You can smuggle but you can't hide: Sanction evasion during the Ukraine crisis

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This paper investigates whether sanctions imposed in the wake of the Ukraine crisis by Western countries and Russia have been evaded by analyzing monthly product-level trade patterns. Consolidating different methods from the literature related to the detection of illicit trade, I find that goods facing sanctions imposed by the Russian government in particular have most likely been evaded. While the detected amounts do not question the general effectiveness of the sanctions, they are non-negligible. Roughly US$482 million, or 8.56% of the total estimated trade loss of $5.633 billion from the Russian sanctions, may have been smuggled either directly or through its neighboring countries. As more than half of the estimated evasion involves trade flows through Belarus and Kazakhstan, the findings highlight the importance of trade policy coordination with third countries, especially if these are part of the same customs union.

Key words: sanctions; embargo; smuggling; evasion; foreign policy
JEL codes: F51, F14, F13

1 Introduction

The past decade in trade policy has seen a return to its politicization. Whether one focuses on the rise of protectionism since the financial crisis of 2008, the active tariff policy introduced by the Trump administration, or China's recent trade restrictions on Australia for pushing for an independent investigation over the Covid-19 outbreak, trade measures have increasingly become an instrument of foreign and industrial policy rather than a multilateral effort to facilitate trade on a level playing field.

This trend often involves – besides targeting of trade with particular countries – forensic interventions aimed at particular sectors, goods, firms, or even individuals. In the case of the United States, for instance, trading partners retaliated to tariffs introduced by the Trump administration by (successfully) targeting goods produced in counties with Republican politicians participating in contested 2018 mid-term elections for Congress (Blanchard et al., 2019).

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Traditionally, such trade policy measures were restricted to political sanctions, which overtly followed foreign policy objectives and included targeted trade measures (Hufbauer et al., 2008). In particular, so-called smart sanctions have targeted individual firms, products, or persons (Cortright and Lopez, 2002). Apart from more focused targeting, modern sanctions go beyond outright trade bans and instead have expanded to include, for example, licensing requirements or tariffs – some on imports, and others on exports.

This rise in active, targeted trade policy obfuscates the already complex international trading system and offers trade actors ample opportunities (and incentives) to evade the new barriers. For instance, when the United States introduced punitive tariffs on China in 2018, U.S. Customs and Border Protection saw a nearly 50% rise in customs rulings related to the misclassification of goods, as firms tried to exploit the fact that early tariff rounds spared products similar to theirs.[2] Similarly, when Russia introduced counter-sanctions on Western agricultural products in the wake of the Ukraine crisis, Russian newspapers reported on Belarusian seafood and tropical fruits appearing in local supermarkets, in clear cases of country-of-origin certificates being mislabeled to evade the import sanctions imposed on products from the European Union (Yeliseyeu, 2017).

The incentives to evade trade barriers are particularly high for political sanctions, as they aim – in the form of goods sanctions – to economically impact the target economy and key decision makers by minimizing trade flows (Eaton and Engers, 1992; Kaempfer and Lowenberg, 1988), as opposed to import tariffs, which are mainly intended to extract rent and to support the implementing jurisdiction's industry. Therefore, a large string of the sanction literature addresses their effectiveness in the context of their (lack of) enforceability (Caruso, 2003; McLean and Whang, 2010; van Bergeijk and Biersteker, 2015). While factors such as missing support from the target's main trading partners (Dizaji and van Bergeijk, 2013; Noland, 2009) or scope of the sanctions (Caruso, 2003; Hufbauer and Oegg, 2003) play prominent roles, these factors are directly linked to the question of whether the imposed barriers are evaded. If large trading partners provide economic assistance (Bonetti, 1998) or enable trade routes such that the sanctioned products arrive in the target country anyway (Early, 2009), sanctions imposed on any goods are unlikely to achieve their desired effect.

While these sanction evasion concepts are theoretically well-established and have been empirically analyzed for comprehensive sanctions typical of the 20th century, this area of research remains largely unexplored in relation to modern targeted sanctions. Instead of sanctions facing goods, recent research on sanction

2 See the U.S. CBP's Customs Ruling Online System (CROSS) and, for example, ruling NY N300833 where beard kits from China had to be reclassified and additional China-specific duties of 10% were incurred.

evasion has focused on the enforceability of person- and firm-related sanctions (Ahn and Ludema, 2020; Haidar, 2017) as well restrictions related to financial flows (Besedeš et al., 2017).

I contribute to this literature by analyzing the prevalence of sanction evasion in the context of modern targeted goods sanctions. More precisely, I identify five different channels of sanction evasion and empirically analyze four of them, thus consolidating the various concepts of smuggling and evasion recorded in the literature.

Based on the example of sanctions implemented by Western economies and Russia in 2014 in relation to the Ukraine crisis, I find potential evidence of direct smuggling of agricultural products banned by Russia. Furthermore, certain neighboring countries – particularly those within the same customs union as Russia – significantly increased their trade with Western sanctioning jurisdictions, indicating potential re-exports or indirect smuggling. However, evidence related to Belarus in particular may be hindered by suppressed data, as indicated by the significant increase in the country's net imports with respect to Russian sanctioned agricultural goods. The analysis does not find any evidence of misclassification of goods. Overall, I estimate sanction evasion of up to $482 million. This represents 8.56% of the estimated decline resulting from the Russian sanctions.

This paper also contributes directly to the literature on the impact of modern sanctions in the context of the Ukraine crisis. For instance, Crozet and Hinz (2020) focus on the direct impact the sanctions had on trade between Western economies and Russia, whereas I look indirectly at whether the impact would have been worse if the sanctions had not been (potentially) evaded.

More broadly, the study offers a contribution to the literature on the effectiveness of modern trade policy. Given how multifaceted trade policy has become in targeting particular product-origin combinations, I provide direct evidence on the degree to which countries are able to enforce the complex network of trade policy instruments. The studied example is particularly interesting, as targeted sanctions also involve the enforcement of trade policy by third countries not directly involved in the trade measures. The findings thus illustrate a further channel through which trade policy may have a political impact on the multilateral stage.

The remainder of the paper is structured as follows. Section 2 summarizes the sanctions introduced in the context of the Ukraine crisis and provides anecdotal evidence on how they may have been evaded. Section 3 details the methodology of the empirical analysis and discusses the various evasion channels, while Section

4 describes the data applied in the analysis. Results are presented in Section 5. Section 6 concludes the paper.

2 Sanctions during the Ukraine crisis

This section first provides an overview of the sanctions introduced during the Ukraine crisis and then contextualizes them in terms of their overall and sector-specific importance. It also illustrates indications of sanction evasion using the anecdotal case of trade in apples involving Belarus.

2.1 History of the sanctions

Following the military invasion of Ukraine by Russia in February 2014, Canada, the European Union, and the United States responded by introducing sanctions against certain Russian and Ukrainian officials[3] on 17 March 2014. The measures included asset freezes, a prohibition for local operators to provide financing, as well as travel bans. In the following weeks, similar sanctions were introduced by Australia, Albania, Iceland, Japan, and Montenegro. In addition, diplomatic measures were imposed: Russia's voting rights in the Council of Europe were suspended, regular bilateral talks with the country were halted, and Russia was no longer invited to G8 meetings.

In the coming months, the Western economies expanded the list of individuals and firms that were covered by sanctions. On 26 June 2014, the European Union additionally introduced an import ban on all goods and an export ban on certain goods and technologies from Crimea and Sevastopol. European businesses were also prohibited from offering any tourism services in the two listed areas.

The largest round of sanctions – which is the primary focus of this paper – was introduced at the end of July as a reaction to the downing of the Malaysia Airlines MH17 airplane on 17 July 2014. On 29 July 2014, the European Union introduced a vast set of "economic sanctions" spanning the areas of finance, energy, defense, and dual-use goods.[4]

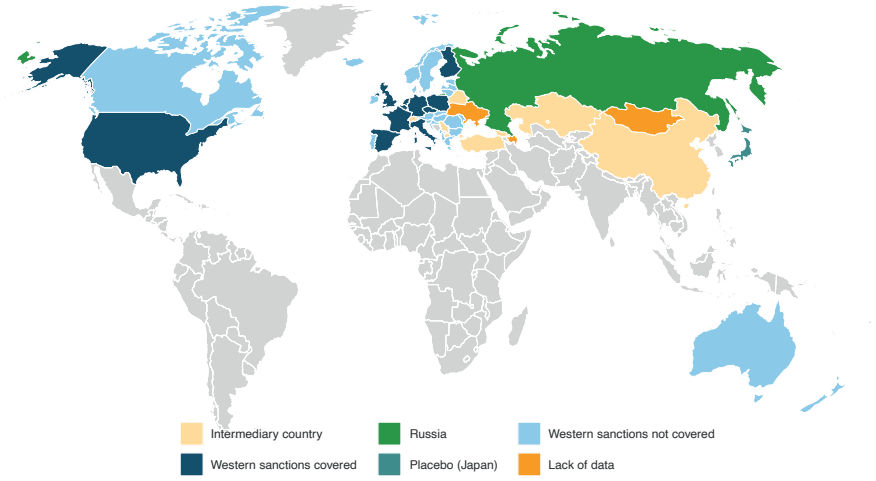
In terms of goods sanctions, this round included an embargo on weapons trade, an export ban for dual-use goods used for military purposes, as well as an export licensing regime for energy-related equipment and technology. A license would

3 These targeted sanctions against individuals and entities were later expanded over time and, in the case of the European Union, for example, involve 177 people and 48 entities as of December 2020.

4 Dual-use goods are products and technology which may be used for both civil and military purposes.

be denied in cases where the goods were exported inter alia for deep-water oil exploration and production. With respect to financial restrictions, access to EU capital markets was limited for Russian state-owned financial institutions to financial instruments lasting a maximum 90 days.[5] The European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD) were no longer allowed to provide lending to Russia. These economic sanctions came into force on 1 August 2014 and need to be renewed every six months. As of December 2020, they remain in force.

Figure 1: Map of countries included in the study



Notes: This figure illustrates the different country groups involved in the sanctions imposed in relation to the Ukraine crisis. Jurisdictions colored blue imposed sanctions on Russia, with the 11 dark blue ones being covered in this study. The identified intermediary countries (see Section 3) are denoted in beige, while Japan serves as a placebo. Azerbaijan, Mongolia, and Ukraine were not included due to a lack of data.

Canada and the United States introduced similar, albeit less extensive, sanctions on the defense, energy and finance industries in July and September 2014, respectively. In August, Ukraine and Japan introduced more individual- and firm-related sanctions, while Norway adopted the same regulations as the European Union's July sanctions. On 28 August 2014, Switzerland passed measures to prevent the circumvention of the EU sanctions (in the form of export licensing regimes) through Swiss territory.[6]

5 This was later restricted to a maximum of 30 days through sanctions imposed on 11 September 2014. The September sanctions also introduced a complete ban on transactions with the five major Russian state-owned banks.

6 Evenett et al. (2017) found that these measures indeed prevented the circumvention of goods sanctioned by the EU. However, the authors also found some indications of potential circumvention in relation to the Russian sanctions.

In summary, Western sanctions on traded goods may be divided largely into three categories: (i) a full trade ban (on weapons); (ii) a partial ban (on dual-use goods if used for military purposes); and (iii) an export licensing regime (for goods used in the oil sector). Out of the dozen countries studied (see Figure 1), only the EU member states imposed all three categories of sanctions. The United States, on the other hand, covered the first and third category. In total, 39 countries[7] imposed sanctions against Russia in relation to the Ukraine crisis. This paper focuses on the twelve largest countries based on 2013 trade statistics: Japan, the United States, and ten EU member states (Belgium, Czechia, Finland, France, Germany, Italy, Netherlands, Poland, Spain, and the United Kingdom). While Japan is used as a placebo (having imposed only non-goods sanctions), the other jurisdictions implemented goods sanctions in August 2014, which is applied as the starting point for the sanction analysis.

Russia retaliated against the Western sanctions by introducing on 7 August 2014 an import ban on a large share of agricultural products from the European Union, the United States, Australia, Canada, and Norway. The list of sanctioned countries was expanded a year later – on 13 August 2015, to be precise – to include Albania, Montenegro, Iceland, and Liechtenstein. The update was also to cover Ukraine starting from 1 January 2016 if it joined the EU Association Agreement (which it did). Furthermore, Russia imposed sanctions on Turkey on 1 December 2015 following the shooting down of a Russian jet by the Turkish military. The sanctions on Turkey, similarly to those on Ukraine, came into force on 1 January 2016. Unlike for other targets of Russian measures, the Turkish sanctions were (partially) lifted on 11 October 2016 and on 2 June 2017.

