2003; Abadie et al., 2010, 2015) to construct a no-war counterfactual for monthly Russian imports.[6] The synthetic control

[2]See Coe and Helpman (1995) and Lawrence and Weinstein (1999) on the link between imports and growth.

[3]Other papers have assessed the long-run implications of the war using general equilibrium model-based approaches (e.g., Mahlstein et al., 2023; Borin et al., 2023a).

[4]For an analysis of the financial effects, see Boungou and Yatié (2022) and Ferriani and Gazzani (2023).

[5]Due to wind-down periods and exceptions, export bans and restrictions were not particularly binding in the first few months following the start of the conflict.

[6]See also Athey and Imbens (2017), Abadie (2021), Gilchrist et al. (2022) for a review and a discussion of the methodology.

method is a statistical tool used to estimate the causal impact of a treatment or intervention – in our case, the war and the following sanctions. The gist of the synthetic control method lies in its ability to create an artificial comparison term that is as similar as possible to the unit receiving the treatment, allowing researchers to make causal inferences even in non-experimental settings. More formally, the synthetic control method provides a data-driven procedure to construct a robust counterfactual from a weighted average of eligible control units.

Gravity models represent a workhorse tool for trade economists (Head and Mayer, 2014), also for the analysis of trade shocks. However, for specific research designs, the features of the synthetic control method might be more suitable. For instance, in the case of endogenous trade policy shocks, such as the war and following sanctions, the gravity coefficients might be highly sensitive to the chosen sample, which can be concerning when choosing a proper counterfactual (Saia, 2017). Without a proper exogenous shock, a standard gravity model may represent "a regression of endogenous variables on endogenous variables" (De Benedictis and Taglioni, 2011). Unlike a standard gravity framework, the synthetic control method may alleviate concern related to non-random assignment of the treatment (Saia, 2017) and the presence of time-varying heterogeneity (Xu, 2017).

In addition to the above issues related to the research design, the synthetic control method yields an immediate, time-varying, and easy-to-interpret measurement of the overall effect of a policy change, where a gravity equation provides a coefficient, indicating its partial effect (Addessi et al., 2019). Furthermore, a static gravity framework may fail to capture a time-varying impact. As we show in Section 4, the average effect of the war and related sanctions on exports to Russia is far from the actual time-varying value. For all these reasons, the synthetic control methodology has been used widely in the international trade literature (e.g., Billmeier and Nannicini, 2013; Saia, 2017; Breinlich et al., 2020; Douch and Edwards, 2022; Adarov, 2023) and to analyze the effects of sanctions on GDP (Gharehgozli, 2017).

In our setting, the war and the following sanctions represent the treatment, whereas the treated units are merchandise exports to Russia from each partner. For such trade flows, the synthetic control method builds a corresponding hypothetical no-war counterfactual, derived from a weighted average of third countries' imports from the same partner. The above weights minimize the distance between the counterfactual exports and the observed ones before the war. In other words, the objective is to find a combination of export flows that may accurately track the targeted export flow before the war. Hence, after the treatment, one may carry over time such weights and use the untreated flows to compute the no-war hypothetical Russian imports from the given partner.

When aggregated, these distinct counterfactual imports constitute the total exports to Russia that would have been observed in a no-war scenario. At each point in time, the total effect of the war and following sanctions on Russian imports is the wedge between the observed Russian imports and their respective counterfactual. Notice that we can use this bottom-up approach also to disentangle the evolution of exports from distinct groups of countries (e.g., sanctioning vs. non-sanctioning countries), or for specific sectors, as we compute a counterfactual for each aggregate and sectoral trade flow to Russia.

2.2 Building the Counterfactual

We consider exports from country i to Russia, $X_{i\to Russia}$ as the treated unit. For such trade flow, there are J^i untreated trade flows that can be used to construct the counterfactual. In line with the literature (e.g., Head and Mayer, 2014; Saia, 2017), we assume that the exports from country i to j are some function of k predictors, $\boldsymbol{Z}^{\boldsymbol{i\to j}} = Z_{1,i\to j}, \ldots, Z_{k,i\to j}$. We denote as $\boldsymbol{Z}^{\boldsymbol{i}}$ the $k \times J^i$-dimensional matrix of predictors of untreated trade flows originating from country i to the J^i destinations. By analogy, $Z^{i\to Russia}$ represents the vector of predictors of the trade flows from country i to Russia. Let $T_0 = 2022M02$ represent the starting time of the war.

https://doi.org/10.1017/S1474745623000484 Published online by Cambridge University Press

We are interested in obtaining the effect of war and sanctions on trade flows to Russia, $\tau_{i\rightarrow Russia,t}$, at time t, i.e.,

$$\tau_{i\rightarrow Russia,t} = X^{W}_{i\rightarrow Russia,t} - X^{NW}_{i\rightarrow Russia,t} \tag{1}$$

for $t > T_0$, where $X^{W}_{i\rightarrow Russia,t}$ are the exports from i to Russia under war at time t and $X^{NW}_{i\rightarrow Russia,t}$ are the exports from i to Russia at time t under no war. It follows that the observed trade exports to Russia correspond to the war scenario, i.e., $X_{i\rightarrow Russia,t} = X^{W}_{i\rightarrow Russia,t}$ for $t > T_0$. Hence, to obtain $\tau_{i\rightarrow Russia,t}$, we need to compute $X^{NW}_{i\rightarrow Russia,t}$. Given a set of appropriately chosen weights, $X^{NW}_{i\rightarrow Russia,t}$ is given by

$$\hat{X}^{NW}_{i\rightarrow Russia,t} = \sum_{j=1}^{J^I} w_{i,j} X_{i\rightarrow j,t} \tag{2}$$

where $w_{i,j}$ represents the weight for the jth untreated export from i to j, with $w_{i,j} \in [0, 1]$ and $\sum_j w_{i,j} = 1$. It follows that the synthetic counterpart for $\tau_{i\rightarrow Russia,t}$ is given by

$$\hat{\tau}^{NW}_{i\rightarrow Russia,t} = X^{W}_{i\rightarrow Russia,t} - \hat{X}^{NW}_{i\rightarrow Russia,t} \tag{3}$$

