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Shooting down trade[1]

Uğur Aytun[1] and Cem Özgüzel[2]

[1]Kütahya Dumlupınar University

[2]OECD & ICM

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[2] Corresponding Author: 2 rue André Pascal, 75016, Paris; cem.ozguzel@oecd.org

Abstract

On 24 November 2015, Turkish military shot down a Russian fighter jet near the Syrian-Turkey border after it violated Turkish airspace for about 17 seconds. Russia retaliated by imposing an embargo on 17 agricultural HS-6 level products from Turkey that would be effective for 22 months. We exploit this natural experiment to evaluate the impact of sanctions on Turkish exports and exporters. Using restrictive customs and firm-level data in a triple difference framework, we estimate the effect of these sanctions on the exports towards Russia, for embargoed and non-embargoed products. We estimate a total trade loss of $3.25bn for Turkish exports, 65% of which stemming from non-embargoed products. We investigate the underlying mechanism through firm-level analysis. First, we find that number of firms that trade with Russia and export volumes decreased dramatically. Second, firms re-routed their exports to bordering countries to circumvent the sanctions. Finally, we find that medium and large firms managed to adjust to the crisis while small firms suffered the main effects of the embargo.

Keywords: embargo, sanctions, international trade
JEL Classification Numbers: F13, F14, F5

1 Introduction

In the morning of 24 November 2015, a Russian Sukhoi Su-21 fighter entered 2.19 kilometers inside the Turkish border, violating Turkish airspace for 17 seconds. After multiple warnings, the Russian jet was shot down by a Turkish Air Force F-16 fighter. A few days later, Russia retaliated by announcing an embargo on Turkish exports that would be effective within a month. The embargo covered 17 products and lasted 22 months, ending only when Turkish President Erdogan apologized to President Putin.

Countries have long used economic sanctions to punish their adversaries as a retaliation to such events.[3] Sanctions can take many forms including restrictions on imports or exports, restrictions on bank activities and financial operations, travel bans or arms embargo. Recent (and ongoing) examples include sanctions imposed on Iran, North Korea, or Russia. Given the frequent use of such tools as part of foreign policy, it is crucial to assess the magnitude of economic costs and the channels through which sanctions may operate.

In this paper, we assess the consequences of trade sanctions imposed by Russia on Turkish exports and exporters as a response to the unexpected "Russian-jet crisis". Building on a standard standard gravity framework, we use a triple difference estimation strategy to identify the impact of the embargo as an interaction of three margins: embargoed vs nonembargoed goods, exports to Russia vs. other countries, pre-embargo and post-embargo periods. Distinguishing these margins allows us to identify three types of effects: first, we are able to measure the decline in exports in sanctioned products to Russia after the embargo. These declines constitute the *direct*

[3] Use of economic sanctions to achieve foreign policy goals can be traced back in history. The Megarian decree in 432 BC offers one of the earliest examples of economic sanctions where the Athenian Empire banned trade with city-state of Megara. In their review of 174 sanction episodes since the World War I, Hufbauer et al. (2008) show the growing frequency in the use of sanctions.

effect of the embargo. Second, faced with sanctions, part of the exports which would have been sent to Russia were diverted to non-sanctioning countries. This is the *substitution effect*. Finally, exports of non-embargoed goods towards Russia could also decline due to overall tensions between two countries. These declines are unintended effects of sanctions and constitute the *spillover effect*.

We first estimate the effect of sanctions on Turkish exports. We use Turkish Customs data (Dış Ticaret İstatistikleri, in Turkish) which covers the complete universe of exporting firms in Turkey and provide monthly firm-level data on all export transactions. We aggregate firm-level transactions by product to obtain the total of Turkish exports. Using this data, we find that the embargo was fully effective in shutting down the exports from Turkey for the sanctioned products. Over the 22 months, the exports of sanctioned products dropped by almost 99% and generating a loss of $1.14bn. The embargo also impacted the bilateral trade with Russia causing a drop in the exports of the non-embargoes products. After the imposition of the embargo, the average Turkish export flows of non-embargoed goods to Russia declined by about $2.11bn or by 22%. Finally, we do not find any statistically significant substitution effect at the aggregate product level.

In the second part of the analysis, we drill further down and focus on the effects of the sanctions on exporting firms. In addition to understanding the adjustment margins for firms, this exercise also allows studying the heterogeneous effects of sanctions by firms' characteristics. To do so, we complement the Turkish Customs data with Annual Industry and Services Statistics (Yıllık Sanayi ve Hizmet İstatistikleri, in Turkish) which provides detailed firm-level information such as turnover, labour costs, number of employees and much more. Using unique firm

identifiers, we are able to match perfectly the customs and firm-level information for all Turkish exporters.

First, we find that firms did not react to the embargo by exiting the embargoed product market. Instead, firms adjusted to the embargo by diverting their trade from Russia to other countries. Specifically, Turkish exporters re-routed their products to bordering countries to circumvent sanctions. This adjustment channel is especially strong for medium and large firms who had the means that allowed them to opt for this solution. Second, the subset of firms that continued to trade with Russia during the embargo, the value of exports decreased both for embargoed products (Direct effect) and also non-embargoed products (Spillover effect). While firms managed to divert part of the exports to other countries (Substitution effect), it did not compensate for the lost trade fully.

This paper is related to the literature on the effectiveness of trade policies such as economic sanctions, embargoes, and boycotts. Eaton and Engers (1999) and Kaempfer and Lowenberg (1988) establish a theoretical framework to study sanctions and their effectiveness, while empirical studies such as Hufbauer et al. (2008) or Bapat et al. (2013) have tested whether such sanctions have been successful or not. Studying a large number of sanction episodes since World War I, they conclude that sanctions are rarely effective, and the effectiveness of the sanctions depends on the market power of the participants. Irwin (2005) and Coulibaly (2005) study the effects of the Jeffersonian embargo on Cuba and South Africa, respectively. Michaels and Zhi (2010) show that the diplomatic clash between France and United States over the Iraq War in 2003 reduced bilateral trade by about 9% for a short period of time. Focusing on the same period, Pandya and Venkatesan (2016) exploit scanner data to show that the sale of French-sounding products declined in U.S. supermarkets.

Our paper is closely related to recent work on the impact of trade sanctions on bilateral trade and exporting firms. Haidar (2017) investigates the impact of Western-imposed sanctions on exports of Iranian firms and show that Iranian exports destroyed by sanctions were deflected to non-sanctioning countries. Crozet and Hinz (2016) focus on the trade loss effects of trade sanctions from the perspective of the sending country during the Russian embargo. Using French firm-level export data, they show that the bulk of the negative impact stems from products that are not directly targeted by the sanctions. Miromanova (2019a) focuses on the other side of the sanctions and studies the effect of self-imposed import embargo of Russia as a retaliation to Western-imposed sanctions. Using bilateral trade data, she finds that Russia's self-imposed import sanctions were not fully effective and only generated a drop in the trade of sanctioned goods by half. Moreover, while importers of sanctioned products diverted their trade to other countries, importation of non-sanctioned products also reduced. Cheptea and Gaigne (2019) also studies the effect of the Russian food embargo on the EU export flows by using triple difference-in-difference-in-difference strategy to estimate the trade losses. Their finding based on partial equilibrium effects is that embargo induced e124 million per month and only 45% of this loss stem from the ban. Studying the effects of the embargo on Russian firms, Miromanova (2019b) also finds that number of importers decreased after embargo started. Moreover, while firms staying in the market decreased the volume of their imports, some firms diverted their trade non-sanctioning countries.