Apart from the clearly announced sanctions, Russia also banned certain meat types from the European Union, Moldova, and Ukraine on health grounds in September and October 2014 (Blanchard and Wu, 2019). However, these measures were not (officially) politically motivated and are hence not covered in this study as sanctions. Instead, they are accounted for in the policy covariates (see Section 4).

An overview of the HS product codes covered by the sanctions on traded goods is provided in Table A.2. The list excludes sanctions imposed by and on jurisdictions that are not covered in this paper (such as Canada, Norway, or Australia).

7 The full set of countries which imposed sanctions on Russia following the Ukraine crisis include the European Union, Japan, the United States, as well as Albania, Australia, Canada, Georgia, Moldova, Montenegro, New Zealand, Norway, and Ukraine.

2.2 Contextualization of the sanctions

As this study abstracts from the analysis of weapons trade due to its special nature,[8] there are three types of goods sanctions covered in this paper. First, Russia imposed sanctions in the form of a "traditional" import ban on large sections of agricultural produce. Based on 2013 import figures, these concern US$9.43 billion of Russian imports (39.8% of total agricultural imports). According to Table A.2 in Appendix A, the sanctions target primarily imports from Poland, the United States, Germany, Netherlands, and Spain. However, in terms of their relative share of trade with Russia, Poland, Spain, and the Netherlands are most affected.

Meanwhile, the Western sanctions have a more complex structure. While the export licenses were imposed on between 30 and 50 products worth $2.4 billion (see Table A.2), the dual-use goods cover over 6,000 different detailed tariff lines classified at the 10-digit CN level (spanning 756 different 6-digit HS codes, or around 15% of all product codes) worth up to $63.6 billion. Importantly, the information registered in the available trade data does not distinguish between cases where a given dual-use good was exported for civil purposes or whether a good was halted from shipping due to being classified for military purposes. As these data are not publicly available, the analysis of goods facing Western sanctions needs to be interpreted as potentially harmed by the sanctions. Russian sanctions are therefore considered to be more stringent in terms of both their intensity (they cover a complete ban with no exceptions) and their scope (all products within a product category are covered). One may thus expect a larger impact on trade with regard to the Russian than the Western goods sanctions:

Hypothesis 1: Trade declines between Western sanctioning countries and Russia are more pronounced for goods facing Russian than Western sanctions.

Should Hypothesis 1 hold, this implies we would be more likely to observe sanction evasion for goods facing Russian sanctions, assuming that evasion is positively correlated with the amount of trade lost due to the sanction imposition.

In terms of trade covered, roughly a quarter (23.8%) of Russian imports are directly impacted by Western or Russian sanctions, with the majority of this trade relating to dual-use goods. Also, one should take into account that imports from the sanctioning countries represent over half of Russia's total imports (see Table A.1). Most of the other important trading partners are analyzed as intermediary

8 Trade in weapons is often underreported or hidden in official figures and this paper is based on a detailed analysis of trade flows.

countries (see Section 3). As a result, the study includes trade covering around 80% of Russia's imports (in 2013 terms) and all 20 of its most important trading partners with the exception of the Republic of Korea and Ukraine.

With respect to the timing, all goods sanctions were imposed within a week of their announcement, so we are unlikely to observe anticipation effects often seen in the sanctions literature (Kaempfer and Lowenberg, 2007). However, this hypothesis is tested in the empirical analysis:

Hypothesis 2: There are no anticipation effects on the imposed goods sanctions by Russia nor on those by the Western countries.

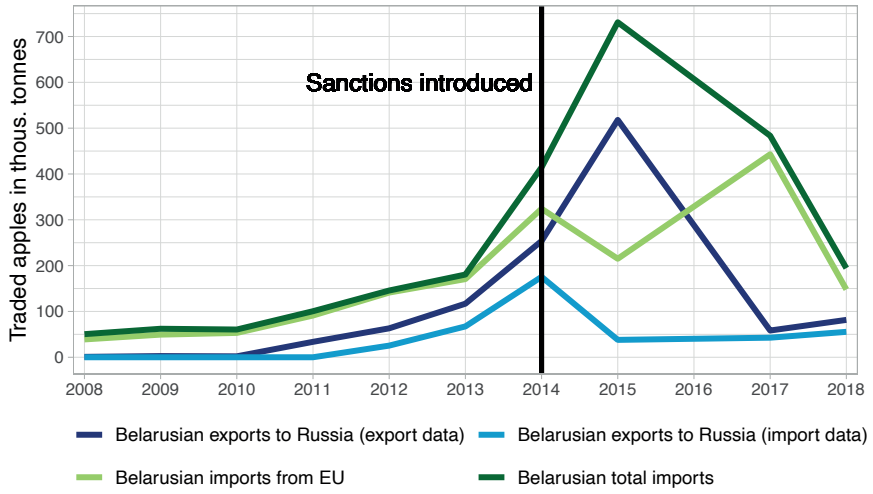
Lastly, one should take into account that trade flows may also have been impacted by sanctions not directly related to goods trade. For instance, Crozet and Hinz (2020) find that over 80% of the trade decline can be attributed to products not directly impacted by the goods sanctions. Their analysis shows also that these declines are positively correlated with those sectors that rely heavily on trade finance. Hence, when estimating the impacts of goods sanctions on trade flows, the paper at hand ought to control for sector-specific effects caused inter alia by the financial sanctions (see Section 3).

2.3 Example of evidence of sanction evasion

When Russia imposed its import ban on agricultural products, Belarus and Kazakhstan, which share a customs union with Russia, refrained from introducing similar measures. Instead, shortly after their imposition by their large neighbor, news articles emerged quoting cases of EU products being smuggled through Belarus into the Russian market (Yeliseyeu, 2017).

While this paper analyzes the case for sanction evasion more systematically, the example of Belarusian apple trade provides an interesting example of how such smuggling can be identified through irregular patterns in trade data. As Figure 2 illustrates, while in 2014 – the year sanctions were introduced – Belarus' apple exports to Russia doubled, according to Russian import data they quickly returned to pre-sanction levels and remained very stable. Meanwhile, Belarusian export data on the same trade flow saw a five-fold increase, with similar surges for Belarus' total imports. A potential explanation for this pattern could be the (illegal) practice of redirecting EU exports through a third country such as Belarus – which is a member of the same customs union as Russia (the Eurasian Economic Union) – allowing for easier illegal re-exporting into Russia.

Figure 2: Trade in apples during the Ukraine crisis



Notes: This figure illustrates annual flows related to the trade in fresh apples (HS code 080810) as reported by Belarus and Russia to UN Comtrade.

Furthermore, Figure 2 indicates that Belarus began sourcing apples from non-EU countries in the years 2014–16, despite nearly all imports previously originating from the European Union.[9] Yeliseyeu (2017) documents how this pattern may be explained by forged certificates of origin, with Belarus officially importing apples from such unlikely countries as Ecuador and Sierra Leone. As these practices repeatedly caught the attention of Russia,[10] Belarus appeared to suppress its export data (and to a lesser degree its import data) after 2015. This led to net imports suddenly reaching 425,000 tonnes in 2017, nearly seven times their pre-sanction amounts.

As this example of sanction evasion shows, indications of such activities can be derived directly from international trade flows. Second, there seem to be numerous methods through which sanctions may be evaded. This paper looks to analyze these points in greater detail and investigate whether sanction evasion

9 Polish export data alone show larger apple exports to its Eastern neighbor in 2015 than the figure indicated by the Belarusian data on total imports from the European Union.

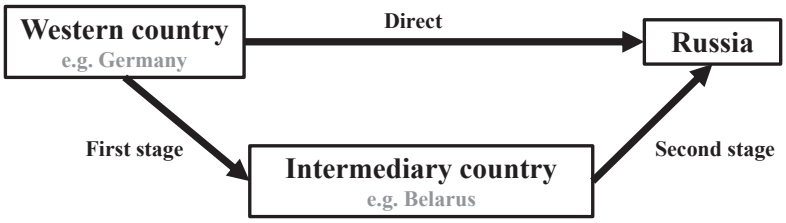
10 Within weeks after the imposition of agricultural sanctions, Russian newspapers reported the appearance of Belarusian oysters and shrimps in Russian supermarkets, which lead Russia to send veterinary officials to Minsk to monitor the situation (Reuters, 2014). In November 2014, Russia also banned imports from 23 Belarusian companies accused of smuggling EU produce (Secrieru, 2015, p. 58). Despite these efforts, anecdotal examples of banned products sold in Russian stores continued in the following years. During a joint press conference of the Russian and Belarusian prime ministers on 29 September 2015, Dmitry Medvedev jokingly referred to hopes of replacing the European goods with "good supplies of citrus fruits, papaya, and some other exotic fruits that are grown well on Belarusian territory" (Russian Government, 2015).

occurred on a broader scale beyond the anecdotal evidence presented above. Thus, a systematic approach to detecting evidence of sanction evasion is presented in the following chapter.

3 Methodology

The sanction evasion analysis is based on trade flows between three country groups: the two parties which imposed sanctions on each other (Russia and the Western countries), as well those countries that have potentially offered a stage to circumvent those sanctions and which are referred to as intermediary countries.

Figure 3: Flow chart of the analyzed trade flows



The Western country group introducing sanctions against Russia has been restricted to the 12 most important trading partners with Russia prior to the imposition of sanctions (see Section 2). This set of a dozen countries includes Japan as a de facto placebo check (as Russia's largest trading partner outside of the three country groups). While Japan did join the remaining G7 member states in imposing (minor) financial sanctions, it refrained from restricting its goods exports to Russia and hence was not targeted by Russia's agricultural counter-sanctions.

Meanwhile, intermediary countries have been chosen either based on a joint border (adjacent countries are well known to trade more which is, for example, manifested by a standard border variable in gravity equations) or based on their role as a trading hub (large ports are often reported as frequent smuggling grounds and have been also investigated in the academic literature; see Fisman and Wei, 2004). The former category includes Belarus, China, Georgia, Kazakhstan, North Macedonia, Serbia, Switzerland, and Turkey.[11] As trading hub countries, the

11 Azerbaijan, Mongolia, and Ukraine were not included due to lack of available monthly data. Also, one should point out that Georgia also imposed sanctions on Russia, but only non-goods-related sanctions. Furthermore, Russia introduced sanctions against Turkey on 1 January 2016.

study includes Hong Kong and Singapore.[12] All country groups are illustrated in Figure 1.

Since the Western economies introduced sanctions on their exports and Russia on its imports, the analysis concerns only trade flowing — directly or indirectly — towards Russia (as indicated by the direction of the arrows in Figure 3).

The following analysis will also refer to trade flows from the Western economies to Russia as "direct flows". Exports from the Western countries to the intermediary countries are referred to as the "first stage", and those from the intermediary countries to Russia as the "second stage".

3.1 Channels of sanction evasion

As described in the examples in Sections 1 and 2, there are numerous channels through which sanctions may be evaded. This paper differentiates between five such channels for potential sanction evasion (see Table 1), which are investigated using direct, first stage, and second stage trade flows. As import and export data for the same trade flow differ according to the reporting jurisdiction, differences between the two variables are also exploited to investigate some channels.

Each sanction evasion channel is analyzed in an event study-type setting, exploiting the variation across products in terms of which trade flows were (directly) impacted by the sanctions. The treatment variables (sanctionsc) thus take on unity whenever a given product was targeted and the sanctions are in force. In general, the difference-in-difference regression equation looks as follows:

$$Trade_{ijpst} = \sum_{c} \beta_c sanctions^{c}_{ijpst} + \gamma X_{ijpst} + \phi_{ijst} + \kappa_p + \epsilon_{ijpst} \quad (1)$$
$$\text{for } c = \text{ Russia, West}$$

where the subscript *i* denotes the exporter, *j* denotes the importer, *p* denotes product (classified in one of 5,206 6-digit HS code products), *s* denotes the sector (classified into 21 HS sections),[13] and *t* denotes time.

12 United Arab Emirates was also considered but no monthly trade data were available.

13 The sectors are relatively broadly defined, as some Russian sanctions covered (nearly) entire 2-digit HS code groups (07 – Vegetables; and largely 08 – Fruits and Nuts). However, robustness checks are conducted with more detailed sector classification.