Let $\boldsymbol{v}_i = (v_{i,1}, \ldots, v_{i,k})$ denote a set of weights assigned to each of the k for the flows originating from country i. The problem of finding the optimal weights $w_{i,j}$ and $\boldsymbol{v}_i$ can then be written as

$$\begin{gathered} \min_{(\mathbf{w}^i, V^i)} (\boldsymbol{Z}^{i\rightarrow Russia} - \mathbf{w}^i \boldsymbol{Z}^i)' \mathbf{V}^i (\boldsymbol{Z}^{i\rightarrow Russia} - \mathbf{w}^i \boldsymbol{Z}^i) \\ \text{s.to } \boldsymbol{w}^i \in [0, 1]^J \text{ and } \sum_{j=1}^{J^i} w_{i,j} = 1 \end{gathered} \tag{4}$$

where $\mathbf{V}^i$ represents a k-dimensional diagonal matrix obtained from the k-dimensional vector $\boldsymbol{v}_i$, and $\mathbf{w}^i$ represents a J^i-dimensional vector of weights $w_{i,j}$.

To obtain $\hat{X}_{i\rightarrow Russia,t}$, we repeat the described procedure for all origin countries i' for which exports to Russia and other $J^{i'}$ destinations are available. By aggregating over all origins i, we obtain the counterfactual total exports to Russia, $\hat{X}^{NW}_{\rightarrow Russia,\, t}$, as

$$\hat{X}^{NW}_{\rightarrow Russia,\, t} = \sum_i \hat{X}_{i\rightarrow Russia,t} \tag{5}$$

Our design also helps us delve into sectoral trade flows to assess the impact of the war and the following sanctions on specific goods (e.g., high-tech items exports). To this end, for the sector-level analysis, we run an ad-hoc synthetic control calibration that features industry-level predictors in the $\boldsymbol{Z^i}$ matrix, and compute the weights needed to obtain the counterfactual sectoral exports to Russia. We detail the data used in the analysis in Section 3.

3. Data

The empirical analysis relies on the Trade Data Monitor panel of monthly bilateral and sectoral trade flows for January 2020–December 2022.[7] We focus on the top 60 exporters to

[7]Sectors are defined as follows, using the HS 2-digit classification: process food 11–24; chemicals 28–40; pharmaceuticals 30; textiles 41–67; metals and basic metals, 72–83; machinery 84; electronics and optical eq. 85, 90; motor vehicles 87, manufacturing NEC 44–49, 71, 91–99. We excluded from the sector-level analysis agriculture, mining and quarrying, non-metallic mineral products and other transport eq., since their synthetic control match is not sufficiently reliable (see Parast et al., 2020).

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Russia,[8] and for each one of them, we build counterfactual exports to Russia by appropriately weighting its exports to 150 trading partners, i.e., our donor pool. To reduce the confounding effect of the war on counterfactual exports, we exclude from the donor pool those countries directly affected by the conflict or indicated as potential hubs for trade with Russia (Ukraine, Turkey, Kazakhstan, Belarus, Serbia, Armenia, Uzbekistan, Kyrgyzstan, Georgia, Azerbaijan).[9] When a country's exports to Russia before the war are not close enough to their counterfactual, we drop the exporting country from the analysis.[10] Our final sample includes 50 exporters whose synthetic exports to Russia are obtained by combining, on average, the flows to four other partners in the donor pool (see the table in the Appendix). Overall, this sample covers more than 80% of total Russian imports before the war.[11]

We consider January 2020–January 2022 as the pre-treatment period and February 2022–December 2022 as the treatment period. In line with the literature on the synthetic control method approach and international trade, we consider the outcome of interest (i.e., export flow to Russia) to be a function of some predictors. In particular, the predictors used in the synthetic control, sourced from the Dynamic Gravity Dataset (Gurevich and Herman, 2018) and Trade Data Monitor are the following:

1. the sum of the logs of real GDPs of the trading partners averaged between 2015 and 2019;
2. a linear approximation of the multilateral resistance between the trading partners (Baier and Bergstrand, 2009) based on distance, common language, and contiguity;[12]
3. the average value of the bilateral trade flows between January 2020 and January 2022;
4. the export shares from the origin country to the trading partner of the four most important exporting sectors from the origin country to Russia in 2021;
5. a dummy for preferential trade agreements covering merchandise trade between 2015 and 2019.

The first three predictors broadly follow Saia (2017) and are commonly used in international trade within the gravity framework (Head and Mayer, 2014) Instead, the sectoral export shares help us select importers from the donor pool whose sourcing of foreign goods is as close as possible to that of Russia. The last predictor allows us to control for the impact of policy variables affecting merchandise exports through the reduction of trade barriers.

In addition to multilateral resistance and preferential trade agreements, in the sectoral level analysis, we use three industry-level variables that allow us to take further into account heterogeneity at the sector level. In the calibration of the industry-level synthetic control, we use the following variables as predictors, instead of the corresponding aggregate variables:

1. the sum of the logs of sectoral gross output of the trading partners averaged between 2015 and 2019, sourced from Eora Global Supply Chain Database;
2. the average value of the sectoral–bilateral trade flows between January 2020 and January 2022;
3. the export share in 2021 of the given sector from the origin country to the trading partner.

[8] Belarus is excluded as trade data are not released since the start of the war, as well as Ukraine, which is directly affected by the war.

[9] The identification of potential hubs follows Borin et al. (2023b) and Chupilkin et al. (2023).

[10] We follow the method designed by Parast et al. (2020) and drop matches with a mean Absolute Standardized Mean Difference above 0.4. In this way, we drop nine countries out of 60 from the analysis.

