Abstract

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JEL Classification: C01, C23, F14

Keywords: Russia, International trade, sanctions, Differences-in-differences, Bilateral trade flows, UNCTAD/BACI data

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Which Sanctions Matter? Analysis of the EU/Russian Sanctions of 2014

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In this paper we use a natural experiment of reciprocal imposition of trade sanctions by Russia and the EU since 2014. Using UNCTAD/BACI bilateral flows data we take this unique opportunity to analyse both sanctions. In particular, we study the effectiveness of narrow versus broadly defined sanctions, and differences in the effectiveness of sanctions imposed on exports and imports. We show that the Russian sanctions imposed on European and American food imports resulted in about 8 times stronger decline in trade flows than those imposed by the EU and the US on exports of extraction equipment. These results do not appear to be driven by diversion of trade flows via non-sanctioning countries. Hence the difference in sanctions’ effectiveness can be attributed to the broader range of sanctioned goods and potentially to a stronger position of enforcement of sanctions on imports rather than exports.

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1 Introduction

International trade, along with other macroeconomic phenomena, is of prime interest to policy makers, and, at the same time, poorly accessible to empirical scrutiny due to the rarity of natural experiments that would reveal changes in trade flows in response to a change in a single variable *ceteris paribus*. In this paper, we utilize trade sanctions imposed by the EU and US on (specific) trade exchanges with Russia, and broader sanctions that Russia, in response, imposed on imported EU food products. This offers a unique opportunity to analyze trade sanctions: first, the data have been generated by a natural experiment; second, we can compare and analyze the effectiveness of narrow versus broadly defined sanctions, and finally, we can empirically test the effectiveness of sanctions imposed on exports and imports, respectively.

For identification purposes, the dramatic events of 2014 in Ukraine, which precipitated rounds of sanctions on imports into the Russian Federation, are an extraordinary opportunity to analyze the dynamics of international trade flows in response to restrictive measures. This episode has a solid claim to be a natural experiment due to the geo-political considerations that drove the imposition of sanctions. If the sanctions had been imposed on primarily economic grounds, then there would have been strong reasons to suspect that countries selected endogenously into the sanctions regime. In this case, the alliance between the US and the EU created powerful incentives to cooperate against Russia, despite the misgivings of individual states. Thus, the selection into sanctions may be viewed as nearly-randomly assigned, opening a unique widow into the effectiveness of international sanctions.

The motivation for focusing on economic sanctions and their effectiveness is the puzzlingly mixed evidence on the topic. Hufbauer et al. (2007) conclude that economic sanctions appear to be effective in compelling the target country to make concessions to the sender countries in about one third of cases (earlier versions of this analysis are Hufbauer et al., 1985, 1990). However, these findings have been found to be sensitive to the choice of econometric specification (Drury, 1998, whose criticisms against Hubauer et al. (1990) were not addressed in the updated version). Furthermore, Pape (1997) pointed out that Hufbauer et al. (1990) seemed to have coded episodes as “successes” of economic sanctions in several
cases which did not warrant it,\footnote{These charges remain unanswered in Hufbauer et al. (2007). For a partial rebuttal, see Elliott (1998), which is addressed in Pape (1998).} thereby compounding the uncertainty surrounding their empirical findings.

In a long stream of economic literature, several hypotheses have been put forward that might explain the limited effectiveness of sanctioning measures. Galtung (1967) suggests that curtailing international trade may stimulate the target country’s internal markets and potentially provoke perverse political responses in the target country (see also Brooks, 2002, for a similar view). Another salient threat to the effectiveness of sanctions is the formation and enforcement of a multilateral agreement on the imposition of measures that create costs to the sender countries (e.g. Mansfield, 1995; Kaempfer and Lowenberg, 1999; Drezner, 2000). In fact, since securing the universal enforcement of sanctions appears so difficult, it has been suggested that economic sanctions ought not to be viewed as a means of punishing the target country, but rather as a way of advancing the agendas of lobbying groups within the sender countries (Kaempfer and Lowenberg, 1988). Alternatively, sanctions might be seen as a form of signaling, in which the target country’s government seeks to persuade its voters and allies abroad that it is willing to take a tough stance against adversaries (Lindsay, 1986).

We contribute to this line of inquiry by studying the most fundamental relationship associated with economic sanctions. Instead of searching for an effect of sanctions on changes in the target country’s policy, we estimate their on trade flows into the target country. This allows us to observe the direct effect of the restrictive measures instead of an effect mediated through a host of other variables, thereby offering a clearer view of the dynamics induced by sanctions. Our identification strategy exploits the recent episode of EU and US sanctions against the Russian Federation in response to the Russian annexation of the Crimean peninsula. This situation is particularly interesting as it consists of two different sanctions packages: first the Western restrictions on exports of equipment for oil and gas extraction into Russia, and second the Russian counter-sanctions against the imports of Western foodstuffs. These two sets of sanctions were imposed in different ways and appear to have different effects. Data on imports of goods that have been sanctioned, and on goods
very similar to them, show that the Western sanctions have a very modest impact on trade inflows of sanctioned goods into Russia, while the Russian counter-sanctions cut the imports of foodstuffs substantially.

This state of affairs can be naturally attributed to the difference in scope of the two sanctions packages. The Western sanctions targeted a very narrow class of goods, thereby allowing Russian importers to find very close substitutes (so close that we are unable to distinguish them from the actual sanctioned goods in our data), which is reflected in the data as a minuscule effect of sanctions on trade flows. In contrast, the Russian sanctions restricted trade in much broader terms, so that no similar substitution was feasible. The more modest approach of the Western coalition to sanctions likely stems from concerns that more radical measures against the Russian oil and gas industry would harm European energy sectors (e.g. Wagstyl, 2017).