This paper contributes to the literature in international trade sanctions and their impact on exports and exporters in several ways. First, to the best of our knowledge, it is the first study that uses a neat natural experiment as a source of identification to causally estimate the effect of product embargo on the exports and the exporters of a sanctioned country. The unexpected

nature of the military conflict and the swiftness of Russia's response created a natural experiment which allows clear identification of the short-term effects of such sanctions. Differently than for instance, Western sanctions on Russia that were implemented gradually over time, these sanctions were unexpected and applied within a month after the incident. Secondly, Russia's reaction was limited mainly to an embargo on specific products. It was not accompanied by other sanctions such as bans on financial institutions, as in Iran in Russia, which may impair a country's trade capacity through other channels. The focus of sanctions on specific products allows us to estimate the loss of exports driven by a single sanction tool (i.e., the trade embargo), and assess the efficiency of such measures. Thirdly, faced with sanctions, Turkish government did not retaliate with its counter-measures to limit trade with Russia. Unlike the above-mentioned papers where bilateral embargoes were imposed, our context allows isolating the effects of Russian embargo on trade. As such, the paper presents evidence on the impact of an unilateral embargo. Fourth, unlike the recent evidence on sanctions faced by Russia or Iran which involve many sanctioning countries, our study focuses on the effects of sanctions involving only two countries. This could be important as, having a broader set of countries towards which sanctioned country (i.e., Turkey), can export to, may undermine the effects of the embargo. Fifth, we contribute to the literature studying the effects of sanctions on firm-level. By combining firm-level customs data with a firm-level survey, we are able to match firm characteristics and study the heterogeneous effects of sanctions across firms types.

The rest of the paper is divided as follows. Section 2 provides a description of the events that led to sanctions and the details of the sanctions. Section 3 explains the setting and the empirical strategy and Section 4 details the data sources. Section 5 presents results. Section 6 concludes.

2 The shootdown and sanctions

On 24 November 2015, a Russian Sukhoi Su-24 aircraft with tail number 83 was returning to Khmeimin airbase, located in the province of Latakia, in Northern Syria 35 kilometres south of Turkish-Syrian border. As the aircraft was heading towards the Turkish airspace, Turkish ground-control station officials sent a warning to the aircraft requesting it to change course. These warnings were repeated nine more times within the next 5 minutes (BBC 2015).

Despite repeated warnings, Russian aircraft did not change course and entered Turkish airspace up to a depth of 2.19 kilometres for about 17 seconds. Consequently, the Russian aircraft was shot down by Turkish F-16 aircraft patrolling the Turkey-Syria border. Russian aircraft, hit by an air-to-air missile, flew back into Syria before crashing into the mountainous Jabal Turkmen area of Latakia, which was contested by Syrian government and rebel forces. Two pilots ejected after the aircraft was hit. While one was killed by ground fire by the Turkmen rebels while in the air, the other one was captured upon landing.

A few hours after the incident, the Russian President Vladimir Putin made a public statement, calling the shootdown as a "stab in the back by terrorist accomplices". Putin also said that Russia would not put up with such attacks and that Russia-Turkey relations would be affected (BBC, 2015). As Foreign Minister Sergey Lavrov cancelled his trip to Turkey due next day, groups gathered outside of the Turkish Embassy in Moscow to protest. On 26 November, Prime Minister Dmitry Medvedev announced that Russia will impose broad economic sanctions against Turkey as retaliation (Nissenbaum et al., 2015).

2.1 Timeline of the sanctions

On November 28, the Russian President Vladimir Putin approved a presidential decree (numbered 583), that would provide the legal ground for imposing economic embargos on Turkish goods and services. Following this decree, the Russian Government released an Executive Order (numbered 1296) on 30 November 2015, detailing the sanctions that will be imposed on Turkey which would be effective of 1 January 2016. The sanctions involved various measures such as prohibiting Turkish companies to carry out activities in Russia, employment of new Turkish workers, suspension of visa-free travel between two countries and the banning of charter flights to Turkey (see Appendix Section: Sanctions for more details on the sanctions). The Russian government imposed an embargo on 17 Turkish products defined by HS-6 codes, which covered fruits, vegetables, flowers, chicken, turkey and salt effective of 1 January 2016 (see Appendix Section: Timeline of product embargo for the full list of sanctioned products).

In the following two years, these bans were gradually lifted. The first change came in October 2016, when Russia excluded 5 products from the banned products list, reducing the number of banned products to 12. In March 2017 and June 2017, Russia excluded 4 and 7 products, respectively. Finally, on 1 November 2017, Russia lifted the ban on the only remaining product (tomato, HS-6 code 070200), from the list ending the embargo.

3 Empirical Strategy

The objective is to analyze the changes in Turkish exports caused by the imposition of the Russian embargo on certain products. The estimation equation is derived from the standard gravity model, which has been used in recent literature studying the impact of economic sanctions.

Let trade between an origin country o and a destination country d at time t be described by an Armington-type gravity structure as in Head and Mayer (2014), so that:

$$X_{odt} = \frac{Y_{ot}}{\Omega_{ot}} \frac{X_{dt}}{\Phi_{dt}} \phi_{odm} \tag{1}$$

where $Y_{ot} = \sum_d X_{odt}$ is the value of production, i.e. all exports, in o at time t and $X_{ot} = \sum_d X_{odt}$ is the value of expenditure, i.e. all imports in d and time t. Ω_{ot} and Φ_{dt} are the so-called outward and inward multilateral resistance terms that reflect the exports' and imports' relative position in the world trade matrix. The structure of these terms is given by:

$$\Omega_{odt} = \sum_{l \epsilon d} \frac{X_{lt}}{\Phi_{lt}} \phi_{olm}, \Phi_{dt} = \sum_{l \epsilon o} \frac{Y_{lt}}{\Omega_{lt}} \phi_{ldm} \tag{2}$$

The bilateral component φ_{odm} subsumes all seasonally-varying bilateral trade barriers and facilitators, which we assume to vary at the month-level denoted by subscript m (as opposed to t for year-month).

By adding product dimension, we estimate Equation 1 with a Pseudo-Poisson Maximum Likelihood procedure regressing bilateral flows between the country of origin o (i.e., Turkey) and destination d (e.g., Russia) on *time*, *destination* × *product*, *destination* × *year*, and *product* × *year* fixed effects.[4]

Based on this gravity equation, we implement two complementary empirical analyses based on bilateral trade data aggregated at the product level and Turkish firm-level export data. Since the model applies to Turkey's trade only, and Turkey is always a trading partner, we drop the i

[4] For a robustness, we also provides results using inverse hyperbolic sine which is defined at zero and behaves similarly to a log-transformation (see MacKinnon and Magee (1990)). Although not presented, we also check the robustness of our results using log-transformation. Results can be provided if requested.

subscript to simplify notation. The data allows us to add a product dimension, which is denoted by the k subscript. We model Russia's embargo as a bilateral trade friction (i.e., part of τ_{ijt}), which reduces the average trade flow T. In order to account for multilateral resistance terms P_{it}, P_{jt} and world income y_t, we include country-year fixed effects, where subscript y denotes the year (since the data is available monthly, we use t index for the monthly-year periods) to model y_{jt} in Equation 2.