[11] The list of exporters is *Argentina*, Austria, Belgium, Bulgaria, Canada, *Chile*, *China*, Croatia, Czech Republic, Denmark, *Ecuador*, Estonia, Finland, France, Germany, Greece, *Hong Kong*, Hungary, *India*, *Indonesia*, *Iran*, Ireland, *Israel*, Italy, Japan, Kazakhstan, Latvia, Luxembourg, *Malaysia*, *Mexico*, Moldova, Netherlands, Norway, *Paraguay*, *Peru*, Poland, Portugal, Romania, *Serbia*, Singapore, Slovenia, *South Africa*, South Korea, Spain, Sweden, Switzerland, *Thailand*, *Turkey*, United Kingdom, United States. Non-sanctioning countries are in italics.

[12] Baier and Bergstrand (2009) derive a linear approximation of the bilateral resistance terms. In particular, let X be a standard gravity variable (in our case, common language, contiguity, distance). Then, the linear approximation reads as $BVX_{ij} = X_{ij} - \frac{1}{N}\sum_{m=1}^{N} X_{mj} - \frac{1}{N}\sum_{k=1}^{N} X_{ik} + \frac{1}{N^2}\sum_{k=1}^{N}\sum_{m=1}^{N} X_{mk}$.

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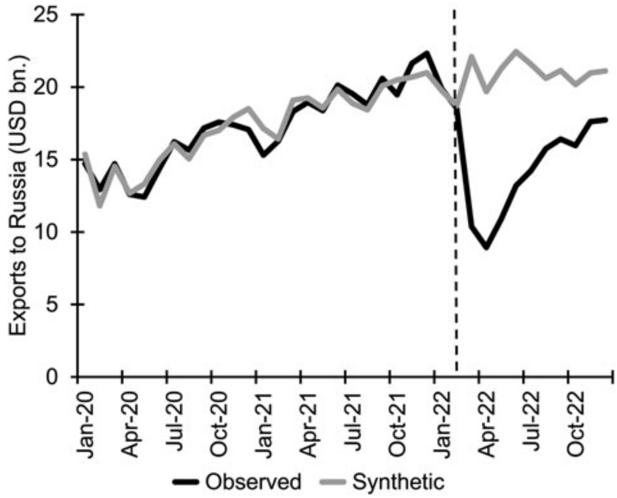

Figure 1. Effects of war and sanctions on exports to Russia
Note: On the vertical axis, we report observed and synthetic exports to Russia in USD bn.

4. Results

4.1 The Effects of the War and the Following Sanctions on Aggregate Russian Imports

Figure 1 compares the evolution of observed exports to Russia with the synthetic counterpart. Before the conflict, the synthetic control matches observed exports to Russia. Following the invasion, we observe a sharp decoupling between the two series. Actual exports plummeted in March and April 2022 while the synthetic control increased, generating the widest gap between them in April (actual flows 55% below their counterfactual). In the latest data points, actual imports recorded a sharp rebound, suggesting an ongoing trend of import substitution and reorganization of logistics, payment systems, and supply chains. In December, exports to Russia stood 16% below their counterfactual, still 5% below their pre-war February level. This evidence suggests that a naive counterfactual, such as that implied by a no-change scenario, would underestimate the drop in Russian imports by about two-thirds.

Exports from both sanctioning and non-sanctioning countries sharply contracted (Figure 2). Initially, exports from sanctioning economies were 66% lower than in the scenario without the war. Flows from non-sanctioning countries were markedly below their counterfactual (−43%). This suggests that export bans and other trade sanctions were not the only drivers at play in determining the sharp contraction of exports to Russia, at least at the initial stage of the war. Other factors may be critical (e.g., restrictions on international payments, logistics disruptions, the contraction of Russian demand, and the exit of multinationals from the Russian market). In the following months, exports from non-sanctioning countries strongly rebounded, while those from sanctioning countries remained subdued. In the last quarter of 2022, flows from sanctioning countries were 53% below the estimated no-war scenario. Instead, exports from non-sanctioning economies exceeded their counterfactual by 31%.[13] Hence, the stabilization of the aggregate export losses observed in the last few months hides a more complex picture at the country group level.

4.2 Country- and Sector-Level Evidence

The impact of the war has been very heterogeneous, even within sanctioning and non-sanctioning groups. In the former group, the US recorded the sharpest fall in exports to Russia (almost 90% below their counterfactual). Most sanctioning countries narrowed the initial

[13] See Simola and Röyskö (2023) who focus on exports from East Asian countries.

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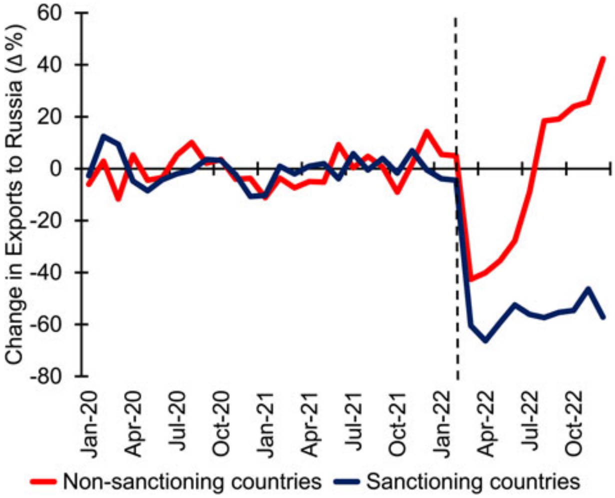

Figure 2. Effects of war and sanctions on exports to Russia, sanctioning vs. non-sanctioning countries
Note: On the vertical axis, we report the percentage difference between the observed and counterfactual exports to Russia for sanctioning and non-sanctioning countries.

gaps from their no-war counterfactual (Figure 3). Among non-sanctioning countries, Turkey is a stark outlier: after contracting in March and April, its exports to Russia rebounded sharply, more than doubling the no-war counterfactual in the last quarter of 2022.