In addition to this mechanism, Russia, by exercising sanctions against imports into its territory may be in an inherently stronger position of enforcement since imports are easier to control and verify in comparison to exports (Feenstra et al., 2005). The asymmetry between sanctions on imports from the target country as opposed to sanctions on exports to it also lies in the fact that while the former removes foreign markets for the sanctioned exporters, the latter creates new markets for the domestic producers in the target country (Brooks, 2002). Therefore, Russian food producers have been provided with incentives to support the perpetuation of sanctions, while Western producers of mining equipment gain a motivation to lobby their government to relieve the restrictions.

The findings of this paper complement several earlier works that attribute the decline of trade with Russia to a decline in oil prices and weakening of the Russian ruble, as well as finding that sanctions on their own had a rather modest impact (Dreger et al., 2016; Ahn and Ludema, 2016; Crozet and Hinz, 2016). The closest work to this paper is the analysis by Crozet and Hinz (2016), who use the same dataset but focus on the effects of sanctions on non-sanctioned trade flows. It is worth noting that analysis of other components of

\footnote{Our dataset resolves trade flows by product categories at the 6-digit Harmonised System level. Some of the goods were sanctioned at the 8-digit level and therefore we observe blocks of goods that contain some sanctioned items and some items that are very similar, but nevertheless not subject to the sanctioning regime. This “granularity” problem is noted also by Crozet and Hinz (2016, pp. 24–25) who use the same data. See the discussion below and Appendix ?? for further details.}
Western sanctions package, such as restrictions imposed on specific firms and individuals is beyond the scope of this study, which focuses on aggregate trade flows. Indeed, there is evidence that entities subject to these specific sanctions were impacted significantly (Ahn and Ludema, 2016).

The remainder of this paper is structured as follows: first we survey the 2014 Russian sanctions episode and describe data that are analyzed to estimate the impact of the sanctions packages. We follow the empirical analysis with robustness checks and brief concluding remarks.

2 Background

The historical and political circumstances surrounding the imposition of sanctions are well summarised in recent literature (e.g. Dreger et al., 2016; Crozet and Hinz, 2016; Moret et al., 2016) and hence the discussion here will be limited to the essential facts that are pertinent to the discussion of economic sanctions. Following the annexation of the Crimean peninsula by the Russian Federation in March of 2014, a coalition of Western countries (EU, US, Canada and their allies) imposed a series of measures restricting trade with Russia. Initially, these measures targeted specific Russian citizens and entities but from mid-2014, the restrictions were expanded to curtail trade in military technology and equipment for the oil and natural gas industry. In response to the Western sanctions, in August of 2014, the Russian Federation imposed retaliatory measures restricting imports of foodstuffs from the EU, US, and their allies.

Several features of these sanctioning measures are noteworthy. The first important point to note is that the Western sanctions were imposed at the 8-digit level of the Harmonised System (HS) for classification of goods, whereas Russian counter-sanctions were imposed at the 4-digit level, thereby covering significantly wider product categories. Thus, finding close substitutes for the sanctioned imports is arguably more difficult under the Russian sanctions.

3For the EU sanctions, see Council Regulation (EU) No 833/2014 (http://data.europa.eu/eli/reg/2014/833/oj). US trade sanctions are imposed by Directive 4 of the Office of Foreign Assets Control under Executive Order 13662 (https://www.treasury.gov/resource-center/sanctions/Programs/Pages/ukraine.aspx).

4The relevant measure is the Decree of the President of the Russian Federation No. 560, English translation is available from http://en.kremlin.ru/events/president/news/46404.
Similarly, there is a much smaller potential for re-classification of goods into non-sanctioned categories. This practice has been documented in the context of tax evasion, where products subject to higher import taxes are re-classified as similar, but less taxed products (Fisman and Wei, 2004). In a more extreme version of this scheme, the same shipment is imported under a low-tax classification and exported under a high-tax classification multiple times, each time allowing the fraudulent exporter to reclaim the tax upon export, which in reality has never been incurred (Baloun and Scheinost, 2002).

A related concern to be raised in this context is the limited retroactivity of the EU sanctions. For contracts made prior to the imposition of sanctions, the sanctioned goods may still be exported to Russia, even if sanctions are in place, provided that the exporters obtained permission from a relevant authority in their home country. Analogous provisions exist in the US sanctioning measures.\(^5\) A remarkable example of this limited retroactivity was the sale of two French Mistral warships to Russia. The delivery of the warships would be permissible despite sanctions being in place, since the deal was struck in 2010, but due to political considerations, the warships were not delivered and the Russian Federation was reimbursed (Tavernise, 2015). To our knowledge, there is no parallel limited retroactivity implemented in the Russian sanctions. Therefore, this adds another layer of difficulty for parties wishing to avoid the Russian sanctions, although anecdotal reports have been made of schemes that have managed to sidestep them (e.g. Kiselyova and Popova, 2016).

3 Data

We use data from the *Base pour l’Analyse du Commerce International* (BACI), which is constructed from the COMTRADE database maintained by the United Nations Statistics Division (see Gaulier and Zignago, 2010, for a detailed description of these data). This is a panel dataset of bilateral trade flows disaggregated by 6-digit Harmonised System (HS) product categories. For each pair of countries in a given year, typically several trade flows are recorded, reflecting flows of different commodities. These trade flows are recorded both in terms of the value traded (in thousands of US dollars) and as the quantity traded. Since

\(^5\)For EU sanctions, cf. Council Regulation No 833, sections 2.2, 3.5, and 4.2. For the US analogue, cf. Sectoral Sanctions Identifications List of the Office of Foreign Assets Control.
quantities reflect the unit of measurement for each type of good separately (tons, meters, etc.), they are not comparable across different commodities and hence we will use trade values in our models.