In the main analysis we use this gravity equation in a difference-in-differences-in-differences estimation (DDD) method, which exploits the variation in time, product and country. We define four embargo periods in line with the removal of sanctions described in Section 2.1:

- Period 1: from January 2016 until October 2016 where sanctioning of 5 products are removed
- Period 2: from January 2016 until March 2017 where sanctioning of 5 products are removed
- Period 3: from January 2016 until June 2017 where sanctioning of 6 products are removed
- Period 4: from January 2016 until November 2017 where sanctioning of one product is removed

3.1 **Product-level analysis**

Gravity equation with a product dimension allows us to study how the embargo impacts bilateral trade at the product level. We use product-level export data between Turkey, Russia and the other trading partners of Turkey. The analysis is disaggregated at the 6-digit product level of HS classification. Adding a product dimension yields to 232 partner countries and 5306 products. We

eliminate all origin-destination-product triads for which we do not observe any trade over the sample period, we have more than four million observations.

Equation 1 above yields to following equation:

$$X_{pkt} = \exp\left(\vartheta_t + \eta_{pk} + \lambda_{py} + \gamma_{ky} + \alpha m_{pt} + \beta \underbrace{D_{p=S}xD_{k=S}xD_{t=S}}_{direct} + \theta \underbrace{D_{p\neq S}xD_{k=S}xD_{t=S}}_{substitution} + \mu \underbrace{D_{p=S}xD_{k\neq S}xD_{t=S}}_{spillover}\right) + \varepsilon_{pkt} \quad (3)$$

In the equation above, ϑ_t is the time fixed effect, η_{pk} is partner-product fixed effect and m_{pt} is the total product import of each partner. Our first coefficient of variable of interest is β, which is the trade elasticity of embargo, which is an interaction of sanctioning country ($D_{p=S}$), products ($D_{k=S}$), and period dummies ($D_{t=S}$) variables relevant with the import ban. Second coefficient is γ which shows whether Turkey could divert embargoed products to non-Russia countries to avoid trade losses. Third elasticity is μ and it measures export losses in non-embargoed products to Russia during the embargo period.

3.2 **Firm-level analysis**

To go beyond the bilateral product-level dimension, we complement our previous findings with an analysis using firm-level data which is important for two reasons. First, it allows understanding adjustment margins of firms faced with embargo. Second, it allows understanding the heterogenous effects of sanctions by firms' sizes and other characteristics.

For this analysis, we combine two firm-level administrative datasets. First, we use Turkish customs data that provides firm-level information on the complete universe of exporting firms. The detailed customs data provides information on monthly exports at the firm-product-destination level. Each observation in our database includes period (year and month), a unique firm code, 8-digit product code, the destination country and the exported value (in dollars).

Second, we match the customs data with Annual Business Registers Frames, which provides detailed firm-level information (e.g., number of employees, gross fixed capital formation, value-added, output, wages, and more) on a large set of firms in Turkey. Using unique firm identifiers, we match these information with customs data. The match is almost perfect, which leaves us with a sample covering the complete universe of the exporting firms in Turkey.

To estimate the effect of the sanctions on the export flows of Turkish firms, we adopt the same DDD approach as before but restrict our sample firms that are present in the market before and during the embargo. Since we only have one exporting country but many firms which may export the same good, there is a need to control firm-related shocks. We extend the gravity equation as follows:

$$X_{fpkt} = \exp\left(\vartheta_t + \eta_{fpk} + \beta \underbrace{D_{p=S}xD_{k=S}xD_{t=S}}_{direct} + \theta \underbrace{D_{p\neq S}xD_{k=S}xD_{t=S}}_{substitution} + \mu \underbrace{D_{p=S}xD_{k\neq S}xD_{t=S}}_{spillover}\right) + \varepsilon_{fpkt} \quad (4)$$

The subscript f refers to firm. Time (ϑ_t) and firm-product-partner (η_{fpk}) fixed effects capture economy-wide time-variant and time-invariant shocks of firms exporting product k to partner p, respectively.

Next we examine whether Turkish firms that exported products that faced sancations are more likely to exit the product market during the embargo. Specifically, we consider a firm that exports a product before the embargo but stops exporting it after the embargo as an exit decision. We focus on firms that traded with Russia before the embargo. Thus the model to be estimated is the following (Miromanova, 2019b):

$$exit_{fk} = \vartheta_h + \eta_f + \underbrace{\beta D_{k=S}}_{embargo} + \varepsilon_{fk} \quad (5)$$

In the equation above, *exit* is a dummy variable taking value 1 if a firm exports product k before the embargo (i.e, in 2015) and stops doing so during the embargo (i.e., after January 2016). $D_{k=S}$ is variable of interest which captures embargoed products and its coefficient shows how likely the embargoed products affect firms' exit decision. ϑ_h and η_f are denoted as two digit HS classification fixed effect and firm-level fixed effects.

Turkish exporters' can adjust to the embargo by also switching their trade partner and diverting their exports from Russia to other countries. We formally test at the firm-level using the following equation:

$$switching_{fk} = \vartheta_h + \eta_f + \underbrace{\beta D_{k=S}}_{embargo} + \varepsilon_{fk} \quad (6)$$

where the binary dependent variable $switching_{fk}$ equals to 1 for each of the following cases. First case, "sanction to sanction": if exporter f exports a product k (embargoed or non-embargoed) before the embargo to Russia, and continues trading with Russia during the embargo, it equals to 1. If the firm stops exporting the product to Russia, then it equals 0. Second case, "Sanction to non-sanction": if a firm that exports a product k to Russia and starts exporting to another country, then it equals to 1.

Finally, we explore the effect of the embargo on the number of exporters (extensive margin) for each country-product-period triad. Our model below is similar with equation (3) with an additional firm-dimension.

$$number_{pkt} = \exp\left(\vartheta_t + \eta_{pk} + \lambda_{py} + \gamma_{ky} + \beta \underbrace{D_{p=S}xD_{k=S}xD_{t=S}}_{direct} + \theta \underbrace{D_{p\neq S}xD_{k=S}xD_{t=S}}_{substitution} + \mu \underbrace{D_{p=S}xD_{k\neq S}xD_{t=S}}_{spillover}\right) + \varepsilon_{pkt} \quad (7)$$

4 Data and sample

We link a number of datasets together for our study. First, we use Turkish Customs data (Dış Ticaret İstatistikleri, in Turkish) which allows us to study the effects of the sanctions on bilateral

trade at the firm-level. Data set covers the whole universe of exporting firms and provides monthly trade data at 6-digit HS level starting from 2002. The trade data includes firm-product-destination information which allows distinguishing the evolution of the bilateral trade but also firm-level trade across time. It includes trade value (in USD) and volume. We complement this data with UNCOMTRADE to construct measures on global trade of products and total product imports of partner countries which we use as control.

As in all trade statistics, observations correspond to positive flows. As the Russian sanctions were fully effective, there are no export flows of any of the embargoed export to Russia during the embargo period. We address the missing data issue by filling these cases with zeros. This allows us to capture the drop in exports to Russia, but also compare the magnitude of the effects with other countries.[5]

Finally, we combine the firm-level customs data with Annual Industry and Services Statistics (Yıllık Sanayi ve Hizmet İstatistikleri, in Turkish) which provides detailed firm-level information. By matching firm identifiers in both datasets, we can merge firm-level trade data with annual firm-level information such as turnover, labour costs, number of employees etc. Since dataset represents the complete universe of firms with more than 19 employees, matching of both datasets was close to 100% of the sample. Similarly above, since triple effects estimation strategy requires adding missing observations recording as zero, we end up with over 5 million observations.

[5] Given the sensitivity of replacing missing observations with zero, we only replace missing trade of product flows of products that faced Russia-embargoed and during the embargo period. For robustness, we also tested our results after replacing the missing trade in all products with zeros, the results hold. We can share these results upon request.

5 Results

Russian Federation is a major trade partner for Turkey. In 2014, it was 14th the most important destination for Turkish exports, and sixth one outside of the European Union, after Iraq, the United States, the United Arab Emirates, Iran and Egypt. However, it was the most important importer of Turkish products that face sanctions.