The war has disproportionately affected exports to Russia in the motor vehicle and electronics sectors due to sanctions targeted at specific products related to these industries (e.g., dual-use items). In the first few months of the war, exports in these industries experienced a 60% reduction compared to the scenario in the absence of war (Figure 4). By the end of 2022, they remained nearly 30% below their respective counterfactual levels.[14] This result is almost entirely driven by the reduction in exports from sanctioning countries, which is only partly offset by the increase in exports from non-sanctioning countries (Figure 5), additional evidence of the effectiveness of export bans and restrictions. Moreover, the sharp drop in these high- and mid-tech flows is likely to hurt the Russian economy in the short term and hinder its potential long-term growth. Russia is highly dependent on imports of such products, and substitution with domestic products seems not viable because of the high technological content.[15]

4.3 Country- and Sector-Level Evidence

Distinguishing trade diversion from potential triangulation attempts and assessing their relative importance would require more information than currently available (e.g., firm-level data). Nonetheless, disaggregated data at our disposal may provide some suggestive evidence regarding the possible presence of the aforementioned phenomena. Since sanctions imposed on exports to Russia have targeted items with relatively high technological content, we focus on high-tech products in this section.[16] More specifically, we analyze the pattern of these flows from sanctioning countries to Turkey, given that its merchandise exports to Russia are well above their corresponding counterfactual in the last quarter of 2022 (as shown in Figure 6).

The first evidence is that Turkish exports to Russia in the high-tech sectors have increased considerably since April, after an initial decline following the outbreak of the war (Figure 6,

[14]Together with mechanical engineering, these sectors account for half of exports to Russia.

[15]Foreign production satisfies 63% of Russia's demand in these industries vs. an average of 35% for the other manufacturing sectors (see OECD TiVA 2018 data and Belotti et al., 2021).

[16]Technology products as proxied by the sum across machinery and mechanical appliances (HS chapter 84), electrical equipment (HS chapter 85), motor vehicles (HS chapter 87), aircraft, spacecraft, and parts thereof (HS chapter 88), ships, boats and floating structures (HS chapter 89), and optical, medical etc. equipment (HS chapter 90).

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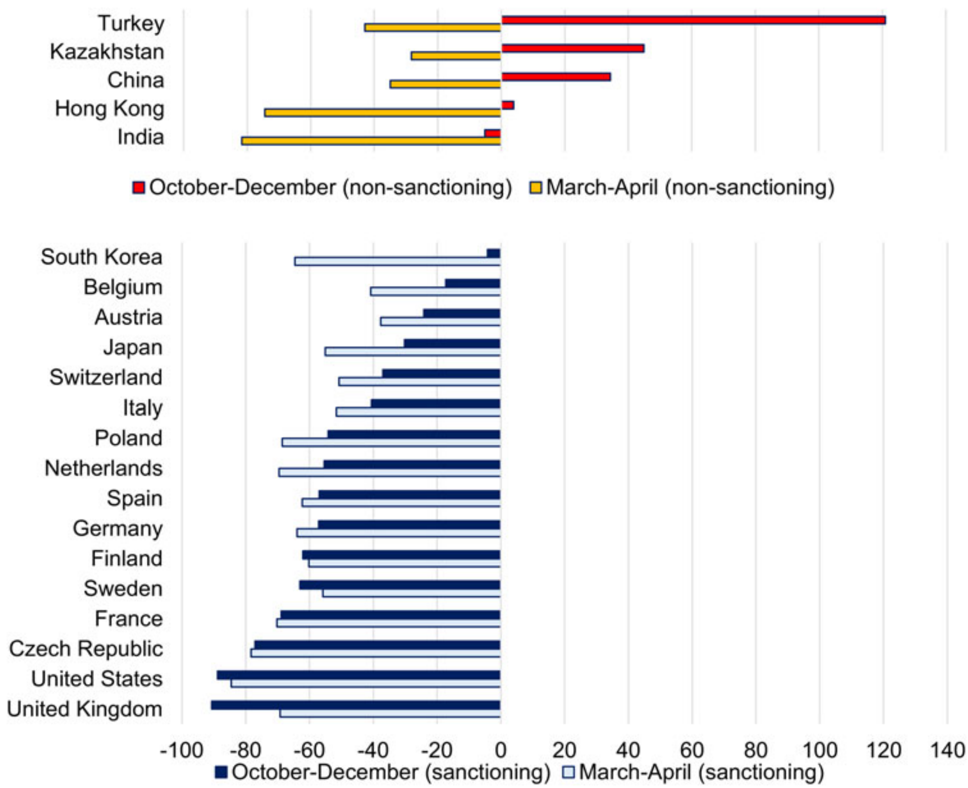

Figure 3. Effects of war and sanctions on exports to Russia by origin country (March–April vs. October–December)
Note: Differences from the counterfactual are in percentage points.

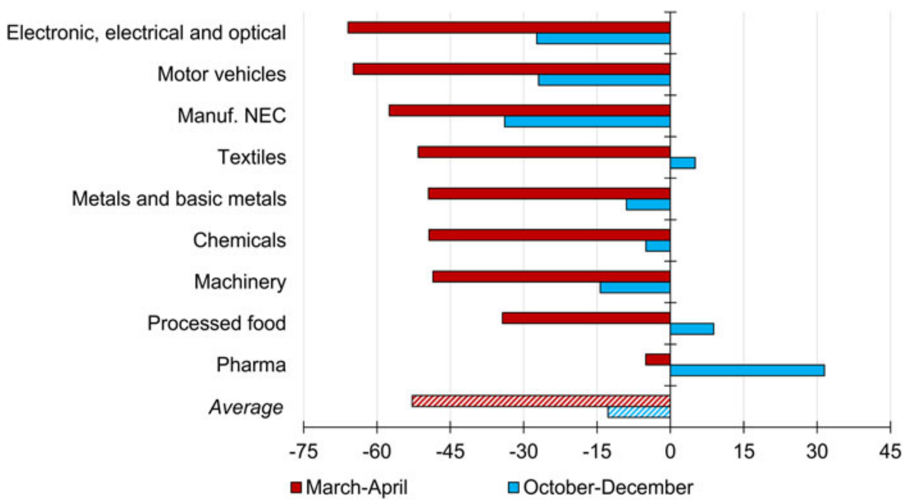

Figure 4. Effects of war and sanctions on manufacturing exports to Russia (March–April vs. October–December)
Note: Differences from the counterfactual are in percentage points.