The sample to be analyzed in this paper consists of trade flows into the Russian Federation between 1995 and 2016. We further limit the sample to products in the same 4-digit HS category as those that are subject to sanctions. In this way, we will be comparing sanctioned and non-sanctioned products that nevertheless belong to a broadly comparable category thereby avoiding contamination of results stemming from different dynamics of trade flows of very different product categories (Bena and Jurajda, 2011).

Having a panel dataset of trade inflows into Russia of sanctioned goods and their near-substitutes, we then construct two dummy indicators of the sanctioned status: one for the extraction equipment sanctioned by the US, the EU, and their allies, and a separate dummy for the retaliatory sanctions against foodstuffs imposed by the Russian Federation (see Appendix for further details). These dummies are equal to one if the exporter $i$ is under the sanctioned regime and the good category $j$ is subject to sanctions under that regime. For the main sample, only US and EU member states are classified as exporters subject to the sanction regime, while their allies who also joined the sanctions are excluded from the sample altogether.\textsuperscript{6} The reasoning for this twofold: Firstly, we wish to limit potential problems with sample selection by eliminating countries that joined the sanctions regime on their own accord following the move by the EU and the US. Secondly, these excluded observations contribute relatively little to the trade flows studied. Including these observations predictably leads to a minuscule change in the estimates (see robustness checks below).

Due to the data limitations, some measurement error is present in these dummies for sanctioned goods. Since the BACI data resolve product categories only at the 6-digit HS level while the sanctions are imposed at an 8-digit level, we will be falsely categorizing some products as sanctioned. At the same time, however, this measurement error is one-sided

\textsuperscript{6}We code the following countries as “sanctioning exporters:” Austria, Belgium-Luxembourg, Bulgaria, Croatia, Cyprus, Czech Rep., Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, USA, and United Kingdom. Sanctioning exporters that were dropped from the main sample but are included in the sample for robustness checks are: Albania, Australia, Canada, Iceland, Montenegro, Norway, Switzerland, and Ukraine.
because no products are falsely categorized as non-sanctioned, which means that our control
group should be unaffected by this data limitation. Since the only contamination occurs
in the treatment group, which contains some members of the control group, we will be
obtaining somewhat conservative estimates of the sanctions’ effects. However, to the
extent that there was a sizable decrease in the imports of the sanctioned items without a
compensating increase in non-sanctioned imports in the same HS6 category, we should be
able to detect this change.

Another limitation of the data is the presence of missing values. While BACI data do
contain information about zero trade flows, this information is not available for all country
dyads and all years. For our main specifications, we do not replace missing trade flows with
zeros, but in robustness checks we show that the addition of zeros makes only a modest
difference in the estimated effects.

Furthermore, it is worth noting that trade inflows of extraction equipment vary quite
wildly in time. Seasonality in extraction equipment is to be expected as these goods are
imported in large one-off deliveries when oil and gas producers expand their capacity (Crozet
and Hinz, 2016). The pronounced, but short-lived peaks in Figure 1 indicate the presence of
large one-off deliveries of extraction equipment. In addition, trade flows are very unequally
distributed across different exporters, which further increases their variances.\footnote{These variances are provided in summary statistics for individual product categories reported in Tables ?? and ??, which are relegated to Appendix ?? in the interest of space.}
Figure 1: Timeline of trade inflows of sanctioned goods into Russia. The first year of sanctions (2014) is indicated by a vertical line.

(a) Extraction equipment

(b) Foodstuffs products

Note that Figure 1 also shows that the inflows of extraction equipment do not seem
to have responded to the imposition of sanctions in 2014 (indicated by the vertical line), while at the same time, imports of foodstuffs have declined sharply. We do observe a decline in goods (extraction equipment as well as foodstuffs) imported from non-sanctioned exporters. This fact makes it very difficult to argue that the trade flows were diverted via non-sanctioning countries in order to bypass sanctions. While it is still possible that there were instances when sanctioned goods were indeed imported despite the restrictions (Geller et al., 2014; Kiselyova and Popova, 2016; Yeliseyeu, 2017), the general trend shows a clear decline of imports even from non-sanctioning exporters. As documented by Dreger et al. (2016) and Crozet and Hinz (2016), a decline in imports is likely a consequence of the weakening of the Russian ruble and falling oil prices.

4 Empirical specification

In order to evaluate the indications from Figure 1 rigorously, we analyze the trade data using a differences-in-differences model. The model is specified as a panel regression with fixed effects for each exporter-good pair (at 6-digit resolution) as well as time fixed effects. In the main specification, time fixed effects are interacted with a Sanctions dummy taking a value of one if a given exporter-good pair is subject to a sanctioning regime and zero otherwise. This dummy is time-invariant, which allows us to interact pre-treatment year dummies with it to test the parallel trend assumption. A simpler model was estimated which replaces the interactions with time fixed effects by interaction with a dummy indicating the post-sanctions period. Formally, the main specification can be written as:

$$Y_{ijt} = \alpha_{ij} + \alpha_t + \sum_{s=2011}^{2016} \beta_s \text{Sanctions dummy}_{ij} \times 1(t = s) + \varepsilon_{ijt},$$ (1)

where $Y_{ijt}$ are imports originating in country $i$ of commodity $j$ in year $t$. Analogously, the simplified specification is:

$$Y_{ijt} = \alpha_{ij}^* + \alpha_t^* + \beta^* \text{Sanctions dummy}_{ij} \times 1(t \geq 2014) + \varepsilon_{ijt}^*.$$ (2)

Both models were estimated for 2010–2016, even though data is available since 1995.
The reason for exclusion of the older portion of the dataset is a concern for the stability of
the data-generating process which might invalidate the estimation results. For example,
the crisis of 2008 would be one potential point that could have altered trade dynamics.
Standard errors were clustered by each exporter yielding a sample with 100 clusters for
sanctions on the extraction equipment and 126 clusters for food products.