As discussed earlier, Russia removed product sanctions gradually, in four waves during 22 months period. Therefore in the analysis, we group products based on the end of their corresponding sanction period. Before we turn to econometrics, we look at how sanctions affected Turkish exports to Russia. Using only the raw data, Figure 1 visualizes the monthly export flows from Turkey to Russia, for four groups of sanctioned products and also for products which were not part of the sanctions. We group all of the products that did not face sanctions and call them non-embargoed products.

The figure reveals a few things. First, until the sanctions (i.e., 2016m1), the embargoed products were exported following a cyclical trend, which is expected given that they were mostly food products. Secondly, while sanctioned products were exported roughly at similar volumes from 2010 until the beginning of the sanctions, the monthly export volume of nonsanctioned products was in a declining trend.[6] Third, following the implementation of the sanctions, the exports of both embargoed and non-embargoed products suffered dramatic drops. Fourth, although exports of embargoed products started picking up as the sanctions were lifted gradually, they remained below the levels observed in pre-embargo period.

[6] While the sources of this decline trend requires further investigation, one possible explanation is the violent macroeconomic shocks that Russia faced in 2014 and 2015.

To eliminate the seasonal variations and observe the effects of trade sanctions on export trends, Figure 2 presents cumulative exports for both embargoed and non-embargoed products to Russia. The figure shows that while total exports to Russia for all products were on a positive trend, they suffered two breaks: first in mid-2014 due to financial crisis following the drop in oil prices and the consequent devaluation in Russian rouble, and second two months before the sanctions (November-December 2015) when the political tensions between Turkey and Russia started harming trade.[7] As the figure shows, starting from January 2016, while the cumulative exports for sanctioned products flat-lined, indicating the halt in the trade of those products, while non-embargoed products continued to increase albeit at a slower pace compared to pre-sanction period.

5.1 Product-level results

We begin our analysis by studying Turkish exports at the product-level, estimating Equation 3. The aggregate exports correspond to the sum of exports of all individual exporting firms, and thus represents the response to the embargo shock of all exporters. Table 1 presents the results with OLS and PPML, using different sets of fixed-effects.

In all columns of Table 1, the coefficient of the variable *direct* is negative and statistically significant. Regardless of the set of fixed effects or the model used, the elasticities remain very similar. Our preferred estimate is in column 6, which shows that embargo succeeded in shutting down completely, or 99% the exports of embargoed products from Turkey to Russia ($e^{-14.957}-1 =$

[7] In our analysis, we included controls to account pre-trends econometrically and did not present significant findings in this version.

-99%). This finding suggest that the embargo against Turkey was effectively implemented, which contrasts the findings related to import sanctions imposed by Russia against Western countries.

Across all columns, *substitution* effect remains insignificant suggesting that Turkish export were not diverted to other countries. Finally, the coefficients for *spillover* effect are negative and highly significant. Estimated elasticities indicate a drop in exports of products which did not face embargo. The elasticity in Column 6 shows that the export of non-embargoed products dropped by 22% ($e^{-.250} - 1 = -22\%$).

Are these declines in trade volumes significant in monetary terms? To put a figure to the loss in exports, we do a "back of the envelope" calculation and estimate the monetary costs of the embargo using the coefficients of column 6 estimated above. We first calculate the average monthly export value to Russia for two years that preceded the sanctions and multiply these average trade values with the coefficient of treatment above, the number of products and duration of sanctions in terms of months. For example, average monthly export to Russia for the product group for which the sanctions ended in October 2016 (period I), the average monthly value of exports is $7\ 020\ 106$ USD. Given that sanctions caused a drop 99% in exports, it is reasonable to say that the exports of these products vanished completely during the sanctions. Considering that sanctions lasted nine months and covered five products, the decline in exports corresponds to $7\ 020\ 106 \times 9 \times 5 = 315\ 904\ 770$ USD. We estimate the trade losses for all embargoed and non-embargoed products [8] in same fashion and find that losses in exports for the products in the first group to be about $1\ 137\ 925\ 256$ and second group to be around $2\ 110\ 852$

[8] Detailed monetary trade losses for embargoed products and non-embargoed products are in Table 12.

622 USD.[9] As the embargo lasted 22 months, it generated a total of 3.25bn USD in export losses which equivalent to 2.25% of 2018 total export of Turkey for all products and to all countries.

5.1.1 Heterogeneous effects by product and partner characteristics

We extend our analysis to heterogeneous effects by product characteristics in Table 2.[10] We split products into two groups, and run separate regressions for each group. As earlier, we present both OLS (Columns 1-2) and PPML (Columns 3-4). In Columns 1 and 3, we focus on the products that are classified as capital, intermediate or consumption goods. Columns 2 and 4 cover the products that are durable or non-durable.

Although there are mixed results between OLS and PPML estimators, we interpret PPML as benchmark. Two results stand out in column 3. First, compared to consumption goods, embargoed intermediate exports have been diverted more successfully to other countries ($Substitution \times Intermediate$). Second, there seems to be additional negative spillovers for intermediate products ($Spillover \times Intermediate$). On the other hand, there is no statistically significant difference between durable and non-durable good in terms of the effect of embargo, in any dimension.

Table 3 explores heteregenous effects due to the differences in the trading partners. Given that there is only a single sanctioning country, *Direct* and *Spillover* effects correspond to the drop in exports toward Russia. That is why, the possible diversion of trade to other countries can only be captured through the *Substitution* effect.

[9] We do not include *Substitution* effect in the calculation as it is not statistically significant. This means that the estimated trade losses present the lower bound.

[10] We group products based on their end-use, according to Broad Economic Classification (BEC) list.

We start by testing whether sanctioned Turkish exports were diverted to other countries, based on their distance to Turkey. Using CEPII's gravity and country profile databases, we group countries into three categories based on their distance to Turkey. Speficially, we consider countries that are $4\,000km$ away from Turkey as *Close*, those that are between $4\,000km$ and $10\,000km$ km as *Middle*, and those which are farther than $10\,000km$ km as *Distant*[11]. This categorisation allows us to test possible heterogenous substitution effects depending on the distance to trading partners.

Columns 1 and 5 present OLS and PPML results, where we interact substitution effects with dummies indicating that trading partner is *Close* or *Middle* (Group *Distant* is the baseline). While the interactions in Column 1 remain insignificant, those in Column 5 shows significant and positive substitution effects towards countries those that are close or within a short distance to Turkey. Considering the insignificant substitution effects observed in Table 1 (where trade to all countries are pooled together), it is possible that insignificant coefficient of substitution observed earlier may be driven high number of countries that are far from Turkey.

In Columns 2 and 6, we test the presence of heterogeneous effects based on income level of trading partner countries. We use CEPII's database, and classify countries as high-Income if their GDP per capita is above $12\,055$ USD in 2018, or not. We do not find any statistically significant effect of country income on substitution.

Neighbors of sanctioning countries may also be affected from the sanctions. Firms may divert their exports to these countries and then deliver to sanctioning country circumventing sanctions.

[11] Distances are in weighted term considering population share of biggest cities of two countries. For more detail information, see Mayer and Zignago (2011)

We tested existence of this sanction avoidance mechanism interacting $Substitution$ effect with Russia's neighboring countries that are geographically and/or historically connected[12], and four countries (Georgia, Belarus, Armenia and Kazakhstan) based on anecdotal evidence[11]. [13] In column 7-8 with PPML estimation, though substitution of embargoed products to all countries remains insignificant, interacting it with anecdotal countries means that embargoed exports to these neighbors significantly increased. However we did not find significant effect of other countries that had historical ties to Russia.