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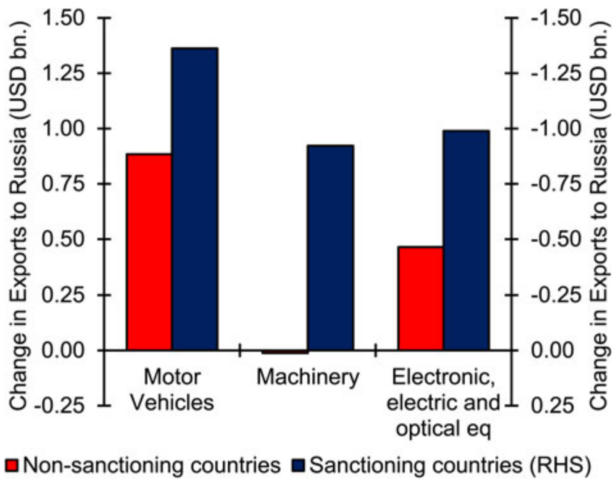

Figure 5. Effects of war and sanctions on exports to Russia in selected sectors
Note: For sanctioning (right-hand-side axis, inverted scale) and non-sanctioning countries (left-hand-side axis), we report the average monthly difference in the last quarter of 2022 between the observed and synthetic exports to Russia in the given sector.

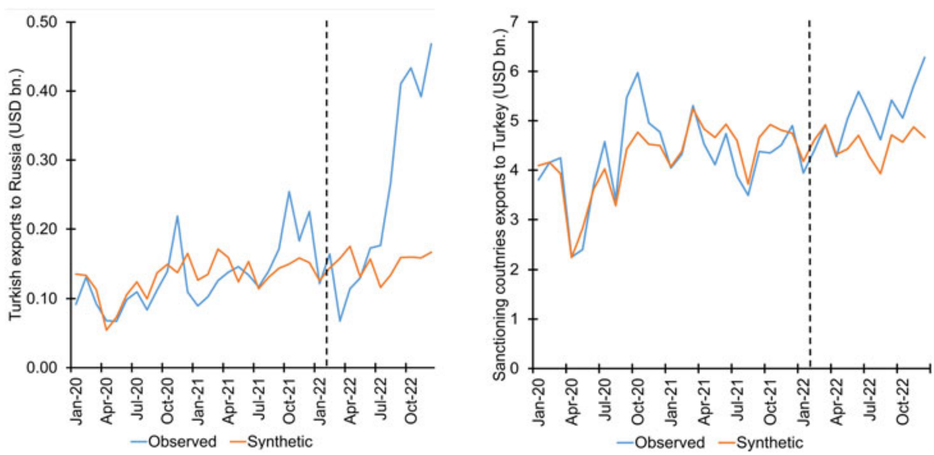

Figure 6. Effects of war and sanctions in the high-tech sectors, the case of Turkey
Notes: Left panel, exports from Turkey to Russia. Right panel, exports from sanctioning countries to Turkey. On the vertical axis, we report observed and synthetic trade flows in USD bn.

left panel). High-tech sectors correspond to Chapters 84, 85, 87, 88, 89, and 90 of the Harmonized System.[17] A necessary condition to support the evidence that exporters may use Turkey as a hub to circumvent sanctions is an increase in sanctioning countries' exports to Turkey with respect to a no-war counterfactual in the high-tech sectors. The right panel of Figure 6 shows that the flows to Turkey associated with this product category are indeed above the corresponding counterfactual. The two pieces of evidence are consistent with the hypothesis

[17]The Harmonized System is an international nomenclature proposed by the World Customs Organization to classify traded products for customs purposes. See https://www.wcoomd.org/en/topics/nomenclature/instrument-and-tools/hs-nomenclature-2022-edition/hs-nomenclature-2022-edition.aspx for further information on the 2022 edition of the HS classification.

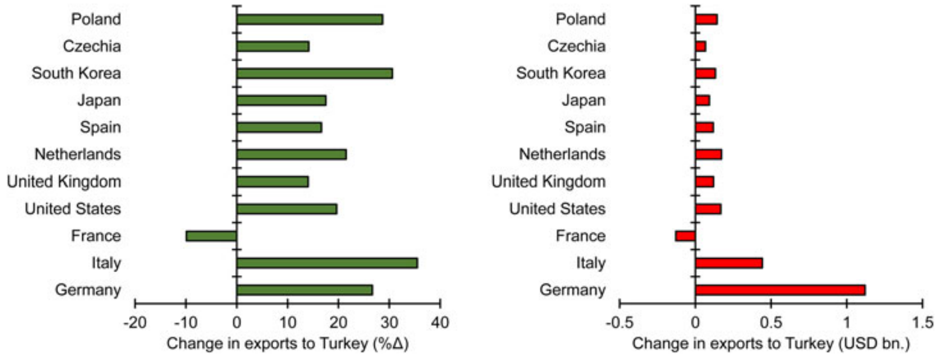

Figure 7. Effects of war and sanctions in the high-tech sectors, the case of Turkey
Notes: Differences from the counterfactual are in percentage points in the left panel and in USD bn in the right panel. Both panels refer to the last quarter of 2022. High-tech sectors correspond to Chapters 84, 85, 87, 88, 89, and 90 of the Harmonized System.