The differences-in-differences model rests on the crucial assumption that observations
after the imposition of sanctions for exporter-good pairs outside the sanctions regime
constitute the appropriate counterfactual for the exporter-good pairs that are subject to
sanctions. For example, if the treatment group of imports exhibited a pro-cyclical dynamics,
while the control group was counter-cyclical, then this model would simply detect this
difference in cyclical behavior rather than the effect of sanctions. This “parallel trend”
assumption can be defeated by data if there are significant pre-intervention interactions
between the Sanctions dummy and year effects. Hence, we conduct a joint test of the
significance of three pre-sanctions interactions by an F-test using the cluster-robust variance-
covariance matrix. The significance of pre-treatment interactions would indicate a rejection
of the crucial “parallel trend” assumption.

5 Results

Russian imports that are subject to the Western sanctions, as well as imports that are subject
to the Russian counter-sanctions, were modeled separately by the the main differences-
in-differences specification (1) and by its simplified version (2). Results from all four of
these models are reported in Table 1. In the interest of space, pre-intervention interactions
are omitted and the results of the joint test of their significance are presented instead.
Figure 2 plots all the coefficients, including the pre-treatment periods, for a convenient
evaluation of the treatment effect and possible pre-trends. The test of the joint significance
of pre-intervention interactions as well as the graphical representation indicate that the
data are consistent with the parallel trends assumption. Hence, we find that the differences-
in-differences methodology seems appropriate for this dataset.
Table 1: Differences-in-differences model of trade inflows into Russia (millions USD).

| Sanctioned goods: | Extraction equip. | Foodstuffs |
|------------------|------------------|------------|
|                  | (1)             | (2)        | (3)        | (4)          |
| Sanctions$x 1(t = 2014)$ | -1.653          | —          | -3.664**   | —            |
|                  | (1.080)         | (1.162)    |            |              |
| Sanctions$x 1(t = 2015)$ | -2.874*         | —          | -6.964***  | —            |
|                  | (1.342)         | (1.564)    |            |              |
| Sanctions$x 1(t = 2016)$ | -2.732          | —          | -6.184**   | —            |
|                  | (1.381)         | (1.987)    |            |              |
| Sanctions$x 1(t \geq 2014)$ | —               | -2.821     | —          | -3.697***    |
|                  | (1.588)         | (0.739)    |            |              |
| Good$x $Exporter FE | Yes             | Yes        | Yes        | Yes          |
| Time FE          | Yes             | Yes        | Yes        | Yes          |
| Observations     | 12,914          | 12,914     | 19,782     | 19,782       |
| Clusters         | 100             | 100        | 126        | 126          |

Tests for joint significance of Sanctions$\times$year interactions (p-values)

|                          | (1) | (2) |
|--------------------------|-----|-----|
| Test 2011–2013           | 0.73| 0.59|
| Test 2015–2016           | 0.17| <0.01|
| Test 2014–2016           | 0.11| <0.01|

Notes: First panel of Table 1 shows the effect of sanctions in particular year (i.e., the interaction of sanctions with the year dummies). Columns (1) and (3) refer to models in which we consider different effects of sanction in each year, while columns (2) and (4) correspond to the case when we assume same sanction effect across all years. In all models we control for good and exporter fixed effects, as well as time fixed effects.

Bottom panel presents joint tests of significance of the sanctions in the specified periods. While the effect on extraction equipment was negative, it was significant only in 2015 on 10% significance level, when considered in joint tests it lost its significance. On the other hand, food-products sanctions shown to be highly significant in all cases, including joint testing.

Standard errors clustered at the exporter level are reported in parentheses. Significance codes: * 10%, ** 5%, *** 1%
Figure 2: Differences-in-Differences plots indicating the mean trade inflows into Russia per exporter-good dyad (in millions USD). First year of sanctions, 2014, is indicated by a vertical line.

(a) Extraction equipment

(b) Foodstuffs
Post-intervention interactions show a remarkable pattern: Western sanctions against extraction equipment do not seem to have an effect on trade inflows into the Russian Federation. The interaction coefficients are negative, indicating that trade flows were lower than they would have been in the absence of sanctions, but this difference is statistically insignificant. Only at the 10% level, are we able to find a single significant interaction, in 2015, but the significance disappears once interactions in 2015 and 2016 are tested jointly. Since the interaction coefficients represent the mean change in trade flows per exporter-good dyad, it is not surprising that they are somewhat limited magnitude. Scaling them up by the number of exporter-good dyads and summing up all these scaled interaction coefficients across 2014–2016 in Column (1) leads to an estimate of the overall value of the lost trade in extraction equipment, which is about 1.3 billion USD (SE = 0.7). This would mean that for 2014–2016, the lost trade value accounts for about 14% of the total trade inflows of sanctioned goods for the three-year period prior to sanctions (2011–2013). However, this value is also only significant at the 10% level. Therefore, the differences-in-differences models indicate that at most, the effect of sanctions is too small to be detected in BACI data.