5.2 **Firm-level results**

The product-level effects observed in the previous section reflect the consequences of the embargo over all Turkish exporters. This overall effect, however, is incomplete as it hides the heterogeneous effects of the embargo on firms which have different abilities and resources, to absorb and adapt to the embargo. For instance, a large firm working with a set of foreign export markets can divert its embargoed product to another country much faster than a small firm that trades only with Russia. On the other hand, small firms may choose to exit the market and stop exporting all together. In this study, we define firm size according to export share of firm f in gross export of Turkey in the first year which firm becomes exporter. Based on this variable we divided into groups having equal number of firms over $39\,000$.

[12] Similar to Crozet et al. (2020), these countries include Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

[13] Our evidence is based on an interview with an executive of large fruit and vegetable exporter to Russia from Mersin province of Turkey.

This section focuses on i) the adjustment margins of firms when faced with the embargo, ii) how firms' characteristics interact with these margins. First, we analyse the changes in the export flows of firms that were exporting with Russia prior to the embargo and continued exporting (to Russia or somewhere else). Naturally, firms can only be part of this analysis if they "survive" through the embargo and remain in the product market. This is why, in a second step, we test whether firms that faced embargo were more likely to exit product market or switch their export market from Russia to another country. Finally, we check the effect of the embargo on the number of firms operating in the market.

5.2.1 Total trade of firms

We begin our analysis by studying the export values of individual firms. Recall that our sample includes Turkish firms that were exporting to Russia before and continued exporting (to Russia or somewhere else) during the embargo period. We estimate Equation 4 in both OLS (Columns 1-2) and PPML (Columns 3-4), for different sets of fixed effects. Table 4 presents regression results. First, table shows that embargo shut down exports of embargoed products to Russia (i.e., *Direct* effect). The elasticities across all columns indicate a drop around 99.9%. Second, *Substitution* effect seems to be positive and statistically significant, meaning that firms have diverted part of their trade. Concretely the estimated elasticities suggest that firms which were operating before the embargo and continued doing so during the embargo have increased the exports of the embargoed products to other markets by 9 to 15%. These results differ from those observed in the product-level analysis which does not show any trade diversion at the aggregate level. Although we need to further examine the sources of these differences, one possible explanation can be due to the difference in the samples. Recall that, product-level analysis corresponded to

the trade of all firms. Anecdotal evidence suggests that some (small) firms who were trading only with Russia before the embargo, have not managed to divert their trade to under countries, and declared bankruptcy. Other firms, who have survived through the crisis, have diverted their trade to other countries. In other words, firms which have diverted their trade to other countries may have survived through the embargo thus driving the positive and significant effects observed at the firm-level analysis.

The elasticities obtained for $Spillover$ indicate a negative spillover effect (i.e., a drop in exports of non-embargoed products to Russia) around 5-7%. These drops are much smaller than 25-39% drop observed in Table 1. These differences can suggest that firms that have survived throughout the embargo may have suffered less severe drops in their overall trade with Russia.

In table 5 we allow firm heterogeneity to interact with the variables of interest. Though significance of $Direct \times Medium$ coefficient imply that medium-sized firms are more likely to be affected by the embargo than small firms, the difference in elasticities do not create a meaningful difference between firms. As all firms that faced sanctions suffered a decline of around 99% in their exports, the differences in the export declines are around 0.000001 $((e^{-14.872}-1)-(e^{-14.872-0.251}-1))$, which can be considered as noise. However, heterogeneity of spillover effect may indicate some differences. At intensive margin non-embargoed exports to Russia have been cut more in medium and large firms than small firms. This could be associated with the fact that as firm size increases their export revenue would be higher, leading to higher price for them.

5.2.2 Market decisions and switching

We continue our analysis of the exporters' behavior by studying their decision to exit a market for a particular product or to switch the country of export.

First, we check whether firms that faced the embargo are more likely to exit the product market. We formally test this by regressing Equation 5 using using linear probability model (LPM). Table 6 presents these results where each column uses different set of fixed effects. Column 1 shows that embargo has not increased the likelihood of a firm to exit the product market. Column 2, adds HS-2 fixed effect, which compares only products that have the same first two-digit, which are thus in a similar export market. Results are informative: compared within a very small group of similar products, the exporters are more likely to exit the specific product market that faced embargo. The effect is statistically significant and suggest that faced with embargo, firms have 2.1% more likelihood to exit that specific product market. In Column 3, we add firm fixed-effects. Once firm characteristics that are constant across time are taken into account, the probability of exiting the product market turns insignificant. Put together, these results suggest that firm characteristics may have determined the impact of embargo on the exit decision of firms.

Building on the previous results, we differentiate exit decisions by firm size. Table 7 presents these results where the embargo dummy is interacted with dummies that indicate whether the firm is mid-sized or large. Compared to small firms, middle-sized firms are less likely to exit the product market that faces embargo. We do not, however, find any significant differential effect for large firms. We will dig deeper into understanding the source of these differences.

Table 8 presents results for switching decisions. Column 1 shows that Russian embargo significantly reduces the likelihood of firms to continue exporting to Russia during the embargo. On the other hand, Column 2 shows that the likelihood of switching from Russia to another

country or adding a partner rises by 26%. These findings are consistent with expectations and confirmed existence of *substitution* effect in Table 4.

Table 9 presents results where firms are differentiated by their size. In column (2) it shows that compared to small firms, medium and large firms are more likely to divert the exports to non-Russia countries. Although further analysis is needed, one possible explanation could be that small firms that have survived through the embargo continued trading with Russia as they did not have many outside options.

5.2.3 Number of firms

The results in the previous section shows that some firms adjusted to the embargo by diverting their trade to other countries. In this section we quantify the effects of the embargo on the number of exporters present in the market for a good k to a partner country p in period t. Estimated model is identical to 3 but dependent variable is number of firms.

Table 10 presents results using PPML, OLS results in levels and asinh with the same set of fixed effects. Table shows few things: First, the number of firms that export the embargoed products to Russia (*Direct* effect) dropped by 99.9%. Second, we do not observe a statistically significant change in the number of exporters that trade embargoed exports with non-sanctioned countries (*Substitution* effect). In other words, the number firms that trading embargoed products with other destinations has not neither increased nor declined. Finally, number of firms exporting non-embargoed products to Russia fell by 14% at least ($e^{-0.16} - 1 = -0.14$).

In Table 11, we differentiate number of firms by their size to identify type of firms that disappear during embargo. Contrary to Table 10, *Substitution* effect here is significant and firm heterogeneity points out that number of medium and large firms exporting embargoed products

to non-sanctioning countries has increased. This finding is consistent with the results on switching (Table 9). Finally, we see that the number of small firms exporting nonembargoed product to Russia have declined faster than medium or large firms underlyning their higher vulnerability vis-a-vis the sanctions.

6 Conclusion

Recent literature and anecdotal evidence show that trade sanctions can have unexpected consequences both. In this paper we present first evidence on sanctions imposed by Russian against Turkey as a retaliated to an unexpected military conflict. The setting provides a natural experiment which provides a neat identification of an embargo of a large economy to one of its most important trade partner.

Our findings show that at the product-level, the embargo stopped completely the exportation of the sanctioned product. While these flows could not be effectively directed toward other countries. Embargo also led to a trade loss in non-embargoed products, being two of third of total monetary loss. These losses vary by product by country heterogeneity.

We then dug deeper to understanding the underlying mechanism behind the aggregate trade figures and studied the impact of the sanctions at the firm-level. We find that compared to larger firms, small-sized firms are more likely exit the product market for embargoed product. Moreover, medium-sized or large firms are more likely to divert their trade to other destinations compared to small firms. Finally, we see that while the number of small sized firms trading with Russia fell, medium and large firms diverted their trade to other markets and suffered less losses.