Table 1: Channels of sanction evasion

Stage	**Direct**		**1st stage**		**2nd stage**	
Type	**Import data**	**Export data**	**Import data**	**Export data**	**Import data**	**Export data**
Data reporter	Russia	Western	Interm.	Western	Russia	Interm.
Direct smuggling	$\downarrow/\rightarrow^{*}$	$\rightarrow/\downarrow^{*}$	$\rightarrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$
Visible reexports	$\downarrow$	$\downarrow$	$\uparrow$	$\uparrow$	$\uparrow$	$\uparrow$
Indirect smuggling	$\downarrow$	$\downarrow$	$(\uparrow)$	$\uparrow/\rightarrow^{\diamond}$	$\rightarrow/\uparrow^{\diamond}$	$(\uparrow)$
Misclassification	$\downarrow^{\dagger}$	$\downarrow^{\dagger}$	$\rightarrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$
Black market	$\downarrow$	$\downarrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$

Notes: This table indicates expected changes (or there lack of) in trade flows of sanctioned products in relation to potential channels of sanction evasion. The $\rightarrow$ represents no expected changes, $\uparrow$ a trade increase, and $\downarrow$ a trade decline. The combinations containing an asterisk * should see a decline in the export data for goods facing export sanctions (i.e. by Western countries) and no change for other products; and vice versa for goods facing import sanctions (i.e. by Russia) in the case of import data. Similarly, flows marked with an $\diamond$ should face an increase in trade for Western sanctioned goods in the second stage but no change in the first stage; and vice versa for goods facing Russian sanctions. The † sign relates to an expected increase in trade for similar products (based on neighboring HS codes). Lastly, brackets () are used in cases where the intermediary country may suppress trade statistics or, as in the case of the black market channel, shipments cross borders unreported in any trade figures.

The dependent variable is based on monthly product-level trade flows between a given country pair *ij*. Some regressions use other variables such as import-to-export-data ratios or net imports as the dependent variable (see the sanction evasion channels below), but they refer to the same *ijpst* dimensions.

Most specifications contain two treatment coefficients with one *sanctions* variable each for Western and Russian sanctions. In some cases, however, the Western sanctions are split into two categories (partial ban and export licensing), as they varied according to the instrument applied on different products.[14]

The coefficient ϕ_{ijst} captures sector- and time-specific fixed effects for each country pair in the given regression. This set of fixed effects is meant to capture any sector-specific trends in trade flows between a pair of countries – in particular, in relation to the effect the financial sanctions imposed on Russia might have had

14 Note that in trade flows concerning the United States, the Western sanctions cover only the oil sector, as the United States, unlike the European Union, did not sanction exports of dual-use goods.

on trade across sectors. It also implies that the treatment variables explain the variation in trade flows between sanctioned and non-sanctioned products within a given sector. In addition, product- specific fixed effects are captured by the coefficient $\varkappa_p$.

Meanwhile, the set of controls X_{ijpst} is focused on other policy instruments that may have affected specific products in the studied time frame. Based on information concerning tariffs, sanitary and phytosanitary measures (SPS), technical barriers (TBT) as well as other non-tariff barriers, two policy covariates are included to capture other unilateral trade policies:[15]

- *Protectionist trade barrier* takes on unity if the given trade flow is facing protectionist at-the-border interventions introduced by the exporting country (e.g., export quotas) or the importing jurisdiction (e.g., a TBT). These interventions may, for example, include tariff increases, new licensing requirements, or import bans.

- *Liberalizing trade intervention* takes on unity if the given trade flow benefits from an at-the-border trade liberalization (e.g., a tariff reduction or the reversal of a previously implemented non-tariff barrier).

While Equation 1 focuses on the identification of the effect sanctions may have on trade flows in general, the event study setup allows the analysis of the strength of any potential effect over time. For that reason, a second regression equation is used where the sanction variables (dummy variables for sanctioned products) are interacted with time dummies:[16]

$$Trade_{ijpst} = \sum_{c} \beta_c sanctions^{c}_{ijpst} \xi_t + \gamma X_{ijpst} + \phi_{ijst} + \epsilon_{ijpst} \qquad (2)$$
$$\text{for } c = \text{ Russia, West}$$

The estimated coefficients from the interaction terms are then plotted as a time series to infer the effects of the sanctions over time. One would expect the coefficient to be indistinguishable from zero prior to the implementation of the sanctions (in August 2014) and potentially statistically significant after the treatment.

The regressions are estimated linearly at first. However, as most of the observations contain zero trade values and trade figures are known to be not normally

15 The covariates abstract from free trade agreements as none of the country pairs introduced new bilateral agreements in the given time frame.

16 The first period, January 2012, is used as a reference point.

distributed, all regressions are also run using a standard-practice pseudo-Poisson maximum likelihood estimation. This method has been proven to correct for both of the above-mentioned issues (Santos Silva and Tenreyro, 2006) and is used as the baseline specification. Given the large amount of fixed effects, the regressions are conducted using the ppmlhdfe package in Stata by Correia et al. (2020).

The estimation is also repeated for particular country pairs and sectors in order to investigate in detail for which countries or industries the given sanction evasion channel might have played a role.

Direct smuggling

The first investigated channel relates directly to trade flows between the sanctioning countries, i.e., the Western economies and Russia. These flows are, by the very nature of trade statistics, reported by both the exporting and importing nation. While one would expect both figures to be identical, it is well-documented in the trade literature that export and import data often differ (Markhonko, 2014). These differences, also referred to as "bilateral asymmetry", arise from varying accounting methods, where only importers include the related freight and insurance costs of shipments. Other known reasons relate to unclear sources of an import or the time delay between the point of departure and arrival of a good (Berger and Nitsch, 2012).

While the above-mentioned arguments may explain general discrepancies between export and import data, Bhagwati found as early as 1964 that the level of discrepancy varies starkly across products and may often be associated with illicit trade. This variation in discrepancy is caused by flows being under- or overreported to evade import tariffs or other forms of trade controls. While there is generally a bilateral asymmetry in trade data, this asymmetry tends to increase when goods are smuggled across borders. Rozanski and Yeats (1994) , Fisman and Wei (2004), and Berger and Nitsch (2012) provide more recent evidence that this phenomenon persists in modern trade data.[17] Should such underreporting be present in the case at hand, export data from the Western economies would see declines with respect to goods sanctioned by the West but there would be a less pronounced decline in trade related to goods sanctioned by Russia. On the other hand, Russian import data would show the opposite effect, with the sanctioned agricultural goods collapsing, and the dual-use goods and oil-sector-related products continuing to be imported.

17 A further method for detecting smuggling in trade, proposed by Demir and Javorcik (2020), involves identifying deviations in the reported trade amounts from Benford's law. As such an analysis would require transaction-level data (which are not available), this paper focuses on identifying smuggling based on bilateral asymmetry.

This hypothesis of no trade decline for the sanctioned goods in the target country's statistics rests on the notion that none of the firms concerned would enforce the ban and all would engage in the act of direct smuggling. As this notion is rather unlikely, the paper at hand shall instead use as the dependent variable in Equation 1 the logarithm of the ratio of import to export data for a given trade flow (henceforth, *tradegap*). This follows the method of Fisman and Wei (2004), with the difference being that here a unity is added to each value[18] for trade data provided by the exporter and the importer:

$$\begin{aligned} tradegap_{ijpst} &= log(1 + trade_{ijpst}^{importer}) - log(1 + trade_{ijpst}^{exporter}) \\ tradegap_{ijpst} &= \sum_{c} \beta_c sanctions_{ijpst}^{c} + \gamma X_{ijpst} + \phi_{ijst} + \kappa_p + \epsilon_{ijpst} \\ &\qquad \text{for } c = \text{ Russia, West} \end{aligned} \tag{3}$$

As long as there are no accounting reasons for bilateral asymmetry to significantly increase for sanctioned goods compared to non-sanctioned products, changes to the *tradegap* could be attributed to an increase in smuggling behavior, given the mechanism described above. In this setting, one would expect the Western sanction coefficient to be positive and the Russian sanction coefficient to be negative when regressing on the *tradegap* in Equation 3:[19]

Hypothesis 3: For goods sanctioned by Russia, importer-based trade figures decline relatively stronger than exporter-based data, and vice versa for goods sanctioned by Western economies.

Furthermore, should direct smuggling be the main channel of sanction evasion, one would not expect a significant increase in trade flowing through the intermediary countries. Hence, one would expect no change in trading patterns between the Western and intermediary economies, or between the intermediary economies and Russia.

Visible re-exports

The second channel of potential sanction evasion focuses on trade flow patterns related to intermediary countries (see Figure 3) – sanctioned products are exported to one of the intermediary countries and then re-exported to Russia. In order to

18 The reason for this deviation from Fisman and Wei (2004) is that, consistent with the implementation of any trade bans, one may expect no trade at all for some products but would still in those cases be very interested in absolute and relative changes between the export and import data.

19 Due to the large amount of fixed effects, the regressions are conducted using the reg2hdfe package in Stata by Guimaraes and Portugal (2010).

evade the Russian sanctions, the products would have to be relabeled with respect to their country of origin. In the case of the Western sanctions, they would have to be exported out of the Western economy destined for an intermediary country and then rerouted to Russia. While such re-exports are illegal under the sanctioning countries' legislation, evaded trade flows may have occurred undetected.[20]

The study of this channel largely follows the methodology of Evenett et al. (2017) and it would see increases in trade flows at both stages, that is, one would expect visible re-exports only if a sanction coefficient is positive in regressions based on Equation 1 for the first and the second stages:

Hypothesis 4: Following the sanction imposition, trade in sanctioned goods increases in the first and second stages relative to non-sanctioned goods.

A similar method has been also applied by Rotunno et al. (2013), who find that Chinese apparel exports were shipped through African countries after the United States imposed quotas on certain Chinese textiles. The authors' definition of a "quota-hopping export platform" may thus be compared with the intermediary countries in this paper. However, they find visible re-exports mostly for American imports facing no rules of origin when shipped from Africa; the observed trans-shipments were therefore legal – unlike potential visible re-exports in the current study.

Indirect smuggling

The third mechanism combines the previously described direct smuggling and visible re-exports channels, as it relates to goods being smuggled indirectly through an intermediary country. In the case of Russian sanctioned products, the goods would be smuggled into Russia, whereas for Western sanctioned products they would be smuggled out of the Western country. Hence, regressions for both the first and second stage are needed, as indicated in Figure 3. For products sanctioned by Russia, the Western economies would (visibly) export more Russian sanctioned goods to intermediary countries relative to non-sanctioned goods as relates to the first stage. In the second stage, the *tradegap* between import and export data would change in the same direction as analyzed in the direct channel for direct smuggling (see Equation 3). Meanwhile, for goods sanctioned by the

20 In the case of Switzerland, for instance, a 2017 report for the Swiss parliament (Parlamentarische Verwaltungskontrolle, 2017) found no evidence of non-compliance in aggregate statistics. However, sanctions-related measures were insufficiently enforced. For example, only very few on-site inspections of sanctions compliance were carried out, and all of them were announced to the firm in advance. Furthermore, Swiss Customs reported that export restrictions – such as those enforced here by the Western economies – are particularly difficult to monitor due to time constraints and insufficient information about downstream activities.

Western countries, one would anticipate an increase in the *tradegap* in the first stage and a trade increase in the second stage:

Hypothesis 5: Goods facing Russian sanctions are exported to intermediary countries and then smuggled into Russia; Western sanctioned goods are smuggled into the intermediary countries and, in a second stage, shipped to Russia.

Using the example of Figure 2 described in Section 2, there are indications of indirect smuggling in the apple trade example for the years 2015 and 2016 in particular, when Belarusian exports to Russia significantly increased compared to pre-sanction levels according to Belarusian but not Russian data. This discrepancy would lead to a strong decrease in the *tradegap* for apples in the regressions related to the second stage trade flows.

Any findings related to the channel of indirect smuggling (as well as visible re-exports) rest on the smuggling entities registering their trade flows in the intermediary country. For example, should indirect smuggling of Russian sanctioned goods have occurred, the trade gap in the second stage flows will only be visible if the exports from the intermediary country were reported (and imports into Russia not reported). At the same time, even if the exports from the intermediary country were registered, the country might have decided to suppress these figures for political motives such as not wanting to anger the sanctioning jurisdictions, which may be crucial trading partners (see the example of Russia's reaction to Belarusian anecdotal evidence in Section 2). My analysis does not distinguish between the two mechanisms, but indications of indirect smuggling - even without export numbers rising – may be found in the data.