The failure to find a statistically significant decline in trade flows into Russia after the imposition of sanctions may appear counter-intuitive, but this is easily explained by the fact that the Western sanctions have been imposed on a very specific set of products that we are unable to distinguish from their close substitutes in our dataset. The sanctions apply to products at the 8-digit HS resolution, while data are available only at the 6-digit level. As a consequence, Russian importers may be switching to non-sanctioned alternatives that fall within the same 6-digit HS code giving the appearance of a subdued effect of sanctions at the 6-digit level. It is also possible that Western exporters may be re-classifying their products at the 8-digit level to evade sanctions while keeping the same 6-digit classification. In the absence of more detailed data that would resolve the 8-digit categories, we are unable to decide which effect prevails in this instance.

On the other hand, the retaliatory sanctions have a very pronounced negative impact on imports, which are overwhelmingly statistically significant. Figure 2 clearly shows the notable fall in trade inflows of foodstuffs into Russia, compared to a rather modest dip in
the imports of extraction equipment. Similarly, the estimate of the overall value of lost trade is 10.5 billion USD (SE = 2.5), which is statistically significant even at the 0.1% level (constituting about a 16% reduction in trade value compared to the period before sanctions). This value may seem somewhat low but it does not reflect the full effect of the trade restrictions. In particular, costs incurred by Western firms relying on Russian markets may be substantial. Nevertheless, our model indicates that the Russian sanctions resulted in about 8 times greater loss of trade than the Western ones (SE of this ratio is 3.6).

At this point, it is worth emphasizing that the standard errors for sanctions × year interactions are actually larger for foodstuffs than for extraction equipment (compare columns (1) and (3) in Table 1). Therefore, the statistical insignificance of Western sanctions is not attributable to insufficient power. In both models (for foodstuffs and extraction equipment), the counterfactual outcome was constructed from goods that are similar to the sanctioned items (falling within the same 4-digit HS classification) and therefore the observed effect can be interpreted as the effect of sanctions alone rather than an artefact arising from different cyclical behaviour of foodstuffs as opposed to mining wares.

Our results are consistent with those of Dreger et al. (2016) who fail to find an effect of the Western sanctions on the exchange rate of the Russian ruble. A natural interpretation of the small estimated effects of Western sanctions in comparison with the Russian countermeasures is that the Western sanctions are less restrictive than the Russian ones. Indeed, there are several reasons supporting this interpretation. First, Western sanctions target more narrowly specified classes of goods, making it easier for Russian importers to find substitutes or for Western exporters to re-classify their exports in a manner similar to the cases documented by Baloun and Scheinost (2002), Hignett (2004), or Fisman and Wei (2004). A second reason why exporters might be able to send sanctioned goods into Russia may be the provisions of EU and US sanctions packages that allow exemptions from sanctions. These exemptions may be claimed for delivery of sanctioned goods that were ordered prior to the imposition of sanctions. Both of these mechanisms make it possible for goods classified at

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8It is lower than the result obtained from gravity model estimated by Crozet and Hinz (2016) who find an effect of 10.7 billion USD for the period between 2014 to mid-2015. We found an effect of 10.5 billion USD from 2014 to the end of 2016.
6-digit HS codes to be imported into Russia and thus we observe only a minuscule effect of sanctions on extraction equipment. In contrast, Russian sanctions, which are imposed at the 4-digit level and do not appear to contain provisions for limited retroactivity cut the trade inflows much more effectively.

6 Robustness checks

Differences-in-differences models rely on the assumption of parallel trends, which implies that the correct counterfactual for the treated group after the intervention is the outcome in the control group. Even though the data in this case do not reject the common trend assumption (see test of pre-trend in Table 1), we nevertheless conduct a robustness check that relaxes this assumption.

To that end, we construct counterfactuals for the treated outcome using information only for the trade flows within each exporter-good pair. This approach is similar to event studies: we estimate an auto-regressive model for the time series of the trade flows prior to the imposition of sanctions and generate predictions from this model for the period after sanctions. Deviations between the observed trade flows and the predicted ones can serve as alternative estimates of the effect of the intervention. The empirical specification is:

\[
Y_{ij,t} = \gamma_{i,0} + \gamma_{j,1} + \gamma_{j,2}Y_{ij,t-1} + \gamma_{j,3}t + \gamma_{j,4}(t \times Y_{ij,t-1}) + \epsilon_{ijt}^{**} 
\]

where \(Y_{ij,t}\) are imports into Russia of goods specified at the 6-digit HS code \(j\) from exporter \(i\) in year \(t\). Apart from exporter-specific fixed effects \((\gamma_{i,0})\), coefficients are allowed to vary by the product HS classification.

We estimate (3) on the sample from 2010 to 2013 and generate one-step ahead predictions and their corresponding standard errors. Despite its parsimony, the model shows an impressive fit both in-sample as well as out-of-sample. The in-sample \(R^2\) for extraction equipment is 0.78 and out-of sample \(R^2\) is 0.69 for the period 2014–2016. For the foodstuffs, the in-sample \(R^2\) is 0.93 and out-of sample \(R^2\) for the sanctioning period is 0.56.\(^9\)

The predicted values are then used to compare the true levels of inflows with the

\(^9\)Reported values are “within” \(R^2\), i.e. they represent fit within each product category.
predicted values. In order to test the predictive performance formally, we compare the distributions of the deviations between the true and predicted values. The equality of these distributions was tested by the Kolmogorov-Smirnov test (KS). To complement the KS test, we also regress the observed values on the predicted ones:

\[
\text{observed values}_{ijt} = \delta_0 + \delta_1 \text{predictions}_{ijt} + \delta_2 \text{sanctions}_{ij} + \delta_3 \text{predictions}_{ijt} \times \text{sanctions}_{ij} + \xi_{ijt}. \tag{4}
\]

After estimating regression (4), we test the null hypothesis that \( \delta_2 = \delta_3 = 0 \). Rejection of this null hypothesis indicates a difference in the predictive power of the model between the sanctioning and control regimes. This test follows the procedure for evaluating forecasts advocated by Mincer and Zarnowitz (1969), and hence we abbreviate it as an MZ test.\(^{10}\)

Table 2 shows that for the extraction equipment, the model is equally successful at predicting inflows into Russia whether there are sanctions in place or not. The only statistically significant difference is detected by the MZ test in 2014 (at 5% level) but the KS test fails to detect a difference. This outcome could be consistent with either a small effect or a potential Type I error. In contrast, sanctions against foodstuffs are reflected in the model’s predictive power, which can be seen on the test results as well as on the more negative means of the prediction errors in the sanctioning group. Both of these results are consistent with the differences-in-differences model indicating that even if the parallel assumption is relaxed, the conclusion remains unchanged.