This study contributes to the burgeoning literature that focuses on understanding the impact of trade sanctions on bilateral trade and exporting firms. To the best of our knowledge, we are

first to study the effects of trade sanctions on the receiving county using a natural experiment. Our results documents how unexpected trade sanctions can impact the economy and trade of the country exposed to sanctions.

Countries have long used economic and trade sanctions as a foreign policy tool to impose costs on their adversaries. Our findings suggest that such embargoes can have a significant impact on bilateral trade even if the embargoes that target a relatively small set of products. Whether these spillover effects are desired or not by the imposing government, it surely is an important piece of information that should be taken into account by the policymaker.

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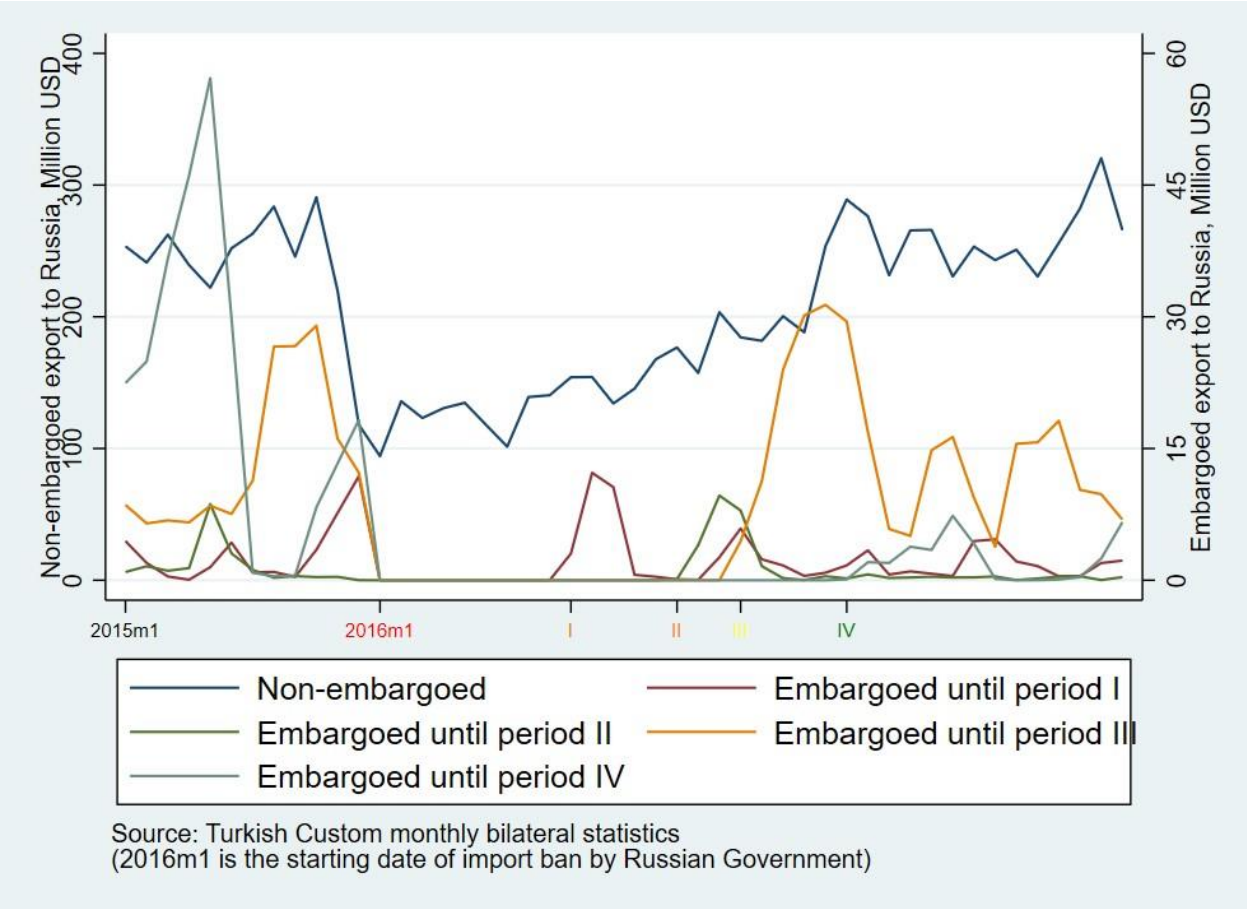
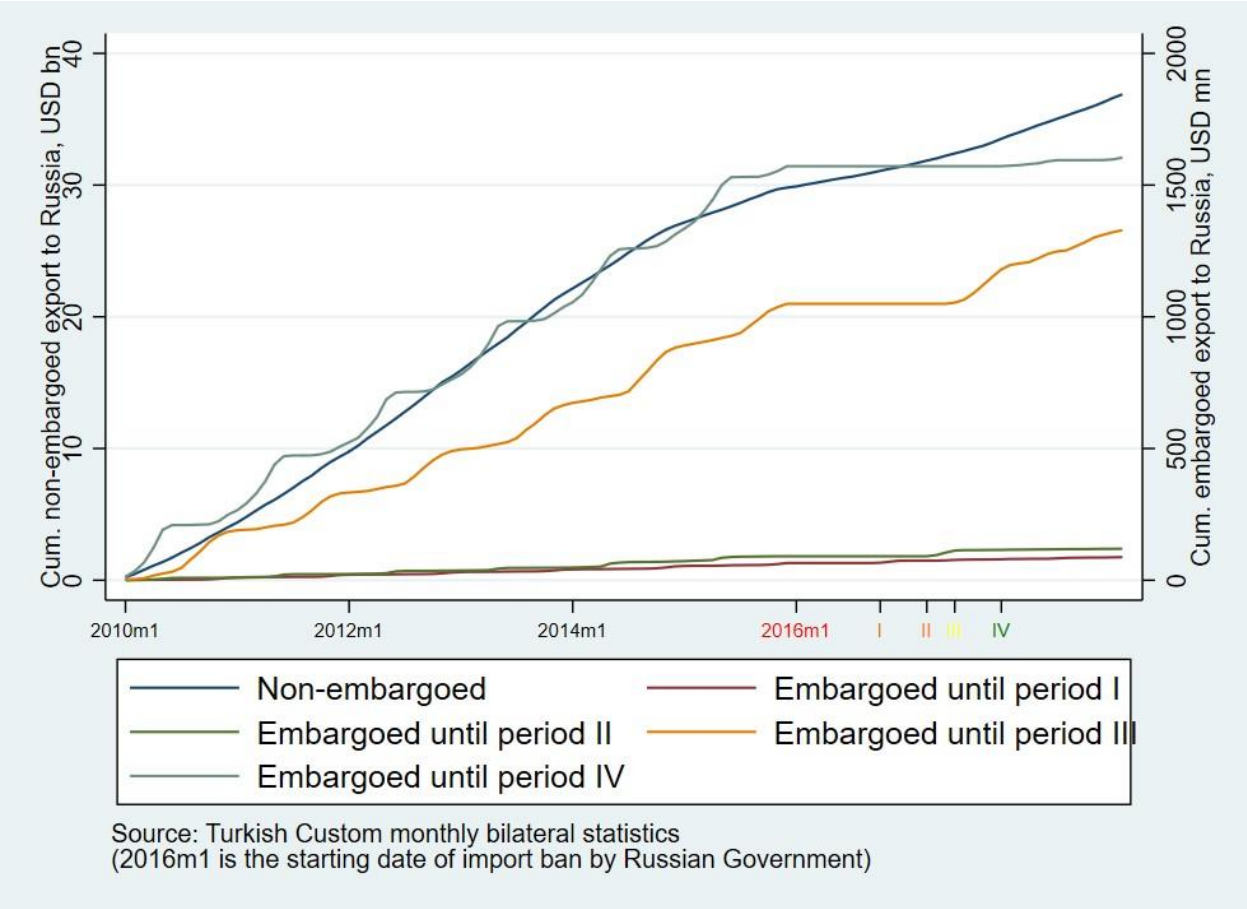
Figure 1: Embargoed and non-embargoed Turkish exports to Russia



