Who is to suffer? Quantifying the impact of sanctions on German firms *

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Abstract

In this paper, we use a novel firm level dataset for Germany to investigate the effect of sanctions on export behaviour and performance of German firms. More specifically, we study the sanctions imposed by the EU against Russia in 2014 in response to the annexation of Crimea and Russia's countermeasures. We find a substantial negative effect on both the extensive and intensive margin of German exports. While the negative effects are strongest for firms exporting products subject to trade restrictions, we provide further evidence on the indirect effects of sanctions. Analysing the impact on broader measures of firm performance, we document that the cost of sanctions is heterogeneous across firms but overall modest. Our results reveal that the negative impact of the shock was concentrated primarily among a small number of firms that were highly dependent on Russia as an export market and those directly affected by the sanctions.

Keywords: sanctions, foreign policy, trade, firm behaviour, Germany.

JEL-Classification: F1, F14, F51, L25.

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1 Introduction

Sanctions are an integral part of the toolbox utilised by countries in achieving foreign policy goals. In recent years, it has become a more frequently used answer to failed diplomacy when military interventions appeared too drastic (The Economist, 2021). While targeted or "smart" sanctions have become increasingly popular (Felbermayr et al., 2020; Morgan et al., 2023) to avoid collateral damage, sanctions are in general costly for both the target country and the imposing country. The academic literature, which we discuss in further detail below, has taken up this rise in popularity of sanctions as a tool of foreign policy, presenting ample evidence on the significant economic consequences for the sanctioned states (the targets) and the sanctioning states (the senders). Somewhat surprisingly perhaps, studies on Germany are scarce and we therefore do not know much about the reaction of German firms, in particular in terms of their trade activities, to economic sanctions – even though the country is one of the top trading nations in the world.

This has, up to now, been mainly due to the unavailability of detailed administrative firm level data on trade and firm performance. In this paper, we overcome this problem using a novel firm level dataset for Germany, combining customs statistics and firm statistics available from the Federal Statistical Office.[1] We use this unique dataset to assess the economic consequences of the sanctions regime introduced in 2014 against Russia, as well as Russia's retaliatory measures, on various dimensions of economic activity of German firms. The sanctions episode originated in the invasion of Russia in Ukraine in 2014. In response to it, the European Union, the United States and several other countries imposed a series of sequential sanction packages against Russia. The measures taken were first targeted at certain individuals and entities, and were complemented by economic sanctions – including trade restrictions – in August 2014. The list of sanctioned products was rather selective and included defence equipment, dual-use goods and technologies, energy equipment as well as selected capital goods. As a response, Russia implemented an embargo on imports of agricultural goods, which is still in place today.

Our analysis builds on German customs data that covers a large majority of German exports and imports at the firm-product-destination level on a monthly basis. As

[1]This data set is the result of a larger project, which was contracted by and received funding from the Federal Ministry for Economic Affairs and Climate Action, aiming to make consistent firm level data sets for Germany available for research.

trade restrictions mostly affected German exports to Russia, we concentrate our analysis on the export-side.[2] The monthly frequency allows us to analyse the short-term reaction of firms' trade activities to the increasing diplomatic tensions surrounding the Crimea conflict and the sanctions imposed in response to it in 2014. We identify the effect on the extensive margin of trade with Russia, i.e. firm continuance or exit from the Russian market, as well as the intensive margin, i.e. export values, quantities and prices, using a difference-in-differences approach. It allows us to estimate the differential response to the political tensions and the sanctions imposed based on firms exporting the same product to Russia and other destination countries. In a further step of the analysis, we link the customs data with annual information on firm statistics available for a representative sample of German firms. This provides us with a linked firm level data set on detailed trade activities as well as firm performance measures. We use this data to explore the impact of the sanctions on general indicators of firm performance over time, employing an event study design. Importantly, we distinguish the effect depending on how exposed a firm is to the Russian market and the sanctions.