It is also noteworthy that this AR model broadly agrees with our main specification in terms of the estimate for the lost trade. Western sanctions led to about 0.8 billion USD of lost trade in extraction equipment under this model while lost trade in foodstuffs is estimated at 5.1 billion USD. Even though the point estimates are lower than in the differences-in-differences specification, the conclusion that Russian sanctions were much more costly remains unchanged.

\(^{10}\)We prefer this test over a test of structural break as the latter tests a over-restrictive null hypothesis. Null hypothesis for test of structural break is the same as above \( (\delta_2 = \delta_3 = 0) \) with two additional restrictions: \( \delta_0 = 0 \) and \( \delta_1 = 1 \). Intuitively, test of structural break tests whether forecasts are unbiased for both treatment and control group, while we only test whether the forecasts are “equally good” between the two groups.
Table 2: Comparison of deviations between observed and predicted values of trade flows in sanctioned goods (in millions USD).

| Exporters: | Control         | Sanctioning       | Test (p-values) |
|-----------|-----------------|-------------------|-----------------|
|           | Year  | Mean  | SD   | Mean  | SD   | MZ  | KS  |
| Extraction eq. | 2014  | 0.45  | 11.41| -1.94 | 6.36 | 0.37| 0.02 |
|           | 2015  | -1.12 | 10.82| -2.22 | 8.93 | 0.74| 0.12 |
|           | 2016  | 0.00  | 8.98 | -0.50 | 10.60| 0.69| 0.97 |
| Foodstuffs| 2014  | 0.26  | 27.78| -2.08 | 15.56| < 0.01| < 0.01 |
|           | 2015  | -2.49 | 49.23| -6.10 | 20.68| < 0.01| < 0.01 |
|           | 2016  | -0.43 | 50.52| -0.43 | 6.88 | < 0.01| < 0.01 |

Notes: Table shows means and standard deviations (SD) of the deviations between observed and predicted values of trade flows of sanctioned goods into Russia. The last two columns depict the test of the null hypothesis that predictive performance is the same for control and sanctioning exporters. MZ stands for the procedure of Mincer and Zarnowitz (1969), while KS is a standard Kolmogorov-Smirnov test of the equality of distributions. Rejection of the null hypothesis in both tests would indicate a difference in the predictive power of the model between the sanctioning and control regimes. At the 1% level, we do not reject the difference between sanctioning and control regimes for extraction equipment, while we found strong evidence of differences for the food products.

Finally, we run a differences-in-differences model without the exclusion of countries that joined the sanctions regime other than the US and the EU. In addition, missing values in the dataset have been replaced by zeros. A comparison of results in Table 3 with the main specification reported in Table 1 shows that the differences in estimates are almost negligible. Even though the interaction coefficients in the extraction equipment model do become significant in this expanded dataset, their significance is marginal. Therefore, even though the models are consistent with a decline in the imports of extraction equipment, the decline is modest in comparison with the other fluctuations in the data.
Table 3: Differences-in-differences model of trade inflows into Russia (millions of USD) with added zeros and full sample of exporters.

| Sanctioned goods: Extraction equip. | Foodstuffs |
|-----------------------------------|------------|
|                                   | (1)        | (2)    | (3)  | (4)  |
| Sanctions×1\(t = 2014\)          | -1.058     | —      | -0.411** | —  |
|                                   | (0.643)    |        | (0.125) |    |
| Sanctions×1\(t = 2015\)          | -1.372*    | —      | -0.921***| —  |
|                                   | (0.756)    |        | (0.198) |    |
| Sanctions×1\(t = 2016\)          | -1.788*    | —      | -0.920** | —  |
|                                   | (0.742)    |        | (0.205) |    |
| Sanctions×1\(t \geq 2014\)       | —          | -1.538*| —      | -0.877***|
|                                   | (0.758)    |        | (0.183) |    |
| Good×Exporter FE                   | Yes        | Yes    | Yes    | Yes |
| Time FE                           | Yes        | Yes    | Yes    | Yes |
| Observations                      | 78,155     | 78,155 | 230,405| 230,405|
| Clusters                          | 145        | 145    | 145    | 145 |

Tests for joint significance of Sanctions×year interactions (p-values)

| Test               | p-value | p-value |
|--------------------|---------|---------|
| Test 2011–2013     | 0.53    | 0.1     |
| Test 2015–2016     | 0.19    | <0.01   |
| Test 2014–2016     | 0.13    | <0.01   |

Notes: The results presented here test the robustness to the replacement of missing values by zero and expanding the sample to include sanctioning exporters beyond EU and US. These results lead largely to the same conclusions as the estimates from the baseline models (cf. Table 1). Standard errors clustered at the exporter level are reported in parentheses. Significance codes: * 10%, ** 5%, *** 1%

In the expanded dataset, the coefficients are closer to zero than in the baseline models in Table 1 because here we are including many exporter-good dyads with zero trade inflows into Russia for the entire period 2010 – 2016. Hence the effect of sanctions appears “diluted” but the conclusions remain largely unchanged: just as before, the effect of Western sanctions led to a loss in traded value of about 2 billion USD (SE = 1.1) while Russian sanctions cost about 17.9 billion USD (SE = 3.9). One slight change compared to the baseline results is
that the test for pre-trend in Column (3) narrowly rejects parallel trends, albeit only at the 10% level. Given the fact that the significance is marginal and that our main results survive even if the parallel trend assumption is dropped altogether (see results in Table 2 above), the significance of pre-intervention terms seems to be of little consequence. As the main results presented in Section 5 survive even under a very different modeling methodology and using a very different sample, there is a solid basis for claiming their robustness.