In Figure 2, this hypothesis would arise particularly for the year 2017, when Belarus officially imported nearly half a million tonnes of apples while exporting less than a sixth of that amount. This led to net imports being seven times higher than the figures registered before any sanctions were imposed. Whether this was a widespread phenomenon is analyzed by regressing on net imports of the intermediary countries. Should the hypothesis be supported, one would expect positive coefficients for the sanction variables in these regressions:

Hypothesis 6: Intermediary countries suppressed data on trade with the sanctioning economy for sanctioned goods.

For these regressions, the function differs slightly, as the subscript i refers to the intermediary country:

$$Netimports_{ipst} = \sum_{c} \beta_c sanctions^{c}_{ipst} \xi_t + \gamma X_{ipst} + \phi_{ist} + \kappa_p + \epsilon_{ipst} \quad \text{for } c = \text{ Russia, West} \tag{4}$$

Lastly, one may argue that the increase in net imports can instead be explained by supply chain processing – firms in intermediary countries imported the sanctioned products, processed them, and exported them (also legally to Russia). Since the Russian sanctions were far more focused on raw materials and intermediate products, this mechanism can be tested for the sanctioned agricultural goods in particular:[21]

Hypothesis 7: Intermediary countries increased imports of sanctioned products in order to process them and (legally) re-export the processed goods.

To test this hypothesis, all goods are classified into intermediary and final goods using the Broad Economic Classifaction (BEC). Should the increase of net imports be related to supply chain processing, that effect would be more pronounced for intermediary goods. This hypothesis can therefore be tested by interacting the sanction coefficient in Equation 4 with an intermediate goods dummy. Evidence for supply chain processing would require a positive coefficient of the interaction term.

Misclassification

A further channel often explored in the context of illicit trade is the misclassification of products to avoid trade barriers. As indicated in the example related to the US-Chinese trade war in Section 1, misclassifications increased for products facing higher tariffs. Similar findings were recorded by Fisman and Wei (2004), with imports of resembling products increasing following the imposition of higher Chinese tariffs.

The current paper follows the methodology of these authors and assumes goods classified in the same four-digit HS category to be similar. Hence, misclassifications are analyzed by looking at the trade patterns of products which

21 An alternative analysis would involve investigating the exports of intermediary countries for downstream products processed from the sanctioned products. However, as available input-output tables are relatively coarse, it is not possible to distinguish downstream products made from sanctioned versus non-sanctioned products.

were not sanctioned but were located in the same four-digit HS code as at least one sanctioned good:

Hypothesis 8: Trade in products adjacent to the sanctioned ones increases.

In this case, the analysis is restricted to Western sanctions as nearly all Russian sanctions were relatively broad (covering each time a 4-digit HS code group). Applying the same methodology for similar products on the 2-digit HS code level to accommodate for the Russian sanction structure would be overly coarse.

Black market

Unlike the previous channels, the notion behind the fifth channel is that any sanction evasion is undetectable, as the sanctioned goods are shipped via the black market instead. Unlike the case of direct smuggling, they do not appear in exports from the Western economies. Furthermore, should goods be smuggled undetected through the black market, this would reduce the total potential amount of sanction evasion estimated in this analysis. The identified amounts may thus be seen as likely lower bounds on the aggregate extent of sanction evasion.

3.2 Methodology-related issues

Trade diversion

Two of the five sanction evasion channels – indirect smuggling and visible re-exports – explicitly involve trade with intermediary countries. However, the observed trade patterns may not necessarily be related to illegal activities but instead to trade diversion (e.g., Haidar, 2017). Rather than trade being routed through intermediary countries, market forces may lead to Western suppliers diverting their goods from the barred Russian market to the markets of the intermediary countries (Bown and Crowley, 2007). At the same time, firms from intermediary countries may exploit the new Russian market conditions and increase their exports to Russia, where they no longer face competition from Western firms (for the sanctioned goods).

Unlike the studied sanction evasion channels, this would fully comply with the legal frameworks of all affected countries. However, the following discussion provides evidence that potential trade diversion may be of limited concern.

First of all, while trade diversion does not weaken the direct enforceability of sanctions, it weakens their effectiveness. The more firms are able to divert their sales, the less of an economic impact the sanctions will have on the target economy. Therefore, should any of the sanction evasion channels through intermediary countries be substantiated, this would provide at the very least evidence of a reduced effectiveness of the sanctions – even if not necessarily due to sanction evasion. In addition, shifting economic ties away from the sanctioning jurisdictions (to intermediary countries) weakens the ability of the sanctioning country to introduce sanctions in the future, as the target economy reduces its dependence on the sanctioning market.

Furthermore, entering a new market is associated with Melitz (2003)-like fixed costs, resulting in exporters entering markets only gradually (Ruhl and Willis, 2017). It is thus questionable whether such vast amounts of goods can be shifted to a new market in such a short space of time (Askari et al., 2009). If the observed trade shifts are indeed linked to trade diversion, one would expect them to occur gradually over the space of several years, as investigated in estimations based on Equation 2.

The current paper also takes into account that the sanctions may have increased trade with intermediary countries (and thereby led to trade diversion) in the context of global supply chains, as described in the section on indirect smuggling. For instance, it would be within the legal bounds of the sanctions for a Belarusian company to import milk from the European Union, produce dairy products from that milk, and export them to Russia, even though shipping both product categories from the European Union into Russia was banned under the agricultural counter-sanctions. Such supply chain adjustments are, however, likely to occur only over time, not immediately after the imposition of sanctions. The role of the sanction evasion and trade diversion mechanisms could also be investigated in regressions on particular subsamples of countries or sectors. For sanction evasion to hold, the effects need to align for the first and second stages for particular countries and sectors, when only those subsets are regressed. Should there be a lack of alignment, this would point to trade diversion.

Lastly, the intermediary markets are usually much smaller than the Russian market (with the notable exceptions of China and Turkey). Trade related to the first stage would face demand size constraints, whereas trade diversion related to the second stage would be limited by relatively small supplies in the intermediary countries. Hence, if, for instance, trade diversion linked to the second stage did take place, one would expect it to be concentrated in those goods for which the

intermediary country possessed a comparative advantage and exported in large amounts beforehand.[22]

Identification

A key concern related to the identification strategy is that the sanctioned products were not chosen at random but instead have been strategically selected by the implementing jurisdictions. This could become particularly concerning should trade in sanctioned products follow a different trend, and thus conflict with the parallel trends assumption needed for the difference-in-difference setting.

One method of investigating whether this concern is substantiated relies on checking the pre-treatment trends (e.g., Freyaldenhoven et al., 2019). Should there be no significant differences in trade flows for sanctioned and non-sanctioned products prior to their implementation in August 2014, this would provide evidence that the parallel trends assumption indeed holds. For this purpose, the coefficients on the treatment and time dummies interaction prior to treatment are checked based on Equation 2.

Furthermore, one should point out that roughly at the same time as the imposition of the goods sanctions, the Russian economy faced a recession following a rapid fall in the price of oil (see Figure B.1) (Dreger et al., 2016). Hence, a rich fixed effects setting has been chosen which should capture sector-specific time trends. For endogeneity to be a concern, for example, the oil price collapse would have to impact sanctioned products (e.g., pork) and non-sanctioned products (e.g., lamb) within the same sector differently.

4 Data

The main data were obtained from the ITC Trade Map, as it contains the most comprehensive compilation of monthly trade statistics. These data are supplemented with trade figures for Belarus, Hong Kong, and North Macedonia from the UN Comtrade monthly trade database. Neither of the two data sources provides sufficient data for Azerbaijan, Mongolia, and Ukraine (as indicated in Figure 1). Furthermore, data for Hong Kong for October 2013 and for the Netherlands for December 2016 are missing. Otherwise, the obtained dataset consists of a balanced panel for direct, first stage, and second stage trade flows

22 Therefore, should large-scale sanction evasion through intermediary countries be identified, the sanction effect could be interacted in the second-stage regressions with the country's pre-sanction export strength of a given product. For the potential evasion discovered to be linked to trade diversion, the estimation should show a positive coefficient for the interaction term.

covering a total of 142 country pairs (see Figure 3) for 60 continuous months from January 2012 until December 2016. The timeframe is capped at the period 2012 until 2016, as Russian monthly trade statistics are available only starting from 2012 and several jurisdictions report only scarcely from 2017 onwards.

Coincidentally, the selected period matches the five-year cycle of the HS product classification system, allowing one to forgo the reclassification of HS codes for consistency. Furthermore, data from the ITC Trade Map are aggregated to the 6-digit HS code level, despite more granular data being available. This is done because lower-level HS structures are not coordinated between countries, which would impede in particular the comparison of importer and exporter data (see Equation 3). Residual product codes such as 999999 covering 4.1% of total trade have been excluded as they cannot be assigned to any standard HS code and usually relate to confidential transactions.[23]

In the context of indirect smuggling (Equation 4), annual trade data from UN Comtrade were used, as this required total import and export data for each intermediary country.

The monthly trade statistics are unavailable for Belarus, Hong Kong, and North Macedonia. Therefore, this part of the analysis is conducted using annual data instead. The sanction variables receive a value of 1 where appropriate for the years 2015 and 2016, and a value of 5/12 for 2014, since the sanctions came into force in August.

With regards to the main monthly trade dataset, the summary statistics show that mean trade flows are between $110,000 and $150,000. Furthermore, trade figures provided by exporters are on average smaller in first stage flows (in line with usual trade data), but this is reversed for exports to Russia, as indicated by the average negative trade gap for direct and second stage flows.

Information on the relevant sanctions was obtained from the legal documents of the implementing jurisdictions. As indicated in Table 2, 14–15% of observations have been affected by Western sanctions, with the vast majority of these (13–14% of total observations) focused on dual-use goods and only roughly 1% on goods in the oil industry. Products facing Russian countersanctions account for around 7% of the trade flows.

23 Russian imports in these confidential trade categories increased significantly in the months of May to July 2014, especially from the United States. However, the numbers quickly declined thereafter and there is no statistically significant change to confidential trade following the imposition of goods sanctions.

Table 2: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Direct flows					
$trade^{importer}$	139,006	1,702,253	0	541,484,000	3,725,280
$trade^{exporter}$	149,029	1,904,472	0	502,990,941	3,725,280
$tradegap$	-0.365	4.043	-19.859	18.722	3,725,280
sanctions Russia	0.074	0.261	0	1	3,725,280
sanctions West	0.136	0.343	0	1	3,725,280
protectionist policy	0.08	0.271	0	1	3,725,280
liberalising policy	0.01	0.098	0	1	3,725,280
First stage flows					
$trade^{importer}$	130,270	6,027,175	0	11,210,574,000	36,644,424
$trade^{exporter}$	114,104	4,805,734	0	7,430,435,483	36,654,620
$tradegap$	0.029	3.149	-22.425	22.514	36,593,444
sanctions Russia	0.065	0.246	0	1	36,705,600
sanctions West	0.138	0.345	0	1	36,705,600
protectionist policy	0.016	0.127	0	1	36,705,600
liberalising policy	0.01	0.098	0	1	36,705,600
Second stage flows					
$trade^{importer}$	110,749	2,228,885	0	1,022,441,000	3,058,800
$trade^{exporter}$	113,872	1,798,663	0	398,394,000	3,053,702
$tradegap$	-0.058	2.787	-19.296	20.042	3,053,702
sanctions Russia	0.065	0.246	0	1	3,058,800
sanctions West	0.151	0.358	0	1	3,058,800
protectionist policy	0.069	0.253	0	1	3,058,800
liberalising policy	0.005	0.072	0	1	3,058,800

Meanwhile, the policy covariates were largely constructed based on information from the Global Trade Alert (GTA), which summarizes economic policy interventions taken unilaterally by governments since November 2008 that affect foreign commercial interests (Evenett, 2019). The database contains detailed information on the affected products at the 6-digit HS code level, the affected jurisdictions, the type of intervention, as well as the inception and removal dates of each policy intervention. The protectionist and liberalizing trade barrier covariates are constructed as dummy variables that take on unity when at least one at-the-border trade policy was in force for a given product-country pair-month combination. These at-the-border policies include import tariffs, licensing regimes, contingent trade-protective measures, and quotas.

The GTA information is supplemented by SPS and TBT notifications obtained from the WTO notification databases. As the affected HS codes are not reported for roughly half of the notifications, relevant policy measures are identified

using corresponding ICS codes and word associations from the notification descriptions. Table 2 indicates that between 1.6% and 8% of the observations face a protectionist trade barrier depending on whether one looks at direct, first stage, or second stage trade flows. However, it is noticeable that exports to Russia face on average more protectionist policies. Liberalizing policies affect only 0.5–1% of the observations.