Source: Turkish Custom monthly bilateral statistics
(2016m1 is the starting date of import ban by Russian Government)

Figure 2: Cumulative embargoed and non-embargoed Turkish exports to Russia



Source: Turkish Custom monthly bilateral statistics
(2016m1 is the starting date of import ban by Russian Government)

Table 1: Total Trade: Specification Choice

	(1) OLS	(2) OLS	(3) OLS	(4) PPML	(5) PPML	(6) PPML
Direct	-13.789***	-13.419***	-13.608***	-13.811***	-13.747***	-14.957***
	(0.361)	(0.365)	(0.458)	(0.100)	(0.182)	(0.366)
Substitution	0.065	0.059	-0.075	0.054	0.054	-0.327
	(0.053)	(0.052)	(0.164)	(0.147)	(0.133)	(0.345)
Spillover	-0.396***	-0.124***	-0.127***	-0.286***	-0.269*	-0.250*
	(0.018)	(0.029)	(0.029)	(0.057)	(0.146)	(0.151)
Constant	9.840***	9.731***	9.736***	14.402***	14.321***	14.325***
	(0.003)	(0.005)	(0.005)	(0.022)	(0.021)	(0.018)
Observations	4,142,580	4,142,565	4,142,032	4,142,580	4,142,565	4,142,032
R_2	0.711	0.713	0.717			
Psuedo R^2				0.908	0.912	0.917
Period FE	Yes	Yes	Yes	Yes	Yes	Yes
Partner-product FE	Yes	Yes	Yes	Yes	Yes	Yes
Partner-year FE	No	Yes	Yes	No	Yes	Yes
Product-year FE	No	No	Yes	No	No	Yes

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors clustered at HS-6 product-level in parentheses.

All estimates also include total product import of each partner. Dependent variable is trade volume.

Table 2: Total trade: Product heterogeneity

	(1)	(2)	(3)	(4)
	OLS Int. and capital good	OLS Non-durable good	PPML Int. and capital good	PPML Non-durable good
Direct	-13.769***	-13.771***	-15.436***	-16.155***
	(0.466)	(0.470)	(0.283)	(0.316)
Direct x Intermediate	2.107***		6.093***	
	(0.463)		(0.207)	
Substitution	-0.106	-0.108	-0.328	-0.282
	(0.178)	(0.176)	(0.344)	(0.315)
Substitution x Intermediate	0.293*		0.578*	
	(0.178)		(0.344)	
Spillover	-0.143***	-0.389***	-0.215	-0.245
	(0.034)	(0.101)	(0.166)	(0.184)
Spillover x Intermediate	-0.027		-0.163*	
	(0.040)		(0.096)	
Spillover x Capital	0.175***		0.093	
	(0.048)		(0.071)	
Spillover x Non-durable		0.208**		0.192
		(0.097)		(0.126)
Constant	9.736***	9.661***	14.325***	14.394***
	(0.005)	(0.011)	(0.018)	(0.021)
Observations	4,142,032	1,369,163	4,142,032	1,369,163
R_2	0.717	0.739		
Psuedo R^2			0.917	0.931
Period FE	Yes	Yes	Yes	Yes
Partner-product FE	Yes	Yes	Yes	Yes
Partner-year FE	Yes	Yes	Yes	Yes
Product-year FE	Yes	Yes	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors clustered by HS-6 in parentheses.

All estimates also include total product import of each partner.
Dependent variable is trade volume. Base categories in column
(1) and (3) and column (2) and (4) is consumption and durable good, respectively.

Table 3: Product-level: Country heterogeneity

VARIABLES	(1) OLS Close and mid-close country	(2) OLS Non-high Income Country	(3) OLS Anectodal transmission	(4) OLS Historical or geog. neighbor
Direct	-13.608***	-13.608***	-13.601***	-13.607***
	(0.459)	(0.458)	(0.459)	(0.460)
Subst	-0.085.	-0.106	-0.125	-0.154
	(0.179)	(0.156)	(0.162)	(0.158)
Subst x Close	0.025			
	(0.088)			
Subst x Mid	-0.098			
	(0.097)			
Subst x Non-high		0.057		
		(0.062)		
Subst x Neighbor			0.722***	0.376***
			(0.180)	(0.122)
Spill	-0.127***	-0.127***	-0.127***	-0.127***
	(0.029)	(0.029)	(0.029)	(0.029)
Constant	9.736***	9.736***	9.736***	9.736***
	(0.005)	(0.005)	(0.005)	(0.005)
Observations	4,142,032	4,142,032	4,142,032	4,142,032
R-squared	0.717	0.717	0.717	0.717
Period fixed effects	yes	yes	yes	yes
Partnerxproduct fixed effects	yes	yes	yes	yes
Partnerxyear fixed effects	yes	yes	yes	yes
Productxyear fixed effects	yes	yes	yes	yes

VARIABLES	(5) PPML Close and mid-close country	(6) PPML Non-high Income Country	(7) PPML Anectodal transmission	(8) PPML Historical or geog. neighbor
Direct	-14.963***	-14.963***	-14.951***	-14.961***
	(0.367)	(0.364)	(0.362)	(0.370)
Subst	-0.528	-0.384	-0.405	-0.372
	(0.344)	(0.297)	(0.336)	(0.323)
Subst x Close	0.189*			
	(0.114)			
Subst x Mid	0.418***			
	(0.152)			
Subst x Nonhigh		0.075		
		(0.126)		
Subst x Neighbor			0.753***	0.176
			(0.133)	(0.161)
spill	-0.250*	-0.250*	-0.252*	-0.250*
	(0.151)	(0.151)	(0.150)	(0.150)
Constant	14.325***	14.325***	14.325***	14.325***
	(0.018)	(0.018)	(0.018)	(0.018)
Observations	4,142,032	4,142,032	4,142,032	4,142,032
Psuedo R2	0.917	0.917	0.917	0.917
Period fixed effects	yes	yes	yes	yes
Partnerxproduct fixed effects	yes	yes	yes	yes
Partnerxyear fixed effects	yes	yes	yes	yes
Productxyear fixed effects	yes	yes	yes	yes

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors clustered by HS-6 in parentheses.
All estimates also include total product import of each partner.
Dependent variable is trade volume. Base categories in column (1) and (3) and column (2) and (4) is far and high-income country, respectively.

Table 4: Intensive margin: Log of firm exports

	(1) OLS	(2) OLS	(3) PPML	(4) PPML
Direct	-11.387***	-11.380***	-15.214***	-15.206***
	(0.045)	(0.045)	(0.285)	(0.284)
Subst	0.064***	0.074***	0.118***	0.126***
	(0.024)	(0.024)	(0.038)	(0.038)
Spill	-0.075***	-0.068***	-0.063***	-0.056***
	(0.008)	(0.008)	(0.018)	(0.018)
Constant	9.734***	9.733***	13.601***	13.601***
	(0.009)	(0.009)	(0.000)	(0.000)
Observations	4,479,619	4,479,619	3,633,995	3,633,995
$R2$	0.956	0.956		
Psuedo R^2			0.917	0.917
Firm-product-partner FE	Yes	Yes	Yes	Yes
Month FE	Yes	No	Yes	No
Year FE	Yes	No	Yes	No
Period FE	No	Yes	No	Yes

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors clustered by partnerxHS6 in parentheses. Dependent variable is trade volume.