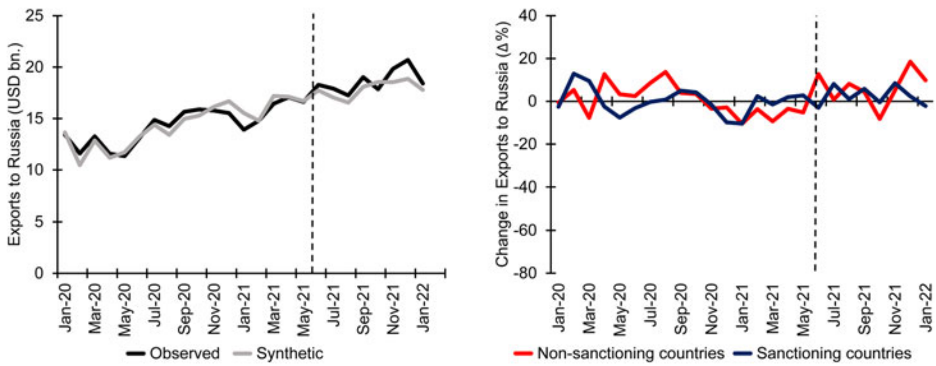

Figure 8. "In-time" placebo effect (shock in June 2021)
Notes: Left panel, aggregate Russian imports, observed and synthetic exports to Russia in USD bn. Right panel, sanctioning vs. non-sanctioning countries, percentage difference between the observed and counterfactual exports to Russia for sanctioning and non-sanctioning countries.

that Turkey may represent a hub to circumvent sanctions, in line with other recent analyses (Borin et al., 2023b; Chupilkin et al., 2023).

Furthermore, we assess the sources of the rise in Turkish high-tech imports, with reference to the sanctioning countries group. We find a sizable rise in imports from Poland, South Korea, and Italy, larger than the corresponding counterfactual by around 30% (Figure 7, left panel). In absolute terms, imports from Germany exceed their counterfactual by around 1 USD bn (Figure 7, right panel), reflecting the sectoral specialization of the country.

4.4 Robustness Checks

To evaluate the robustness of our analysis, we perform an "in-time" placebo test, changing the date of the shock (i.e., the war) to June 2021. The test shows that the observed series and its synthetic counterpart are really close, without any clear decoupling since June 2021 (Figure 8). Furthermore, we rerun the analysis, including the observations starting from January 2015, without any major change in the results.[18]

[18]Results available upon request.

5. Conclusions

We apply the synthetic control method to estimate trade flows in a no-war counterfactual using bilateral, sectoral trade statistics at monthly frequency. We find that the war and the following sanctions have significantly impaired the ability of Russia to import goods from sanctioning countries by drastically hitting some critical, high-technology sectors. Even if exports from non-sanctioning economies exceeded their no-war counterfactual in the last available periods underlying our analysis, suggesting that some trade diversion is taking place, the overall capability to source specific products has been crippled by the imposed restrictions. The substantial shortage of key inputs and consumer goods is likely to reduce substantially Russian welfare and growth in the short and long run.

Additional research on the impact of specific sanctions and bans is ongoing (see Borin et al., 2023b). For instance, the sharp contraction of exports from non-sanctioning countries at the initial stage of the war suggests that factors such as restrictions on international payments and logistics disruptions might have played a relevant role beyond the bans imposed on exports from sanctioning countries. However, the effects of these other factors might have been short-lived since shipments from non-sanctioning economies swiftly rebounded later on.

The empirical approach proposed in this study – which relies on disaggregated, timely bilateral and sectoral trade flows at a monthly frequency – could be useful to assess the effect of any shock on trade flows almost in real time and inform the debate among policymakers concerning the design of optimal sanctioning policies. Some caveats are in order. An increase in indirect exports to Russia through non-sanctioning countries to bypass sanctions (rerouting) might inflate the counterfactual, leading to an underestimation of the impact of the war and related sanctions on Russian imports. To reduce this bias, we excluded from the donor pool those countries which might have redirected flows to Russia. In addition, the deflection of trade flows previously destined for Russia to other final markets may bias the construction of the counterfactual, as exports to donors would not be exogenous to the shock.[19] Right after the start of the war, these channels became limited, and reallocation may require some time. However, the synthetic counterfactual may be less reliable as we depart from the treatment date.

Statement of Data Availability. The replication package for this paper is available at Mancini, Michele; Conteduca, Francesco Paolo; Borin, Alessandro, 2024, 'Replication Data for: The real-time impact of the war on Russian imports: a synthetic control method approach', https://doi.org/10.7910/DVN/JQTF20, Harvard Dataverse.

References

Abadie, A. (2021) 'Using Synthetic Controls: Feasibility, Data Requirements, and Methodological Aspects', *Journal of Economic Literature* 59, 391–425.

Abadie, A., and J. Gardeazabal (2003) 'The Economic Costs of Conflict: A Case Study of the Basque Country', *American Economic Review* 93, 113–132.

Abadie, A., A. Diamond, and J. Hainmueller (2010) 'Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program', *Journal of the American Statistical Association* 105, 493–505.

Abadie, A., A. Diamond, and J. Hainmueller (2015) 'Comparative Politics and the Synthetic Control Method', *American Journal of Political Science* 59, 495–510.

Adarov, A. (2023) 'Eurasian Economic Integration: Impact Evaluation Using the Gravity Model and the Synthetic Control Methods', *Review of World Economics* 159(2), 467–504.

Addessi, W., B. Biagi, and M.G. Brandano (2019) 'Evaluating the Effect of the Introduction of the Euro on Tourist Flows: A Synthetic Control Approach', *The World Economy* 42(5), 1554–1575.

Athey, S., and G.W. Imbens (2017) 'The State of Applied Econometrics: Causality and Policy Evaluation', *Journal of Economic Perspectives* 31, 3–32.

[19]On deflection, see Haidar (2017), who shows that Iran deflected a large share of exports to non-sanctioning countries, and Besedeš et al. (2017), who find that Germany increased cross-border financial flows towards the largest trading partners of financially sanctioned countries.

https://doi.org/10.1017/S1474745623000484 Published online by Cambridge University Press

Baier, S.L., and J.H. Bergstrand (2009) 'Estimating the Effects of Free Trade Agreements on International Trade Flows Using Matching Econometrics', *Journal of International Economics* 77(1), 63–76.