7 Conclusion

This paper contributes to the long stream of economic literature on sanctions by analyzing their impact on trade flows into the target country. Specifically, we examine the Russian sanctions imposed on European and American food imports and the impact of EU and US sanctions on exports of extraction equipment to Russia.

Using a difference-in-difference approach on data covering the imports of sanctioned goods into Russia at the 6-digit HS resolution, our results indicate that the Russian sanctions decreased imports by about 10.5 billion USD, while the EU and US sanctions led to about 1.3 billion USD of lost imports of the sanctioned goods (about 8 times smaller effect). We find no evidence that this result is driven by substitution between different trade channels. For this explanation to hold, non-sanctioning exporters would have to supply more of the sanctioned goods after 2014. Instead, the opposite is the case: exports of the sanctioned goods into Russia declined even from non-sanctioning countries.

The reason for the differential impact of the sanctioning measures might be due to the different ways these sanctions were imposed. While the EU and US sanctions targeted the exports of a very narrow class of goods with close substitutes, the Russian sanctions restricted trade imports in much broader terms. This policy difference may have enabled Russian importers to find close substitutes for the sanctioned products, and therefore the impact on goods that have been sanctioned at the 8-digit HS level is undetectable in data at the 6-digit level. It is also possible that in tandem with this substitution plan, Western exporters may be re-classifying their products, thereby sending the same exports as before under labels that do not fall within the sanctions regime.

In addition, the Western sanctions allow the exporters to honor the contracts made
prior to the imposition of export restrictions. Hence, it may be that no substitution and no re-classification is necessary to explain our results, provided that the Russian importers have made sufficiently long-term contracts for the supply of extraction equipment. Since it is improbable that many contracts for the food imports last more than a year, data on Russian sanctions are unlikely to contain much of these “grandfathered” imports, providing another possible explanation of the increased effectiveness of Russian counter-measures compared to the Western sanctions. Finding out which effect dominates requires a more finely-resolved dataset, which is left for future research.

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SUPPLEMENTARY MATERIAL

A Further data characteristics

The full dataset records trade inflows into the Russian Federation from the following countries and territories: Afghanistan, Albania, Algeria, Andorra, Anguilla, Argentina, Armenia, Australia, Austria, Azerbaijan, Bangladesh, Belarus, Belgium-Luxembourg, Benin, Bolivia, Bosnia Herzegovina, Br. Virgin Islands, Brazil, Brunei, Bulgaria, Burkina Faso, Cameroon, Canada, Chile, China, China Hong Kong SAR, Colombia, Congo, Costa Rica, Croatia, Cuba, Curacao, Cyprus, Czech Rep., Cote d’Ivoire, Dem. Peoples Rep. of Korea, Dem. Rep. of the Congo, Denmark, Dominican Rep., Ecuador, Egypt, El Salvador, Estonia, Ethiopia, FS Micronesia, Falkland Islands Malvinas, Fiji, Finland, France, Georgia, Germany, Ghana, Greece, Greenland, Guatemala, Guinea, Guinea-Bissau, Honduras, Hungary, Iceland, India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Kyrgyzstan, Laos, Latvia, Lebanon, Libya, Lithuania, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Mauritania, Mauritius, Mexico, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Rep. of Korea, Rep. of Moldova, Romania, Rwanda, Saint Helena, San Marino, Saudi Arabia, Senegal, Serbia, Seychelles, Singapore, Slovakia, Slovenia, So. African Customs Union, Spain, Sri Lanka, State of Palestine, Sweden, Switzerland, Syria, Tajikistan, Thailand, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, USA, Uganda, Ukraine, United Arab Emirates, United Kingdom, United Rep. of Tanzania, Uruguay, Uzbekistan, Venezuela, Viet Nam, Yemen, and Zimbabwe.

For our main specification, we code the following countries as “sanctioning exporters:” Austria, Belgium-Luxembourg, Bulgaria, Croatia, Cyprus, Czech Rep., Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, USA, and United Kingdom.

The remaining exporters under the sanctioning regime (excluded in the main specification, but included in Robustness checks): Albania, Australia, Canada, Iceland, Montenegro, Norway, Switzerland, and Ukraine.
The following two tables provide summary statistics for individual product categories disaggregated at 4-digit HS codes. For clarity, these codes are accompanied by brief descriptions of the relevant product category.