Table 5: Log of firm exports: by firm size

	(1) PPML
Direct	-14.944*** (0.028)
Direct x Medium	-0.193*** (0.044)
Direct x Large	-0.274 (0.309)
Subst	0.490* (0.260)
Subst x Medium	-0.065 (0.345)
Subst x Large	-0.368 (0.262)
Spill	0.193** (0.091)
Spill x Medium	-0.289** (0.125)
Spill x Large	-0.250*** (0.092)
Constant	13.601*** (0.000)
Observations	3,633,995
Psuedo R^2	0.917
Firm-product-partner FE	Yes
Month FE	No
Year FE	No
Period FE	Yes

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors clustered by partner X HS-6 X ID in parentheses.
Dependent variable is trade volume. Base category is small firms.

Table 6: Exit decision

	(1)	(2)	(3)
VARIABLES	exit	exit	exit
Embargo	-0.003	0.021*	-0.014
	(0.007)	(0.012)	(0.011)
Constant	0.085***	0.084***	0.084***
	(0.003)	(0.000)	(0.000)
Observations	6,157,630	6,157,630	6,152,961
HS-2 fixed effects	no	yes	yes
Firm fixed effects	no	no	yes

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors clustered by HS-2 in parentheses.

Dependent variable is a dummy variable which equals to 1 if a firm exported product k before the embargo and ceased after the embargo.

Table 7: Exit decision by firm size

	(1) exit
Embargo	0.005
	(0.020)
Embargo x Medium	-0.054***
	(0.018)
Embargo x Large	-0.017
	(0.011)
Constant	0.084***
	(0.000)
Observations	6,152,961
HS-2 FE	Yes
Firm FE	Yes

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors clustered by HS-2 in parentheses.

Dependent variable is a dummy variable which equals to 1 if a firm exported product k before the embargo and ceased after the embargo. Base category is small firms.

Table 8: Switching decision

	(1)	(2)
	S to S	S to NS
Embargo	-0.261***	0.258***
	(0.091)	(0.098)
Constant	0.507***	0.128***
	(0.011)	(0.010)
Observations	9,645	9,645
HS-2 FE	Yes	Yes
Firm FE	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors clustered by HS-6 in parentheses.

Dependent variable is a dummy variable which equals to 1 if a firm exported product k to only Russia before the embargo and maintains after the embargo in column (1). It equals to 1 in column (2) If a firm leaves to export product k to Russia and switches or adds a partner.

Table 9: Switching decision by firm size

	(1)	(2)
	S to S	S to NS
Embargo	-0.116	-0.586***
	(0.193)	(0.154)
Embargo x Medium	0.122	0.707***
	(0.213)	(0.220)
Embargo x Large	-0.165	0.868***
	(0.207)	(0.116)
Constant	0.505***	0.130***
	(0.011)	(0.009)
Observations	9,645	9,645
HS-2 FE	Yes	Yes
Firm FE	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors clustered by HS-6 in parentheses.

Dependent variable is a dummy variable which equals to 1 if a firm exported product k to only Russia before the embargo and maintains after the embargo in column (1). It equals to 1 in column (2) If a firm leaves to export product k to Russia and switches or adds a partner. Base category is small firms.

Table 10: Extensive margin: Number of firms

	(1)	(2)	(3)
VARIABLES	PPML	Asinh OLS	Level OLS
Direct	-11.709***	-1.747***	-3.410***
	(0.035)	(0.019)	(0.205)
Subst	-0.242	-0.117	-1.614
	(0.192)	(0.125)	(1.324)
Spill	-0.160***	-0.107***	-0.708***
	(0.029)	(0.014)	(0.129)
Constant	1.984***	1.007***	2.700***
	(0.001)	(0.000)	(0.002)
Observations	3,528,107	4,101,877	4,101,877
R_2		0.724	0.910
Psuedo R^2	0.625		
Period FE	Yes	Yes	Yes
Partner-product FE	Yes	Yes	Yes
Partner-year FE	Yes	Yes	Yes
Product-year FE	Yes	Yes	Yes

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors clustered by HS-6 in parentheses. Dependent variable is number of firms for each product-period-partner triad.

Table 11: Number of firms by firm size

	PPML
Direct	-10.760***
	(0.033)
Subst	-2.976***
	(0.209)
Subst x Medium	1.477***
	(0.151)
Subst x Large	3.316***
	(0.171)
Spill	-3.567***
	(0.122)
Spill x Medium	1.606***
	(0.114)
Spill x Large	3.888***
	(0.119)
Constant	1.479***
	(0.000)
Observations	4,267,669
Psuedo R^2	0.405
Period FE	Yes
Partner-product FE	Yes
Partner-year FE	Yes
Product-year FE	Yes

*** p<0.01, ** p<0.05, * p<0.1

Robust standard errors clustered by HS-6 in parentheses

Dependent variable is number of firms for each product-period-partner-size quadrilateral. Base category is small firms.

Table 12: Monetary cost of Russia sanctions

Direct effect	Period I	Period II	Period III	Period IV
Average monthly trade to Russia in 2015 ($)	7,020,106	589,020	2,643,202	21,567,924
Percentage Loss $(100 \times (e^{14.957} - 1))$ (%)	99.9	99.9	99.9	99.9
Number of months sanctioned	9	14	17	22
Number of products in 2015	5	4	7	1
Cumulative loss ($)	315,904,770	32,985,120	314,541,038	474,494,328
Total lost due to direct effect ($)				1,137,925,256
Spillover effect				
Average monthly trade to Russia in 2015 ($)	163,314.06	163,314.06	163,314.06	163,314.06
Percentage Loss $(100 \times (e^{0.250} - 1))$ (%)	22.1	22.1	22.1	22.1
Number of months sanctioned	9	5	3	5
Number of products in 2015	2,656	2,656	2,656	2,656
Cumulative loss ($)	1,108,795,261.6	615,997,367.6	369,598,420.5	615,997,367.6
Total lost due to spillover effect ($)				2,110,852,622
Total lost (direct effect+spillover effect) ($bn)				**3,249**

We utilized *Direct* and *Spillover* coefficients of column 6 in Table-1 to estimate percentage losses.
We did not take account coefficient of *Substitution* because it is statistically insignificant.

A Appendix: Timeline of product embargo

1. In November 2015, Russia issued a presidential executive order (No 583) to ban theimport of agricultural products, raw materials and food products, effective on January 1, 2016.

2. In October 2016, Russia makes some amendments to import ban by excluding following products:

    - 080510 fresh and dried oranges
    - 080520 fresh and dried mandarins
    - 080910 fresh apricots
    - 080930 fresh peaches including nectarines
    - 080940 fresh plums and blackthorn

3. In March 2017, the Russian government made amendments to list by eliminating products below:

    - 060312 Clove
    - 070310 Onion and shallots
    - 070410 Broccoli
    - 250100 Salt

4. In June 2017, the following products have been excluded from the prohibiting:

    - 020714 Chicken

- 020727 Turkey
- 070700 Cucumber and gherkin
- 080810 Apples
- 080830 Pears
- 080610 Grapes
- 081010 Strawberries

5. Effective on November 1, 2017, tomato (070200) ban lifted by the Russian Government