5 Results

This section first assesses how much trade has been lost due to the sanctions, before turning to the posited hypotheses with respect to the various sanction evasion channels in the second subsection. For those channels where evasion is detected, it will be quantified and benchmarked against the aggregate amount of (lost) trade.

5.1 Impact of the sanctions

Prior to analyzing the channels of sanction evasion, the effectiveness of the sanctions ought to be assessed first. If there were no trade reduction caused by the measures, no efforts would be necessary to study their evasion.

The first analysis is based on the difference-in-difference setting specified in Equation 1. As indicated in Table 3, the Russian sanctions have significantly reduced imports from the Western economies. The effect is stable to different choices of covariates, although it is less pronounced when using export data instead of import data (columns 5–7 and 2–4, respectively).[24] Figure 4 shows that this trade reduction caused by the Russian sanctions remains persistent over the two and half years following their imposition.

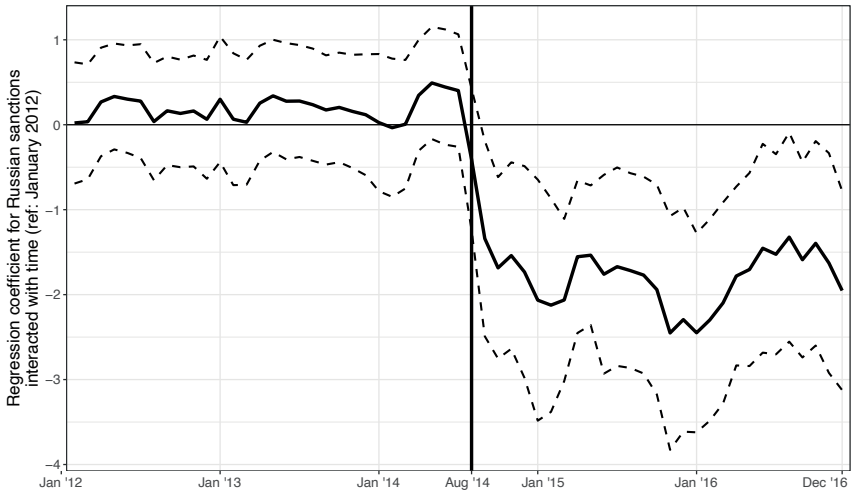
24 As a robustness check, the regressions were also run with a more conservative definition of sectors at the 2-digit HS code level. The results are very similar, with only the Russian sanction coefficient being ca. a third lower. This is expected, as most Russian sanctions target entire 2-digit HS codes (see Table A.1).

Table 3: Regression results for direct trade flows

	(1) Import data	(2) Import data	(3) Import data	(4) Import data	(5) Export data	(6) Export data	(7) Export data
Regression	linear	PPML	PPML	PPML	PPML	PPML	PPML
sanctions Russia	-0.430***	-1.852***	-1.852***	-1.852***	-1.513***	-1.513***	-1.513***
	(0.071)	(0.113)	(0.113)	(0.113)	(0.096)	(0.096)	(0.096)
sanctions West	-0.049***	0.086***	0.071***		0.112***	0.136***	
	(0.013)	(0.023)	(0.025)		(0.035)	(0.040)	
sanctions West dual-use				0.073***			0.132***
				(0.026)			(0.040)
sanctions West oil technology				0.073			0.033
				(0.064)			(0.100)
misclass. West			-0.040			0.065**	
			(0.028)			(0.027)	
misclass. West dual-use				-0.018			0.058**
				(0.030)			(0.027)
misclass. West oil technology				-0.100*			0.045
				(0.057)			(0.058)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.526	0.734	0.734	0.734	0.735	0.735	0.735
N	1,020,551	3,132,029	3,132,029	3,132,029	3,274,785	3,274,785	3,274,785

Notes: The regressions are based on Equation 1. Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. For the PPML regressions a Pseudo R^2 is displayed. The dependent variable in the linear regression is logarithmised, i.e., it only includes positive trade flows.

Figure 4: Russian sanction coefficient in direct trade flows over time



Notes: This figure illustrates the effect of Russian sanctions on direct trade flows over time. The coefficient is based on Equation 2 and the standard errors are clustered at the sector-country pair-time level. The dotted lines represent the 95% confidence interval for each month's estimated coefficient. January 2012 serves as the reference time point.

According to the figure, there was also no statistically significant effect of the sanctions prior to their announcement, which may address the selection issues raised in Section 3.

There is a slight positive increase in the months prior to August 2014 (relative to the referenced January 2012); however, the rise is not statistically significant based on the 95% confidence interval. This result supports Hypothesis 2 that there are no anticipation effects of the sanctions, as they were implemented rapidly.

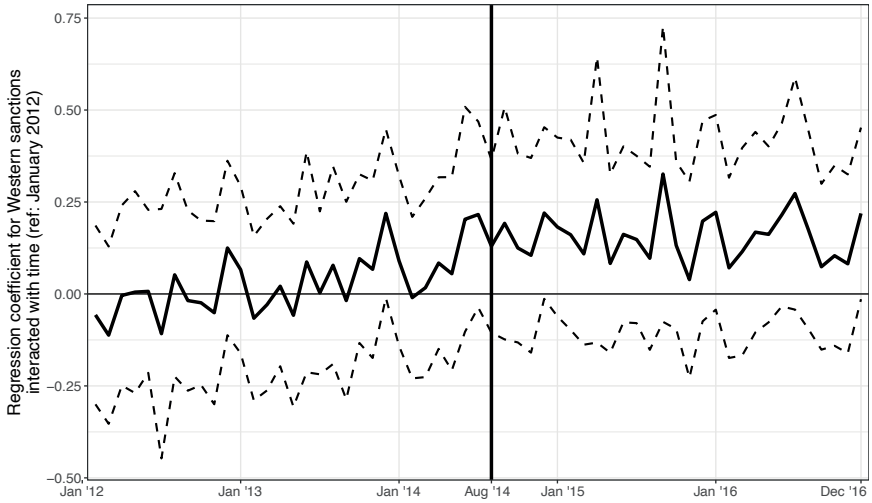
The negative impact of the Russian sanctions also holds separately for all eleven studied Western economies facing sanctions (see Table B.5 in Appendix B). The strongest declines occurred for Belgium, Poland, and Spain. Meanwhile, the placebo regressions conducted for Japan and depicted in Table B.3 show no significant changes to trade patterns for goods sanctioned by Russia compared to other goods within those sectors.[25] In terms of sectors, the animal and vegetable industries were more severely impacted in relative terms than food processing (see Table B.6).

25 The export data-based regressions show a small positive coefficient; however, it is statistically significant only at the 10% level.

Hypothesis 1 is also supported by the empirical results, as the negative impact is significantly greater for Russian sanctions than for Western sanctions. In fact, the effect of the Western measures is even positive, though significantly smaller in absolute terms than the counterpart's negative effect. Based on columns 4 and 7 in Table 3, this positive effect is driven by the sanctions on dual-use goods. Given that the list of dual-use items was constructed in 2005 (with only minor annual amendments since), it is hard to argue that the positive coefficient may be explained by endogeneity concerns. Rather, these results point to a potentially ineffective use of the Western sanctions. Another explanation could be that, as explained in Section 2, the dual-use measures affected only parts of the studied 6-digit HS codes and were banned solely for military purposes. The available trade data thus do not allow for a conclusive statement on the impact of the Western sanctions related to dual-use goods.

A similar conclusion can be drawn based on the Western sanction coefficient for individual month-year combinations. As shown in Figure 5, there is a rise in the coefficient around the time the sanctions were introduced – notably already prior to their imposition. However, all of the time-specific coefficients are indistinguishable from zero based at the 95% confidence interval.

Figure 5: Western sanction coefficient in direct trade flows over time



Notes: This figure illustrates the effect of Western sanctions on direct trade flows over time. The coefficient is based on Equation 2 and the standard errors are clustered at the sector-country pair-time level. The dotted lines represent the 95% confidence interval for each month's estimated coefficient. January 2012 serves as the reference time point.

In terms of country variation, the significant increase was observable for seven of the eleven countries[26] (see Table B.5). Furthermore, the increase is concentrated in the construction, textile, and machinery industries (Table B.6), as only six of the thirteen sectors concerned saw significant increases. Two sectors (chemicals and wood) even recorded significant negative impacts from the Western sanctions.

Overall, these results suggest that Russian sanctions were more effective (in terms of trade flows aggregated to 6-digit HS codes) and I am more likely to observe evasion for sanctioned agricultural products. The following evasion analysis therefore puts a strong emphasis on the Russian as opposed to the Western sanctions. Also, the size of any detected evasion is benchmarked against the estimated direct loss from the goods sanctions. Keeping everything else constant, the goods sanctions alone reduced imports of agricultural produce into Russia from the (studied) eleven sanctioned countries by $5.633 billion between August 2014 and December 2016, according to the regression specification 3 in Table 3. This is equivalent to 59.73% of the total agricultural imports in 2013 affected by the sanctions.[27] While this loss over nearly two and half years may appear surprisingly low given that roughly half of all agricultural imports were banned, one should take into consideration that these goods also faced numerous other sanctions such as new restrictions on trade finance. Furthermore, the finding is in line with Crozet and Hinz (2020), who show that the majority of the goods trade decline was caused by non-goods sanctions.

5.2 Testing the sanction evasion channels

Direct smuggling

Evidence of direct smuggling is detected by comparing exporter- and importer-reported trade flows of the sanctioned products. In line with Hypothesis 3, the estimated decline for goods facing Russian sanctions is more pronounced in data reported by Russia than in the equivalent export data from the Western sanctioned economies (see Table 3). This difference is further explored in *tradegap* regressions based on Equation 3. As the estimated coefficients for Russian sanctioned goods in Table 4 are statistically significant at any of the usual levels, the estimation further strengthens the claim that direct smuggling occurred for products sanctioned by Russia following the imposition of the sanctions. The

26 Interestingly, there is an even stronger increase in sanctioned dual-use products from Japan (see Table B.3) than for any of the countries that imposed sanctions on dual-use goods.

27 According to export data-based estimates in specification 6 in Table 3, the decline was lower at $4.227 billion, or to 44.82% of the 2013 agricultural imports affected by the sanctions. This difference is discussed in the context of direct smuggling in the following subsection.

obtained coefficient remains stable when the regression is repeated only for those observations that saw positive trade of at least $50,000 in both the export and import data.[28]

Table 4: Regression results for direct smuggling

	(1) *Tradegap*	(2) *Tradegap*	(3) *Tradegap*	(4) *Tradegap*
sanctions Russia	-0.165***	-0.161***	-0.161***	-0.157***
	(0.039)	(0.039)	(0.039)	(0.039)
sanctions West	0.009	0.030		-0.010
	(0.018)	(0.019)		(0.011)
sanctions West dual-use			0.010	
			(0.019)	
sanctions West oil technology			0.503***	
			(0.073)	
Sample	Full	Full	Full	Int. margin
Covariates	No	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes
R^2	0.154	0.155	0.155	0.271
N	3,414,840	3,414,840	3,414,840	336,144

Notes: The regressions are based on Equation 3. Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

Based on the relevant coefficient from the third specification in the table, a back-of-the-envelope calculation is conducted to estimate the approximate value of goods that may have been directly smuggled into Russia.[29] If the sanctions had not been imposed, the *tradegap* between the import and export data of the sanctioned products would have been around 16 percentage points higher.[30] In other words, the sanctions led to import data being underreported for the sanctioned products. The counterfactual amount of trade using import data without the effect of the sanctions is around $187 million higher, providing a rough estimate of the amount smuggled directly in trade between the eleven Western economies and

28 The threshold of $50,000 to define the extensive margin is based on the widely used definition from Evenett and Venables (2002).

29 This estimation is based on the assumption that no factors other than smuggling will have impacted the bilateral asymmetry of import and export data for the sanctioned products relative to other products in the given sector.

30 Before the sanctions were imposed, the average observation for a good sanctioned by Russia was $105,670 according to import data and $93,020 based on export data. After August 2014, the *tradegap* turned negative as the average flow was $8,053 and $9,192, respectively.

Russia. This is equal to 3.31% of the total estimated decline in direct trade flows of sanctioned agricultural goods.

Interestingly, specification 3 in Table 4 provides evidence of direct smuggling of oil-sector products facing Western sanctions as well. In line with Hypothesis 3, the coefficient for Western sanctioned products is positive. The *tradegap* increased by around 50% for those goods, despite no trade decline being estimated in the direct channel (see regressions 4 and 7 in Table 3). No such effects were detected for dual-use goods.