The detail of our data allows us to investigate the heterogeneity in firms' reaction to the restrictive trade measures from various angles. Do firms adjust their total exports and the number of products exported? Are export products that are not directly targeted by sanctions also affected? Do firms exporting to Russia stay in the market despite the political tensions and the sanctions, or do they exit the market? And how does firm performance change, in particular in terms of total sales as well as employment? Which firms are most affected?

By answering these questions we primarily contribute to the growing literature on sanctions and firm behaviour. Though being relatively well researched on the macroeconomic level – see, for example Hufbauer and Jung (2020) for a recent overview – studies on the economic consequences of international sanctions at the firm level have only recently gained momentum. For example, Crozet and Hinz (2020) and Gullstrand (2020) explore the effects of the Russian sanctions regime on French and Swedish firms, respectively, whereas Ahn and Ludema (2020) consider the other side, analysing how Russian firms cope with the restrictive measures.

We add to this literature in a number of ways. Firstly, we use data that have hitherto

[2]Even though the share of Russia in total German imports is higher than its share in total exports, around 3/4 of total imports from Russia have traditionally been energy goods.

not been available to researchers, combining micro level information on trade and firm performance for Germany. This is particularly interesting as Germany is the world's third largest exporter after the US and China, with Russia as the 11th most important export destination accounting for 3.3 percent of total exports in 2013, the year before the sanctions were imposed. We estimate the effect of the sanctions on a whole cascade of export margins of German firm level trade, looking at both the extensive as well as the intensive margin. In addition, our firm level data allows us to go one step further than Gullstrand (2020) and Crozet and Hinz (2020), for the first time analysing the effect of trade sanctions on the performance of firms in a sanctioning country. More specifically, we look at the impact on total sales and labour market outcomes using an event study design, taking into account effect heterogeneity depending on the degree of firms' exposure to the Russian market and trade restrictions. Besedeš et al. (2021) investigate the performance of German firms in response to several episodes of financial sanctions and find no significant effect. To our knowledge, no prior research has evaluated the impact of trade sanctions on firm performance.

Our results show that German firms suffered on all margins of exporting considered. On the extensive margin, we observe a significant drop in the probability to serve the Russian market relative to other destinations by almost 7 percent after diplomatic tensions increased in late 2013, and by 13 percent after the EU imposed economic sanctions in August 2014. The negative effect is mainly driven by a reduction in new entrants but firm exits from the Russian market increased as well. Firms continuing to trade with Russia reduced the value, quantity and product scope exported. For example, their export growth to Russia dropped by 7.5 percentage points relative to other destination countries in the first period of increased political tensions starting in December 2013. As soon as actual trade-restricting measures were put in place in August 2014, this negative effect amplified to -17 percentage points. Adding the product dimension to our analysis, we find that the negative effects are strongest for firms exporting products subject to trade restrictions. However, also exports of products not directly targeted by the sanctions were significantly negatively affected, confirming previous evidence of indirect effects of sanctions. In this regard – and contradicting existing evidence on product resilience – we find that firms particularly reduce exports of their core products to Russia.

The analysis of firm performance reveals that the cost of sanctions is heterogeneous

across firms but overall modest. We use our trade data to calculate measures of pre-conflict exposure to Russia and the sanctions, respectively, to take into account differences in treatment intensity. We only find a negative effect on total sales for firms highly dependent on Russia as an export market, suggesting that other firms could divert their business to alternative markets. Furthermore, we find a significant decrease in terms of employment for all firms exposed to the shock but again the effect is most pronounced for the small number of firms highly reliant on Russia. Distinguishing between firms exporting products to Russia that are sanctioned from August 2014 onward and those exporting only non-sanctioned products shows that the effects are largest for firms directly restricted in their export activity by the sanctions. These firms constitute less than 4 percent of our sample of exporters. On average, their sales were 4.2 percent lower than those of firms not exporting to Russia, and their employment declined by up to 6.4 percent in 2016, the year when the negative effects peaked. Comparing our results to Ahn and Ludema (2020) who estimate that a Russian firm directly targeted by Western sanctions, on average, lost around one-quarter of its operating revenue, over one-half of its asset value and about one-third of its employees in comparison to non-targeted peers, the negative impact on German firms is small.