Belotti, F., A. Borin, and M. Mancini (2021) 'icio: Economic Analysis with Intercountry Input–Output Tables', *The Stata Journal* 21(3), 708–755.

Besedeš, T., S. Goldbach, and V. Nitsch (2017) 'You're Banned! The Effect of Sanctions on German Cross-Border Financial Flows', *Economic Policy* 32(90), 263–318.

Billmeier, A., and T. Nannicini (2013) 'Assessing Economic Liberalization Episodes: A Synthetic Control Approach', *Review of Economics and Statistics* 95(3), 983–1001.

Borin, A., F.P. Conteduca, E. Di Stefano, V. Gunnella, M. Mancini, and L. Panon (2023a) 'Trade Decoupling from Russia', *International Economics* 175, 25–44.

Borin, A., G. Cappadona, F.P. Conteduca, B. Hilgenstock, O. Itskhoki, M. Mancini, M. Mironov, and E. Ribakova (2023b) The Impact of EU Sanctions on Russian Imports. VoxEU column, 24 May 2023.

Boungou, W., and A. Yatié (2022) 'The Impact of the Ukraine–Russia War on World Stock Market Returns', *Economics Letters* 204, 110516.

Bown, C.P. (2022) 'Russia's War on Ukraine: A Sanctions Timeline', Peterson Institute for International Economics, www.piie.com/blogs/realtime-economic-issues-watch/russias-war-ukraine-sanctions-timeline

Breinlich, H., E. Leromain, D. Novy, and T. Sampson (2020) 'Voting with Their Money: Brexit and Outward Investment by UK Firms', *European Economic Review* 124, 103400.

Broda, C., and D.W. Weinstein (2004) 'Variety Growth and World Welfare', *American Economic Review* 94(2), 139–144.

Chupilkin, M., B. Javorcik, and A. Plekhanov (2023) 'The Eurasian Roundabout: Trade Flows Into Russia Through the Caucasus and Central Asia (February 23, 2023)', EBRD Working Paper No. 276.

Coe, T., and E. Helpman (1995) 'International R&D Spillovers', *European Economic Review* 39, 859–887.

De Benedictis, L., and D. Taglioni (2011) 'The Gravity Model in International Trade', in L. De Benedictis and L. Salvatici (eds.), *The Trade Impact of European Union Preferential Policies*. Berlin, Heidelberg: Springer, pp. 55–90.

Douch, M., and T.H. Edwards (2022) 'The Bilateral Trade Effects of Announcement Shocks: Brexit as a Natural Field Experiment', *Journal of Applied Econometrics* 37(2), 305–329.

Ferriani, F., and A.G. Gazzani (2023) '). The Impact of the War in Ukraine on Energy Prices: Consequences for Firms' Financial Performance', *International Economics* 274, 221–230.

Gharehgozli, O. (2017) 'An Estimation of the Economic Cost of Recent Sanctions on Iran Using the Synthetic Control Method', *Economics Letters* 157, 141–144.

Gilchrist, D., T. Emery, N. Garoupa, and R. Spruk (2022) 'Synthetic Control Method: A Tool for Comparative Case Studies in Economic History', *Journal of Economic Surveys* 37(2), 409–445.

Grzegorczyk, M., J.S. Marcus, N. Poitiers, and P. Weil (2022) *The Decoupling of Russia: High-Tech Goods and Components*. Bruegel-Blogs, https://link.gale.com/apps/doc/A698791904/AONE?u=anon~cab18c60&sid=googleScholar&xid=9aa7a475.

Gurevich, T., and P. Herman (2018) 'The Dynamic Gravity Dataset: 1948–2016', USITC Working Paper 2018-02-A. Available at US International Trade Commission, www.usitc.gov/publications/332/working_papers/gurevich_herman_2018_dynamic_gravity_dataset_201802a.pdf.

Haidar, J.I. (2017) 'Sanctions and Export Deflection: Evidence from Iran', *Economic Policy* 32(90), 319–355.

Head, K., and T. Mayer (2014) 'Gravity equations: Workhorse, Toolkit, and Cookbook', in G. Gopinath, E. Helpman, and K. Rogoff (eds.), *Handbook of International Economics*, Vol. 4. Elsevier, Chapter 3, pp. 131–195.

Lawrence, R.Z., and D.E. Weinstein (1999) 'Trade and Growth: Import-Led or Export-led? Evidence from Japan and Korea', National Bureau of Economic Research Working Paper, 7264.

Mahlstein, K., C. McDaniel, S. Schropp, and M. Tsigas (2022) 'Estimating the Economic Effects of Sanctions on Russia: An Allied Trade Embargo', *The World Economy* 45(11), 3344–3383.

Parast, L., P. Hunt, B.A. Griffin, and D. Powell (2020) 'When is a Match Sufficient? A Score-Based Balance Metric for the Synthetic Control Method', *Journal of Causal Inference* 8(1), 209–228.

Saia, A. (2017) 'Choosing the Open Sea: The Cost to the UK of Staying Out of the Euro', *Journal of International Economics* 108, 82–98.

Simola, H., and A. Röyskö (2023) 'Russia's Technology Imports from East Asia', *Asian Economic Papers* 22(1), 1–10.

Sonnenfeld, J., S. Tian, F. Sokolowski, M. Wyrebkowski, and M. Kasprowicz (2022) Business Retreats and Sanctions are Crippling the Russian Economy, available at SSRN 4167193.

Steinbach, S. (2023) 'The Russia–Ukraine War and Global Trade Reallocations', *Economics Letters* 226, 111075.

Xu, Y. (2017) 'Generalized Synthetic Control Method: Causal Inference with Interactive Fixed Effects Models', *Political Analysis* 25(1), 57–76.