Repeating the *tradegap* regression for Japan as a placebo test (see specification 5 in Table B.3), the bilateral asymmetry between the import and export data did not significantly change for the Western sanctioned goods relative to non-sanctioned goods. While there is a small increase in the Russian sanctions coefficient, the estimate is statistically significant only at the 10% level. These findings largely support the notion that no direct smuggling occurred for Japan, as it did not impose goods sanctions and it did not face Russian countermeasures.

Visible re-exports

Following Evenett et al. (2017) and Rotunno et al. (2013), a further method of investigating sanction evasion involves analyzing trade flows through intermediary countries (see Figure 3). Should re-exports of sanctioned goods have taken place, there would be a significant increase in trade in sanctioned goods relative to non-sanctioned goods at both stages of evasion.

As indicated in Tables 5 and 6, there is no evidence that such visible re-exports occurred for goods sanctioned by Russia in the context of all the studied intermediary countries combined. Neither is there evidence of re-exports for any individual sector (see Tables B.9 and B.12). However, three intermediary countries did significantly import more products sanctioned by Russia from the Western economies (see Table B.8): Belarus, Kazakhstan, and Georgia.[31] All three of these countries border Russia and the former two are part of the Eurasian Economic Union — a customs union led by Russia — making transportation without strict border controls more likely.

31 Note that a significant effect for each of three economies is detected only when regressions are based on import (and not export) data. Also, the regression relating to Turkey indicates a slight increase for Russian sanctioned goods as well; however, that effect is significant only at the 10% level.

Table 5: Regression results for first stage trade flows

	(1) Import data	(2) Import data	(3) Import data	(4) Export data	(5) Export data
Regression	linear	PPML	PPML	PPML	PPML
sanctions Russia	0.060**	0.046	0.046	-0.161	-0.161
	(0.024)	(0.111)	(0.111)	(0.117)	(0.117)
sanctions West	-0.096***	-0.351***		0.216***	
	(0.008)	(0.026)		(0.053)	
sanctions West dual-use			-0.342***		0.232***
			(0.027)		(0.055)
sanctions West oil technology			-0.338***		-0.116**
			(0.042)		(0.050)
Covariates	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes
R^2	0.484	0.809	0.809	0.788	0.788
N	6,822,405	32,850,185	32,850,185	31,731,981	31,731,981

Notes: The regressions are based on Equation 1. Standard errors clustered at the sector- country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. For the PPML regressions a Pseudo R^2 is displayed.

While a significant increase in trade of sanctioned goods in the first stage is a necessary condition for visible re-exports, this evasion channel requires a similar increase in the second stage as well. However, such a surge is documented only for one of the three jurisdictions, namely, Kazakhstan. The regressions therefore provide only very limited evidence for Hypothesis 4.

In a counterfactual exercise without the effect of the sanctions for Kazakh trade, exports of the sanctioned agricultural products from the eleven studied Western countries to the Central Asian economy would have been $163.4 million lower. In the second stage, Kazakh exports to Russia for those goods would have been $92.4 million lower. Taking the lower of the two figures as an approximation of the detected visible re-exports, this amount represents 1.64% of the estimated decline in Russian sanctioned goods.[32] Meanwhile, the Western sanctions coefficients indicate statistically significant changes for Western sanctioned goods compared

32 As suggested in Section 3, the visible re-exports could have occurred due to trade diversion rather than re-exports per se. Therefore, a sector-level regression for Kazakhstan is conducted for both stages. The estimates are particularly large and significant for HS section I and are aligned for both stages, providing support for the re-export hypothesis.

to non-sanctioned goods in both stages. In the first stage, all flows of Western sanctioned goods seem to fall except for dual-use goods when using export data. The second stage sees increases across the board – with the exception of goods related to the oil industry when using (Russian) import data. Similarly to the regressions on the impact of sanctions (see the previous subsection), the results related to Western sanctions are unexpected. They not only reject Hypothesis 4 but provide statistically significant results in the opposite direction to expected. In order to test what drives these results in further detail, more fine-grained trade data on the Western sanctioned products would be required.

Table 6: Regression results for second stage trade flows

	(1) Import data	(2) Import data	(3) Import data	(4) Export data	(5) Export data
Regression	linear	PPML	PPML	PPML	PPML
sanctions Russia	0.166**	0.107	0.107	0.141	0.141
	(0.065)	(0.110)	(0.110)	(0.111)	(0.111)
sanctions West	0.077***	0.138**		0.182***	
	(0.020)	(0.060)		(0.039)	
sanctions West dual-use			0.141**		0.166***
			(0.061)		(0.040)
sanctions West oil technology			0.041		0.537***
			(0.071)		(0.139)
Covariates	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes
R^2	0.520	0.794	0.794	0.801	0.801
N	519,551	2,681,985	2,681,985	2,639,659	2,639,659

Notes: The regressions are based on Equation 1. Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. For the PPML regressions a Pseudo R^2 is displayed.

Lastly, the regressions in Table B.11 show a significant surge in Russian sanctioned goods in the second stage from Serbia. However, this strong effect is observed only for the second stage, as the coefficient in the first stage (see column 7 in Table B.8) is both small and statistically insignificant. This result may point towards trade diversion rather than sanction evasion regarding agricultural goods originating from Serbia.

Indirect smuggling

In the context of visible re-exports, Belarus and Georgia saw increases in Russian sanctioned products in the first stage, but there were no significant surges in trade flows related to the second stage. As suggested by Hypothesis 5 on indirect smuggling, sanction evasion could have also occurred by routing Russian sanctioned goods to intermediary countries and then smuggling them indirectly from these neighboring or trade hub countries. If this channel were present, one would expect a decrease in the tradegap for the Russian sanction coefficient in the second stage regressions, since the smuggled products would appear only in the export data and not in the import data between the intermediary countries and Russia.

As indicated in Table B.11 in Appendix B, the Russian sanction coefficient is significantly negative only for Georgia (and is positive for Belarus). Across all countries, the coefficient is positive at the 5% significance level and turns negative when the sample is reduced to flows on the intensive margin (see columns 1–4 in Table B.11). There is thus limited evidence of indirect smuggling occuring in relation to the Russian sanctions. For Georgia, the estimated smuggled amount is equal to $38.95 million for the years 2014–2016. While this amount may seem negligible, it corresponds to 57% of Georgia's 2013 imports of the (Russian) sanctioned products from the eleven Western economies and 3.36% of Georgia's total 2013 imports from those countries.

Looking at potential indirect smuggling of Western sanctioned goods, we see an increase in the tradegap in the first stage only for oil-technology goods and a slight decrease in the coefficient for dual-use goods (Table B.7). However, for indirect smuggling of the Western sanctioned oil goods to have occurred as described in Hypothesis 5, there would have to be a significant increase in trade in the second stage flows. As the results show a surge only using export data and not import data, I conclude that there is insufficient evidence to support the case for large-scale indirect smuggling of goods related to the Western sanctions. There is also no indication for such sanction evasion using country-specific regressions (see Tables B.8 and B.11).

Given the limited evidence for indirect smuggling, one may have to take into account the possibility of data suppression or unreported trade, as suggested by Hypothesis 6 in Section 3. Therefore, potential effects of sanctions on net imports are analyzed as described in Equation 4. On aggregate, there is no significant effect of the sanctions on the net imports of the intermediary countries.[33] However,

33 Also, Figure 2 indicates that data suppression became a problem only in 2017. Hence, the regressions were also run for specific years, and no significant effects were found.

when the regressions are repeated on a country level (see the upper part of Table B.13), a strong and statistically significant (Russian) sanction coefficient stands out for Belarus. In fact, based on the estimated coefficient, counterfactual net imports of goods sanctioned by Russia ceteris paribus would have been less than half as large. This corresponds to roughly US$771 million, or 32% of Belarus' net import value in 2013 (for the sanctioned products). Notably, this figure relates to total net imports and not only the eleven studied Western economies. Since the first stage regressions (see Table B.8) represent a trade increase in sanctioned goods worth $163.7 million (42.75% of 2013 trade in the sanctioned products), this amount provides a more comparable estimate of indirect smuggling through Belarus.

As described in Section 3, the effect of net imports is also analyzed in an interaction term with an intermediate goods dummy (see Hypothesis 7). If the rise in net imports were due to supply chain adjustments rather than indirect smuggling, we would expect the interaction term of the sanction coefficient and the intermediate good dummy to be positive. However, the coefficient in the context of Belarus is not statistically significant (see the lower part of Table B.13).

Lastly, in the context of Figure 2, it was discussed that some amount of sanction evasion may have occurred by forging the certificates of origin to disguise the products' EU origin before being shipped to Russia (Yeliseyeu, 2017). This was investigated using annual world product-level import and export data for the years 2012 to 2016. Indications of forgery were identified through unlikely origin-product combinations of intermediary countries' imports, defined as combinations that were not recorded in a given year in the imports of any other destinations (i.e., not intermediary countries) as well as not in the exports of those origin countries. Several hundred such combinations were found but there was no significant uptick in anomalies after August 2014. Sanctioned products were also no more likely to experience such unusual flows when the statistics were checked for individual intermediary countries. I hence conclude that there is no evidence of large-scale forging of certificates of origin in the context of the evasion of sanctioned goods.

Misclassification

The last investigated channel for sanction evasion relates to one of the most frequently used statistics to detect the evasion of trade policies. Actors may try to avoid a given policy by misspecifying their product as a similar good that does face the trade barrier. Given that Russian sanctions were defined relatively coarsely, the current analysis is restricted to the goods facing Western sanctions. For those products, I find a statistically significant increase only in relation to

dual-use goods, which on average did not face a decline in the first place (see specifications 4 and 7 in Table 3). I therefore reject Hypothesis 8.

Overall, I find only limited amounts of sanction evasion in relation to the Ukraine crisis, given that the total amount of lost trade between 2014 and 2016 due to the Russian sanctions is estimated at $5.633 billion. For Western sanctioned dual-use goods, I even estimate a trade increase for direct flows between the Western economies and Russia. However, the evasion that was detected is observed across numerous channels. Apart from evidence of around $187 million of trade being directly smuggled, there are indications of sanction evasion through intermediary countries. Interestingly, the countries concerned all border Russia and two of them share a customs union with Russia. Sanctioned products worth $92 million may have been visibly re-exported through Kazakhstan, while $39 million worth of agricultural produce may have been indirectly smuggled through Georgia. Lastly, a surge in Belarusian net imports of sanctioned products may indicate indirect smuggling of products worth $164 million. The combined total of $482 million represents 8.56% of the total estimated decline in direct trade flows resulting from the Russian sanctions on agriculture. While these estimates should be treated as back-of-the-envelope calculations, they amount to a non-negligible share of total trade – especially considering the exclusion of undocumented trade between Western economies and Russia (see the black market channel in Table 1).

Furthermore, one should note that the above analysis was conducted to investigate large-scale sanction evasion across numerous channels for two dozen countries. The results abstract from firm- or product-specific cases of evasion evidence as presented anecdotally in Figure 2. Further analysis of individual cases of sanction evasion would require transaction-level data ideally from all countries concerned. This, however, would require a level of cooperation between the jurisdictions that imposed sanctions on each other.

6 Conclusion

In this paper, I investigate whether sanctions imposed in the wake of the Ukraine crisis by Western countries and Russia have been evaded by analyzing monthly product-level trade patterns. Consolidating different methods from the literature related to the detection of illicit trade, I find that goods sanctions imposed by the Russian government in particular have most likely been evaded. While the detected amounts do not call into doubt the general effectiveness of the sanctions, they are non-negligible. Roughly $482 million, or 8.56% of the total estimated trade loss of $5.633 billion from the Russian sanctions, may have been smuggled either directly or through Russia's neighboring countries.

In terms of policy implications, as more than half of the estimated evasion involves trade flows through Belarus and Kazakhstan, the findings highlight the importance of trade policy coordination with third countries, especially if these are part of the same customs union.

This analysis shows numerous indications of how sanctions may be smuggled. In order to provide further robustness to these results, more fine-grained data would be necessary (particularly to estimate the impact of the Western sanctions). Such resources would allow an investigation of other indications of illicit trade as well, such as deviations from Benford's law (Demir and Javorcik 2020).