The remainder of this paper is structured as follows. Section 2 provides an overview of the growing literature investigating the economic effects of sanctions. In section 3, we briefly summarise the political events surrounding the Crimea conflict and the sanctions imposed in 2014. Section 4 describes the novel firm level data used in this paper. In section 5, we investigate the short-term effects of the sanctions on export activity – both on the extensive and intensive margin – at the firm level, before turning to an analysis of the impact on firm performance in section 6. Section 7 concludes.

2 Literature

There is a vast literature investigating the economic consequences of sanctions.[3] Empirical studies mostly focus on the impact of sanctions on target countries. In general, sanctions are found to hurt the receiving country in terms of trade values, income and

[3]The literature on sanctions also covers topics related to their effectiveness and political consequences. A recent example is Gold et al. (2023) who show that regime support significantly increased in Russia in response to the 2014 sanctions. We concentrate on the economic impact of sanctions in this literature review.

welfare (Hufbauer et al., 1997, 2009; Felbermayr et al., 2020). At the same time, sanctions imply costs for the sending countries, although existing evidence points towards rather limited effects (Morgan et al., 2023). Recent papers, among others, discuss the role of threats versus the actual imposition of sanction regimes (Afesorgbor, 2019), its relaxation (Attia et al., 2020), the role of coalitions among sending and/or receiving countries (Chowdhry et al., 2022; Joshi and Mahmud, 2016), the impact on consumer prices (Hinz and Monastyrenko, 2022) and regional inequality (Lee, 2018) as well as evidence on evasion of sanctioning measures (Tyazhelnikov et al., 2022).

In contrast, our paper studies the consequences of a specific sanctioning regime, namely the regime against Russia in the wake of it's annexation of Crimea in 2014, for German firms. We contribute to the growing literature analysing the economic impact of sanctions on the more disaggregated level of the firm. The insights are still relatively scarce, despite their relevance in uncovering channels and heterogeneities that underlie the aggregate impact of sanctions. Few studies investigate the impact of sanctions on the performance of firms in sanctioned states. Ahn and Ludema (2020) focus on quantifying the cost to Russian firms of the same sanction episode that is the subject of our study. They find that companies directly targeted by the "smart" sanctions imposed lose around one-quarter of their operating revenue, and about one-third of their employees when compared to similar non-targeted companies. They also find evidence that firms of strategic importance to the government systemically outperform non-strategic firms under sanctions, suggesting that the regime is shielding them from economic harm. Haidar (2017) provides evidence on trade diversion by Iranian non-oil exporters in response to economic sanctions, showing that two-thirds of total firm exports were deflected to non-sanctioning countries. Even though aggregate exports rose, exporters reduced prices and sold higher quantities when exporting to a new destination, leading to significant welfare losses.

Studies concentrating on firms in sanctioning countries have mostly focused on their export behaviour. Crozet and Hinz (2020) evaluate the costs of sanctions imposed against Russia in 2014 and Russia's counter measures on the sending country. They perform both a general equilibrium counterfactual analysis and firm and product level estimations to show that both sides of the sanction regime suffered in terms of export losses. More importantly, they find that the bulk of the impact stems from products that are not directly targeted by sanctions and that the drop of Western exports has not been driven by a change in Russian consumers' preferences, but mainly by

an increase in country risk affecting international transactions with Russia. Crozet et al. (2021) further explore the reactions of firms in the sending country to sanctions. They analyse four sanctions episodes using monthly data on the universe of French exporting firms. They find that the introduction of new sanctions in Iran and Russia significantly lowered firm level probabilities of serving these sanctioned markets. Additionally, the impact of sanctions is very heterogeneous along firm dimensions and by case particularities. Firms that depend more on trade finance instruments are more strongly affected, while prior experience in the sanctioned country considerably softens the blow of sanctions, and firms can be partly immune to the sanctions effect if they are specialised in serving "crisis countries". Jäkel et al. (2022) confirm that sanctions lead to market exit and lower exports analysing Danish firms' export behaviour in over 60 sanctioned countries over 15 years. At the same time, they uncover considerable variation in the effects depending on the type and objective of the sanctions imposed.