Appendix: Weights of the synthetic control

origin	*donor 1*	*donor 2*	*donor 3*	*donor 4*	*donor 5*	*donor 6*	*donor 7*	*donor 8*	*donor 9*	*donor 10*
AR	CZ: 0.47	DZ: 0.35	DE: 0.17							
AT	*CN*: 0.33	IR: 0.32	IL: 0.16	XK: 0.07	BE: 0.07	*PL*: 0.05				
BE	*CN*: 0.37	XK: 0.17	CH: 0.15	IR: 0.15	SA: 0.14	IQ: 0.02				
BG	IR: 0.43	*CN*: 0.34	BR: 0.09	XK: 0.07	HU: 0.04	AT: 0.03				
CA	ZM: 0.62	BR: 0.3	AT: 0.07							
CH	IR: 0.44	SA: 0.23	BR: 0.15	DZ: 0.08	*CN*: 0.07	JP: 0.03				
CL	SA: 0.59	IN: 0.17	DE: 0.11	FR: 0.1	JP: 0.04					
CN	AF: 0.39	DE: 0.28	IN: 0.27	*MN*: 0.03	US: 0.02					
CZ	*CN*: 0.56	HU: 0.22	FR: 0.12	AF: 0.1						
DE	IR: 0.28	LY: 0.21	*CN*: 0.15	*NO*: 0.14	BR: 0.12	IT: 0.1				
DK	HU: 0.38	BR: 0.32	IR: 0.17	*CN*: 0.12						
EC	SA: 0.61	*CN*: 0.13	*PL*: 0.11	JP: 0.08	US: 0.07					
EE	*LV*: 0.49	CU: 0.27	NZ: 0.21	PH: 0.03						
ES	KW: 0.37	BA: 0.24	*CN*: 0.15	BR: 0.14	JP: 0.1					
FI	SE: 0.54	MT: 0.46								
FR	SA: 0.47	BR: 0.2	*CN*: 0.17	AT: 0.08	DZ: 0.06	PY: 0.04				
GB	BR: 0.36	DZ: 0.15	LU: 0.12	CD: 0.11	*CN*: 0.1	AT: 0.08	SK: 0.07	BI: 0.02		
GR	MY: 0.78	*CN*: 0.22								
HK	BR: 0.69	DE: 0.31								
HR	LK: 0.91	IT: 0.09								
HU	*CN*: 0.4	IR: 0.37	*PL*: 0.21	LY: 0.03						

(*Continued*)

(*Continued.*)

origin	*donor 1*	*donor 2*	*donor 3*	*donor 4*	*donor 5*	*donor 6*	*donor 7*	*donor 8*	*donor 9*	*donor 10*
ID	FR: 0.5	ES: 0.16	ZA: 0.14	MM: 0.12	AU: 0.08					
IE	BR: 0.32	IN: 0.29	IS: 0.22	AT: 0.12	DZ: 0.04	*CN*: 0.02				
IL	JP: 0.35	FR: 0.31	KH: 0.28	*NO*: 0.05						
IN	FR: 0.39	TM: 0.37	JP: 0.15	CH: 0.06	QA: 0.03					
IR	QA: 0.55	BR: 0.41	*CN*: 0.04							
IT	*CN*: 0.47	IR: 0.27	HR: 0.08	MO: 0.07	IN: 0.05	LY: 0.05				
JP	BR: 0.98	*CN*: 0.02								
KR	BR: 0.68	CD: 0.25	*CN*: 0.04	SA: 0.04						
KZ	*CN*: 0.62	SE: 0.34	TM: 0.05							
LU	MT: 0.52	*CN*: 0.31	IT: 0.13	NZ: 0.04						
LV	*EE*: 0.66	*LT*: 0.27	AU: 0.07							
MD	DE: 0.97	RO: 0.02								
MX	SA: 0.88	AU: 0.07	PR: 0.04	DE: 0.02						
MY	FR: 0.55	MO: 0.13	BR: 0.11	*NO*: 0.11	IR: 0.05	*FI*: 0.04				
NL	*CN*: 0.39	SK: 0.17	IQ: 0.15	BR: 0.07	HU: 0.06	DZ: 0.05	LU: 0.04	CD: 0.03	ML: 0.02	IR: 0.02
NO	*FI*: 0.54	LK: 0.46								
PE	SA: 0.69	DE: 0.11	*PL*: 0.09	FR: 0.08	AU: 0.04					
PL	SK: 0.58	*LT*: 0.22	AU: 0.17	DE: 0.03						
PT	IR: 0.62	*CN*: 0.28	CD: 0.08	ML: 0.03						
PY	SK: 0.46	CL: 0.17	BR: 0.12	IL: 0.12	*CN*: 0.08	IN: 0.06				
RO	*CN*: 0.41	IL: 0.23	BR: 0.17	XK: 0.15	DE: 0.03					

RS	IT: 0.5	MC: 0.39	*LT*: 0.11			
SE	IR: 0.34	AT: 0.29	*CN*: 0.21	*LV*: 0.16		
SG	ZA: 0.53	AT: 0.26	IT: 0.08	BR: 0.05	IR: 0.05	FR: 0.03
SI	IN: 0.35	IR: 0.26	CH: 0.16	*CN*: 0.13	TM: 0.11	
TH	ES: 0.35	SA: 0.34	IR: 0.16	*NO*: 0.09	MO: 0.08	
TR	IT: 0.51	NZ: 0.25	*LV*: 0.24			
US	AT: 0.95	BR: 0.05				
ZA	IQ: 0.46	CA: 0.24	MX: 0.16	*NO*: 0.13	*CN*: 0.02	

Donor pool and export to Russia. *Origin country* represents the source of the export flows to Russia. The columns *donor 1–donor 10* report the contributor to the respective flows (with the attached weight) and are ordered in terms of weights. Countries are reported according to their ISO 3166-2 code. Countries bordering with Russia are in italic.

Cite this article: Mancini M, Conteduca FP, Borin A (2024). The Real-Time Impact of the War on Russian Imports: A Synthetic Control Method Approach. *World Trade Review* **23**, 433–447. https://doi.org/10.1017/S1474745623000484