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Appendix A: Sanctions introduced in relation to the Ukraine crisis

Table A.1: Russia's main trading partners based on 2013 import data

Exporter	Trade Value (in m USD)	Country category	Share	Cumul. share	Rus. sanct.	West. sanct.
World	314,945	-	100.00%	-	9,431	65,982
China	53,173	Intermediary	16.88%	16.88%	980	18,752
Germany	37,905	Sanctions	12.04%	28.92%	814	9,529
USA	16,718	Sanctions	5.31%	34.23%	846	501
Ukraine	15,791	Sanctions	5.01%	39.24%	-	-
Italy	14,554	Sanctions	4.62%	43.86%	299	4,098
Belarus	13,959	Intermediary	4.43%	48.29%	2,501	3,536
Japan	13,560	Non-goods san.	4.31%	52.60%	7	2,686
France	13,021	Sanctions	4.13%	56.73%	445	2,893
South Korea	10,305	-	3.27%	60.01%	-	-
Poland	8,321	Sanctions	2.64%	62.65%	1,145	2,014
UK	8,106	Sanctions	2.57%	65.22%	66	1,624
Turkey	7,273	Intermediary	2.31%	67.53%	1,527	1,081
Netherlands	5,837	Sanctions	1.85%	69.38%	797	1,051
Kazakhstan	5,665	Intermediary	1.80%	71.18%	31	1,033
Finland	5,396	Sanctions	1.71%	72.90%	367	1,693
Czechia	5,318	Sanctions	1.69%	74.59%	19	1,738
Spain	4,915	Sanctions	1.56%	76.15%	796	647

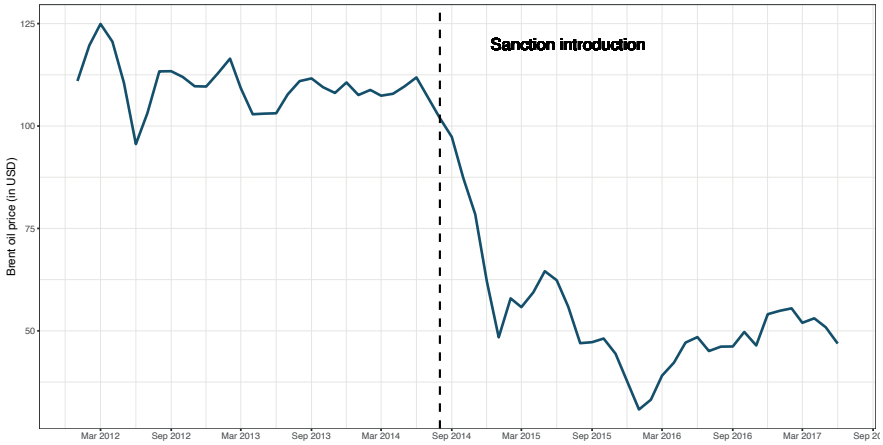
Notes: The amounts in the last two columns relate to trade affected by Russian/ Western sanctions in millions of 2013 US dollars; whereas the totals in the first row of the last two columns relate to the direct trade flows (see Figure 3). The aggregate trade statistics are based on annual data, whereas the last two columns on monthly figures.

Table A.2: List of HS codes hit by sanctions during the Ukraine crisis

Implementer	**EU**			**USA**	**Russia**	
Type	**Export licensing**	**Dual-use goods ban**	**Arms embargo**	**Export licensing**	**Import ban**	**Import ban**
Target	Russia	Russia	Russia	Russia	i.a. EU, USA	Turkey
Products	73041100	Too long;	93	7304110000	0201	020714
	73041910	6197 tariff		7304191020	0202	020727
	73041930	lines		7304191050	0203	060312
	73041990			7304191080	0207	070200
	73042200			7304195020	0210	070310
	73042300			7304195050	0301	070410
	73042910			7304195080	0302	070700
	73042930			7304220000	0303	080510
	73042990			7304233000	0304	080520
	73051100			7304236000	0305	080610
	73051200			7304241000	0306	080810
	73051900			7304246000	0307	080830
	73052000			7304291055	0308	080910
	730611			7304293155	0401	080930
	730619			7304295000	0402	080940
	73062100			7304296100	0403	081010
	73062900			7305111000	0404	250100
	82071300			7305115000	0405	
	82071910			7305121000	0406	
	841350			7305125000	0701	
	841360			7305191000	07020000	
	84138200			7305195000	0703	
	84139200			7305203000	0704	
	84304900			7305207000	0705	
	87052000			7306110000	0706	
	89052000			7306191000	070700	
	89059010			7306195000	0708	
	84313900			7311000000	0709	
	84314300			7613000000	0710	
	843149			8207130000	0711	
				8207191030	0712	
				8207192030	0713	
				8207195030	0714	
				8413500010	0801	
				8413600050	0802	
				8413820000	0803	
				8413920000	0804	
				8421398020	0805	
				8421398030	0806	
				8421398040	0807	
				8430494000	0808	
				8430498010	0809	
				8430498020	0810	
				8431390050	0811	
				8431434000	0813	
				8431438010	160100	
				8431438090	1901901100	
				8479899850	1901909100	
				8705200000	2106909200	
				8708998175	2106909804	
				8905200000	2106909805	
				8905901000	2106909809	

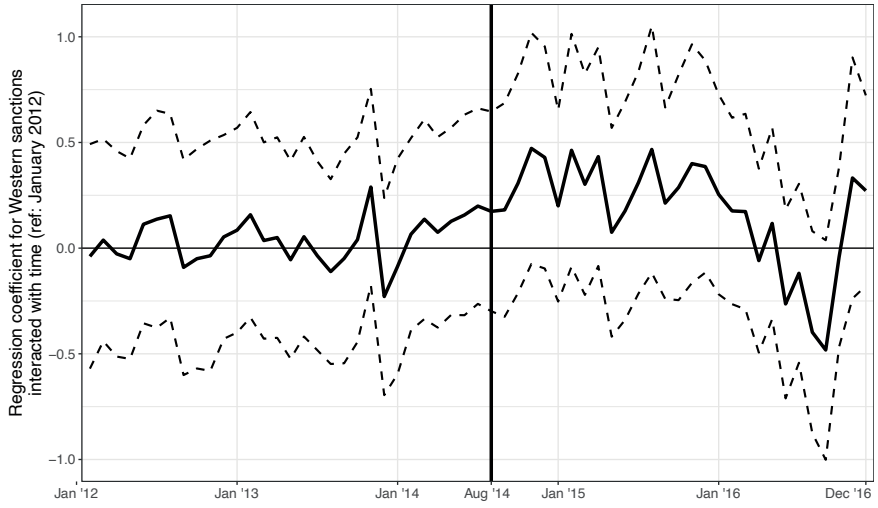
Appendix B: Additional charts and tables

Figure B.1: The Brent oil price during the Ukraine crisis.



Source: IMF Primary Commodity Data.

Figure B.2: Western sanction coefficient in 2nd stage trade flows over time.



Notes: This figure illustrates the effect of Western sanctions on 2nd stage trade flows over time. The coefficient is based on Equation 2 and the standard errors are clustered at the sector-country pair-time level. The dotted lines represent the 95-percent confidence interval for each month's estimated coefficient.

Table B.3: Placebo regression results for direct trade flows (Japan)

	(1) Import data	(2) Import data	(3) Export data	(4) Export data	(5) Data gap
Regresion	PPML	PPML	PPML	PPML	Linear
sanctions Russia	-0.026	-0.026	0.360*	0.360*	0.060*
	(0.199)	(0.199)	(0.215)	(0.215)	(0.032)
sanctions West	0.287***		0.350***		-0.038
	(0.049)		(0.062)		(0.039)
sanctions West dual-use		0.284***		0.349***	
		(0.048)		(0.063)	
sanctions West oil technology		-0.013		0.102	
		(0.157)		(0.113)	
Covariates	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes
R^2	0.943	0.943	0.952	0.952	0.386
N	167,907	167,907	138,979	138,979	310,440

Notes: The regressions are based on Equation 1 (specifications 1-4) and Equation 3 (specification 5) Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. For the PPML regressions a Pseudo R^2 is displayed.

Table B.4: Regression results for direct trade flows using 2-digit HS codes as sectors

	(1) Import data	(2) Import data	(3) Import data	(4) Export data	(5) Export data	(6) Export data
Regression	PPML	PPML	PPML	PPML	PPML	PPML
sanctions Russia	-1.169***	-1.169***	-1.169***	-1.110***	-1.110***	-1.110***
	(0.090)	(0.090)	(0.090)	(0.089)	(0.089)	(0.089)
sanctions West	0.070***	0.049**		0.075***	0.097***	
	(0.022)	(0.024)		(0.021)	(0.023)	
sanctions West dual-use			0.053**			0.094***
			(0.025)			(0.021)
sanctions West oil technology			0.050			0.006
			(0.065)			(0.099)
misclass. West		-0.050*			0.049**	
		(0.027)			(0.021)	
misclass. West dual-use			-0.022			0.053**
			(0.028)			(0.020)
misclass. West oil technology			-0.143**			-0.022
			(0.058)			(0.058)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.766	0.766	0.766	0.773	0.773	0.773
N	2,937,381	2,937,381	2,937,381	3,129,430	3,129,430	3,129,430

Notes: The regressions are based on Equations 1 wth sectors specified as 2-digit HS codes instead of the usual HS sections. Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. For the PPML regressions a Pseudo R^2 is displayed.

Data source: UN Comtrade Database.

Table B.5 Regression for direct channel by country

	(1) Belgium	(2) Czechia	(3) Finland	(4) France	(5) Germany	(6) Italy	(7) Netherlands	(8) Poland	(9) Spain	(10) UK	(11) USA
Import data regressions											
sanctions	-3.278***	-1.269***	-1.073***	-1.288***	-0.964***	-2.535***	-2.022***	-3.130***	-4.034***	-0.417**	-1.351***
Russia	(0.328)	(0.174)	(0.194)	(0.170)	(0.103)	(0.295)	(0.198)	(0.356)	(0.554)	(0.184)	(0.221)
sanctions	-0.007	0.246***	0.006	-0.069	0.144***	0.152***	0.074	0.127***	0.391***	0.142**	0.176*
West	(0.127)	(0.049)	(0.070)	(0.054)	(0.035)	(0.050)	(0.107)	(0.030)	(0.090)	(0.065)	(0.100)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.853	0.885	0.867	0.879	0.907	0.862	0.851	0.891	0.840	0.891	0.862
N	159,398	157,638	141,536	212,880	248,160	229,020	180,178	193,140	188,220	192,540	218,340
Export data regressions											
sanctions	-2.722***	-1.789***	-1.287***	-1.129***	-0.728***	-1.875***	-0.842***	-2.363***	-4.956***	-0.957***	-1.358***
Russia	(0.248)	(0.223)	(0.288)	(0.189)	(0.099)	(0.185)	(0.170)	(0.278)	(0.494)	(0.177)	(0.258)
sanctions	0.067	0.213***	-0.019	0.216***	0.032	0.225***	-0.120**	0.161**	0.256***	0.620***	0.034
West	(0.042)	(0.056)	(0.044)	(0.078)	(0.037)	(0.041)	(0.049)	(0.066)	(0.063)	(0.151)	(0.124)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.890	0.889	0.880	0.855	0.920	0.867	0.869	0.872	0.828	0.885	0.813
N	210,780	195,780	233,820	215,340	268,800	235,440	230,880	250,740	212,280	207,180	206,589

Notes: Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

Table B.6 Regression for direct channel by section

HS section	(1) I Animals	(2) II Vegetables	(3) IV Foodstuffs	(4) V Minerals	(5) VI Chemicals	(6) VII Plastic	(7) X Wood	(8) XI Textiles
sanctions Russia	-3.284***	-3.766***	-0.250***					
	(0.298)	(0.247)	(0.087)					
sanctions West				-0.142	-0.168***	0.097***	-0.261*	0.064
				(0.119)	(0.052)	(0.030)	(0.156)	(0.104)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.768	0.586	0.619	0.817	0.803	0.659	0.676	0.625
N	169,448	186,480	141,840	87,840	513,360	151,200	99,360	541,440

HS section	(9) XII Footwear	(10) XIII Construction	(11) XIV Stones	(12) XV Metals	(13) XVI Machinery	(14) XVII Vehicles	(15) XVIII Instruments	(16) XX Misc.
sanctions West	-0.075	0.209***	-0.363	0.018	0.125***	0.336**	0.167***	0.482***
	(0.216)	(0.064)	(0.225)	(0.063)	(0.032)	(0.170)	(0.048)	(0.126)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.877	0.579	0.739	0.642	0.586	0.794	0.772	0.732
N	33,182	101,520	27,778	385,200	548,640	79,200	149,760	84,960

Notes: Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

Table B.7: Regression results for indirect smuggling (first stage)