Table 1: Summary statistics for annual trade flows into Russia of extraction equipment across different exporters (in thousands of USD)

| HS4  | Description                                      | Mean   | SD   | N  |
|------|--------------------------------------------------|--------|------|----|
| 7304 | Tubes, pipes and hollow profiles, of iron/steel  | 2307   | 11930.8 | 5683 |
| 7305 | Other tubes with diam. >406.4mm (iron/steel)     | 6067.9 | 35253 | 1236 |
| 7306 | Other tubes of iron or steel                     | 1054.4 | 4580.7 | 3585 |
| 8207 | Interchangeable tools for hand tools             | 893.3  | 3792.7 | 6583 |
| 8413 | Pumps for liquids; liquid elevators              | 2228.3 | 10129.2 | 9015 |
| 8430 | Other moving, extracting or boring machinery     | 3378.8 | 17115.7 | 3405 |
| 8431 | Parts for the machinery in 8425 to 8430          | 2461.2 | 9910.9 | 6097 |
| 8705 | Other tubes and pipes                            | 4398.8 | 13937 | 1523 |
| 8905 | Light-vessels, fire-floats, floating cranes etc. | 20841.4 | 126221.3 | 273 |

Table 2: Summary statistics for annual trade flows into Russia of foodstuffs across different exporters (thousands of USD)

| HS4  | Description                                      | Mean   | SD   | N  |
|------|--------------------------------------------------|--------|------|----|
| 0201 | Meat of bovine animals, fresh or chilled          | 8141.2 | 36776.1 | 512 |
| 0202 | Meat of bovine animals, frozen                    | 33433.8 | 125367.6 | 850 |
| 0203 | Meat of swine, fresh, chilled or frozen           | 19160.8 | 63320.1 | 1223 |
| 0207 | Poultry meat and offal, chilled or frozen         | 13910.4 | 64058 | 1165 |
| 0210 | Meat and edible meat offal, salted, or smoked     | 433.9  | 1090.2 | 643 |
| 0301 | Live fish                                        | 266    | 934.5 | 432 |
| 0302 | Fish, fresh or chilled                           | 5802.2 | 42593.8 | 981 |
| 0303 | Fish, frozen, excluding fish fillets              | 3639.2 | 14236.2 | 2972 |
| 0304 | Fish fillets, fresh, chilled or frozen            | 3023.8 | 11357.6 | 1192 |
| 0305 | Fish, dried, smoked, salted or in brine           | 1355.1 | 6311.1 | 766 |
| 0306 | Crustaceans                                      | 2568.1 | 10074.3 | 1089 |
| Code | Description                                         | 0307 | 0401  | 0402  | 0403  | 0404  | 0405  | 0406  | 0701  | 0702  | 0703  | 0704  | 0705  | 0706  | 0707  | 0708  | 0709  | 0710  | 0711  | 0712  | 0713  | 0714  | 0801  | 0802  | 0803  | 0804  | 0805  | 0806  | 0807  | 0808  |
|------|----------------------------------------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0307 | Molluscs                                           | 648.3| 2560.1| 1287  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0401 | Milk and cream, not concentrated                   | 3601.3| 18517 | 547   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0402 | Milk and cream, concentrated                       | 6848.3| 28901.5| 965   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0403 | Buttermilk, curdled milk and cream etc.            | 2684.7| 10284.6| 579   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0404 | Whey                                               | 2023.1| 6988.8 | 531   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0405 | Butter and other fats and oils derived from milk   | 15293.6| 40089.7| 513   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0406 | Cheese and curd                                    | 10533.5| 44747.4| 1965  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0701 | Potatoes, fresh or chilled                         | 3701.5| 12297.5| 762   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0702 | Tomatoes, fresh or chilled                         | 10841.9| 34915.4| 765   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0703 | Onions, shallots, garlic etc.                      | 2160.2| 7122.8 | 1295  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0704 | Cabbages, cauliflowers, etc.                       | 1255.5| 3453.9 | 1024  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0705 | Lettuce and chicory                                | 497.7 | 1752.4 | 726   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0706 | Carrots, turnips, salad beetroot etc.              | 1542.4| 5355.2 | 978   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0707 | Cucumbers and gherkins, fresh or chilled           | 3929.6| 10524.6| 496   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0708 | Leguminous vegetables                              | 41    | 93.6  | 417   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0709 | Other vegetables, fresh or chilled                 | 1584.7| 6581  | 2517  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0710 | Vegetables, frozen                                 | 783.9 | 2659.2| 1631  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0711 | Vegetables, not for immediate consumption          | 341.5 | 1439.8| 315   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0712 | Dried vegetables                                   | 532.7 | 2155.4| 1086  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0713 | Dried leguminous vegetables                        | 257.1 | 893.4 | 1524  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0714 | Roots and tubers with high starch content          | 23    | 75.2  | 193   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0801 | Coconuts, Brazil nuts and cashew nuts              | 1212  | 5465.8| 772   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0802 | Other nuts, fresh or dried                         | 1805.2| 8760.4| 1681  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0803 | Bananas, including plantains, fresh or dried       | 24496.6| 96360.4| 325   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0804 | Dates, figs, pineapples etc.                       | 741.6 | 2932.4| 1999  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0805 | Citrus fruit, fresh or dried                       | 5453.4| 18332 | 2617  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0806 | Grapes, fresh or dried                             | 5014.3| 15483.1| 1211  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0807 | Melons and papaws, fresh                           | 1208.6| 5979.6| 853   |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| 0808 | Apples, pears and quinces, fresh                   | 7622.3| 21080.8| 1602  |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
| Code | Description                                      | Quantity | Value   | Unit |
|------|--------------------------------------------------|----------|---------|------|
| 0809 | Apricots, cherries, peaches etc, fresh          | 2034.3   | 7075.3  | 2514 |
| 0810 | Other fruit, fresh                              | 2266.6   | 7639    | 1999 |
| 0811 | Fruit and nuts, frozen                          | 673.1    | 2048    | 1118 |
| 0813 | Fruit, dried, including mixtures                | 859.3    | 3592.6  | 1967 |
| 1601 | Sausages and similar products                   | 5380     | 16648.6 | 503  |
| 1901 | Malt extract                                    | 2426.6   | 7731.3  | 1859 |
| 2106 | Food preparations not elsewhere specified      | 4996.5   | 15612.3 | 1950 |