	(1) *Tradegap*	(2) *Tradegap*	(3) *Tradegap*	(4) *Tradegap*
sanctions Russia	0.035***	0.036***	0.036***	0.028
	(0.012)	(0.012)	(0.012)	(0.020)
sanctions West	-0.043***	-0.025***		-0.032***
	(0.005)	(0.005)		(0.004)
sanctions West dual-use			-0.030***	
			(0.005)	
sanctions West oil technology			0.088***	
			(0.019)	
Sample	Full	Full	Full	Int. margin
Covariates	No	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes
R^2	0.061	0.061	0.061	0.145
N	34,039,746	34,039,746	34,039,746	1,623,139

Notes: The regressions are based on Equation 3. Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

Table B.8 Regression for first stage by country

	(1) Belarus	(2) China	(3) HongKong	(4) Georgia	(5) Kazakhstan	(6) N. Maced.	(7) Serbia	(8) Singapore	(9) Switzerland	(10) Turkey
Import data regressions										
sanction	0.374**	-0.013	0.169	0.227***	0.343***	0.042	0.097	0.112	0.107	0.134*
.Russia	(0.152)	(0.066)	(0.109)	(0.082)	(0.107)	(0.070)	(0.077)	(0.132)	(0.079)	(0.075)
sanctions	0.084**	-0.347***	-0.433***	0.138*	0.109	0.464***	-0.188***	-0.488***	-0.059*	-0.137***
West	(0.042)	(0.045)	(0.078)	(0.083)	(0.071)	(0.056)	(0.033)	(0.044)	(0.030)	(0.045)
Pseudo R^2	0.641	0.855	0.867	0.599	0.666	0.818	0.728	0.855	0.912	0.749
N	2,780,219	3,146,450	2,713,688	2,323,626	2,682,163	2,734,684	2,942,417	3,096,816	3,356,818	3,064,299
Export data regressions										
sanctions	0.119	-0.385***	0.068	-0.215	0.042	-0.087	0.056	0.030	0.010	0.139
Russia	(0.192)	(0.094)	(0.112)	(0.152)	(0.132)	(0.082)	(0.070)	(0.129)	(0.078)	(0.100)
sanctions	0.172***	0.129***	0.382**	0.196*	0.081	0.181	0.094*	-0.094*	0.638***	0.052
West	(0.034)	(0.044)	(0.175)	(0.115)	(0.083)	(0.120)	(0.053)	(0.057)	(0.156)	(0.039)
Pseudo R^2	0.669	0.839	0.841	0.674	0.639	0.814	0.674	0.804	0.858	0.738
N	2,762,576	3,189,484	3,131,177	2,465,533	2,750,984	2,421,637	2,951,959	3,072,571	3,230,173	3,145,246
Tradegap regressions										
sanctions	0.015	0.009	-0.026	0.019	0.027	0.007	0.078***	0.096**	0.089	0.039
Russia	(0.019)	(0.028)	(0.019)	(0.014)	(0.022)	(0.008)	(0.025)	(0.042)	(0.079)	(0.024)
sanctions	-0.039**	-0.052***	0.022	0.007	-0.007	-0.049***	-0.084***	-0.019	0.013	-0.029*
West	(0.015)	(0.017)	(0.014)	(0.010)	(0.014)	(0.013)	(0.016)	(0.014)	(0.013)	(0.017)
R^2	0.143	0.099	0.090	0.067	0.106	0.125	0.103	0.081	0.130	0.098
N	3,409,666	3,409,666	3,352,752	3,409,666	3,409,666	3,409,666	3,409,666	3,409,666	3,409,666	3,409,666

Notes: Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The import and export data regressions are based on Equation 1, and the tradegap regressions on Equation 3. All regressions contain policy covariates.

Table B.9 Regression for first stage by section

HS section	(1) I Animals	(2) II Vegetables	(3) IV Foodstuffs	(4) V Minerals	(5) VI Chemicals	(6) VII Plastic	(7) X Wood	(8) XI Textiles
sanctions Russia	-0.073	0.266	0.046					
	(0.051)	(0.246)	(0.056)					
sanctions West				0.038	-0.332***	0.074***	0.427***	0.096
				(0.117)	(0.045)	(0.023)	(0.084)	(0.059)
Pseudo R^2	0.720	0.871	0.679	0.788	0.779	0.766	0.744	0.678
N	1,624,912	1,827,189	1,377,180	914,836	5,132,052	1,387,536	924,960	5,190,716

HS section	(9) XII Footwear	(10) XIII Construction	(11) XIV Stones	(12) XV Metals	(13) XVI Machinery	(14) XVII Vehicles	(15) XVIII Instruments	(16) XX Misc.
sanctions West	0.103	0.011	0.161	0.079***	-0.412***	-0.810***	-0.208***	-0.010
	(0.117)	(0.045)	(0.187)	(0.030)	(0.030)	(0.099)	(0.045)	(0.035)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.860	0.637	0.902	0.691	0.739	0.818	0.810	0.771
N	279,697	927,970	253,817	3,700,208	5,080,119	837,081	1,383,527	771,366

Notes: Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The regressions are based on Equation 1 and use importer-reported trade data. All regressions contain policy covariates.

Table B.10: Regression results for indirect smuggling (second stage)

	(1) *Tradegap*	(2) *Tradegap*	(3) *Tradegap*	(4) *Tradegap*
sanctions Russia	0.105**	0.106**	0.106**	-0.108***
	(0.051)	(0.051)	(0.051)	(0.034)
sanctions West	-0.010	-0.009		0.044***
	(0.015)	(0.015)		(0.013)
sanctions West dual-use			-0.009	
			(0.016)	
sanctions West oil technology			0.001	
			(0.055)	
Sample	Full	Full	Full	Int. margin
Covariates	No	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes
R^2	0.067	0.067	0.067	0.380
N	3,099,226	3,099,226	3,099,226	190,185

Notes: The regressions are based on Equation 3. Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.

Table B.11 Regression for second stage by country

	(1) Belarus	(2) China	(3) HongKong	(4) Georgia	(5) Kazakhstan	(6) N. Maced.	(7) Serbia	(8) Singapore	(9) Switzerland	(10) Turkey
Import data regressions										
sanctions	-0.161**	-0.005	-3.570***	-0.705	1.157***	1.417***	1.171***	-0.602	-0.044	-0.250
Russia	(0.078)	(0.076)	(1.207)	(0.505)	(0.212)	(0.355)	(0.347)	(0.780)	(0.104)	(0.352)
sanctions	0.051	0.134*	-0.010	-1.188***	-0.035	-0.534	0.374***	-0.348*	0.206**	0.122
West	(0.043)	(0.077)	(0.238)	(0.453)	(0.115)	(0.588)	(0.075)	(0.209)	(0.100)	(0.075)
Pseudo R^2	0.861	0.909	0.671	0.931	0.864	0.783	0.861	0.780	0.847	0.852
N	240,420	252,780	93,217	24,733	158,803	20,918	77,630	60,726	146,825	176,713
Export data regressions										
sanctions	-0.231**	0.200***	-0.089	-0.210	0.584***	-0.308	1.073***	0.830*	-0.359***	-0.032
Russia	(0.094)	(0.064)	(0.574)	(0.595)	(0.192)	(0.701)	(0.300)	(0.427)	(0.106)	(0.251)
sanctions	0.001	0.204***	0.310***	-1.984***	0.063	-0.326	0.406***	0.394	-0.104	0.128**
West	(0.045)	(0.039)	(0.086)	(0.455)	(0.115)	(0.530)	(0.064)	(0.260)	(0.066)	(0.059)
Pseudo R^2	0.935	0.906	0.923	0.934	0.914	0.803	0.856	0.721	0.893	0.868
N	247,140	243,720	74,263	24,250	165,960	12,177	86,335	74,109	147,485	198,118
Tradegap regressions										
sanctions	0.684**	-0.138**	-0.014	-0.061***	0.344***	0.330***	0.066**	0.040**	-0.026	-0.170***
Russia	(0.295)	(0.055)	(0.022)	(0.023)	(0.075)	(0.065)	(0.031)	(0.018)	(0.025)	(0.040)
sanctions	-0.135***	0.106**	-0.099***	-0.010	0.087**	-0.011	-0.002	-0.228***	0.088**	0.108***
West	(0.029)	(0.043)	(0.034)	(0.011)	(0.039)	(0.008)	(0.020)	(0.033)	(0.036)	(0.039)
R^2	0.335	0.317	0.380	0.224	0.202	0.527	0.236	0.323	0.356	0.248
N	310,440	310,440	305,266	310,440	310,440	310,440	310,440	310,440	310,440	310,440

Notes: Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The import and export data regressions are based on Equation 1, and the tradegap regressions on Equation 3. All regressions contain policy covariates.

Table B.12 Regression for second stage by section

HS section	(1) I Animals	(2) II Vegetables	(3) IV Foodstuffs	(4) V Minerals	(5) VI Chemicals	(6) VII Plastic	(7) X Wood	(8) XI Textiles
sanctions Russia	-0.056	0.155	-0.184					
	(0.083)	(0.165)	(0.139)					
sanctions West				-0.119	-0.087	0.076	-0.425***	0.310***
				(0.356)	(0.125)	(0.072)	(0.129)	(0.082)
Pseudo R^2	0.853	0.691	0.574	0.751	0.663	0.758	0.714	0.797
N	97,610	150,855	113,878	59,309	408,945	107,952	69,387	465,842

HS section	(9) XII Footwear	(10) XIII Construction	(11) XIV Stones	(12) XV Metals	(13) XVI Machinery	(14) XVII Vehicles	(15) XVIII Instruments	(16) XX Misc.
sanctions West	-0.347**	0.473***	0.519**	0.186***	0.216**	0.005	-0.308***	0.219***
	(0.167)	(0.062)	(0.235)	(0.068)	(0.102)	(0.107)	(0.116)	(0.049)
Covariates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.922	0.787	0.715	0.694	0.822	0.735	0.663	0.914
N	22,889	74,166	17,094	319,992	457,800	61,258	109,917	62,946

Notes: Standard errors clustered at the sector-country pair-time level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The regressions are based on Equation 1 and use importer-reported trade data. All regressions contain policy covariates.

Table B.13 Regression for net imports by intermediary country

	(1) Belarus	(2) China	(3) HongKong	(4) Georgia	(5) Kazakhstan	(6) N. Maced.	(7) Serbia	(8) Singapore	(9) Switzerland	(10) Turkey
Baseline regressions										
sanctions Russia	0.750***	0.044	0.163	-0.005	-0.402**	0.096	0.006	-0.043	0.053	0.089
	(0.248)	(0.104)	(0.100)	(0.210)	(0.165)	(0.158)	(0.081)	(0.036)	(0.082)	(0.066)
sanctions West	-0.017	0.049	-0.013	0.146**	0.017	-0.047	-0.095*	-0.104**	0.033	0.127***
	(0.058)	(0.041)	(0.087)	(0.061)	(0.039)	(0.043)	(0.050)	(0.047)	(0.032)	(0.032)
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.921	0.957	0.913	0.904	0.914	0.915	0.914	0.912	0.956	0.948
N	19,201	8,307	15,330	20,252	22,439	19,378	18,781	17,150	19,604	15,736
Regressions containing interaction of Russian sanction and intermediate good dummy										
sanctions Russia	0.772***	0.086	0.138	-0.010	-0.411**	0.102	0.034	-0.042	0.056	0.088
	(0.243)	(0.111)	(0.103)	(0.218)	(0.164)	(0.162)	(0.087)	(0.035)	(0.080)	(0.075)
intermediate good	6.763	0.165	-0.034	11.008	-0.507	3.721	2.248	-0.259	-0.529	0.789
	(5809)	(173)	(261)	(2503)	(1341)	(2974)	(5983)	(1341)	(675)	(1201)
interaction: sanction x intermediate good	-0.772	-0.503**	0.636***	0.113	0.202	-0.102	-0.539**	-0.072	-0.106	0.014
	(0.520)	(0.249)	(0.220)	(0.281)	(0.315)	(0.181)	(0.263)	(0.077)	(0.310)	(0.301)
sanctions West	-0.017	0.049	-0.013	0.146**	0.017	-0.047	-0.095*	-0.104**	0.033	0.127***
	(0.058)	(0.041)	(0.087)	(0.061)	(0.039)	(0.043)	(0.050)	(0.047)	(0.032)	(0.032)
FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.921	0.957	0.913	0.904	0.914	0.915	0.914	0.912	0.956	0.948
N	19,201	8,307	15,330	20,252	22,439	19,378	18,781	17,150	19,604	15,736

Notes: All regressions include sector-year fixed effects. Standard errors clustered at the sector-year level in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01. The regressions are based on Equation 4.