Most similar to our paper are Gullstrand (2020) and Besedeš et al. (2021). The former aim at quantifying the cost of the sanctions imposed against Russia in 2014 for Swedish firms. They find a rather limited impact, however, with a highly asymmetric reach. Both intensive and extensive margin of trade with Russia of banned products dropped and, to a lesser extent, of non-banned products. Furthermore, the sanctions created disruptions on overall domestic production of banned products, sales on other markets and a new export pattern. These effects were more pronounced for firms with their core products exposed to these sanctions, for firms in financial distress and in regions with a relatively low level of labour productivity. Besedeš et al. (2021) investigate the impact of financial sanctions on non-financial firms in Germany covering restrictions imposed against 23 countries during the period 1999 to 2014. They find no effect of financial sanctions on measures of firm performance such as employment or total sales, concluding that the economic costs of financial sanctions to the sanctioning country are limited. While sanctions reduce German financial activities with sanctioned countries, firms expand their activities with non-sanctioned countries. In contrast to their paper, we look at trade activities of German firms as well as firm performance in reaction to one specific sanction regime, namely that against Russia in 2014.

3 Background: Crimea conflict and sanctions in 2014

The imposition of sanctions against Russia by the EU was motivated by the illegal annexation of Crimea in February 2014 (European Council, 2022). Ukraine has long been suffering from an internal conflict surrounding the polarisation of its citizens between the hope to move closer towards Western Europe and the desire to form closer ties with Russia. This conflict peaked in late 2013 when the country was confronted with a wave of protests, eventually leading to the Ukraine revolution, known as the Euromaidan revolution. The pro-Russian government was displaced leading to the uprising of pro-Russians into separatist movements and armed conflict in south-eastern Ukraine and Crimea. On March 16, 2014 Crimea was split from the rest of the country as a result of a referendum on the absorption of Crimea by the Russian Federation, which most countries condemned as illegal.

As a response, in mid-March 2014 the EU and allied western countries issued a first set of sanctions targeted against senior political and military personnel, including diplomatic measures, travel bans, asset freezes, and the prohibition of financial transactions. The situation further escalated after the shoot down of a civilian aircraft over the separatist region of Donbass in July 2014. The EU and its western allies responded by imposing trade restrictions and further financial sanctions.[4] European firms were restricted from exporting to the Russian Federation military and dual-use products as well as technology and capital goods specific to the oil and mining industry, and from buying certain Russian financial assets. In addition, targeted sanctions were imposed against entities directly operated by the Russian government or those providing material or financial assistance to it. Entities that stood in any direct or indirect economic relation with a sanctioned individual were also blocked from doing business with the EU. These included firms facilitating significant (financial) transactions for targeted individuals or subsidiaries that were owned by the latter by at least 50 percent (Ahn and Ludema, 2020). The tightening of financial sanctions inhibited access of major Russian financial institutions to international western financial markets and, hence, access to financing (Ashford, 2016).

On August 7, 2014 Russia imposed countermeasures by putting a strict embargo

[4] 37 countries imposed sanctions against Russia in response to the Crimea crisis, including the 27 EU countries, the UK, the US, Canada, Australia, Norway, Iceland, Lichtenstein, Albania, Montenegro, and Ukraine.

on imports of 48 specific agricultural and food products from countries that had introduced sanctions. The embargo affected dairy products, fish and meat as well as fresh and frozen fruits and vegetables.[5]

4 Data

Our empirical analysis uses on a novel dataset for Germany, based on firm level data from foreign trade statistics. This dataset was generated by the German Federal Statistical Office.[6] It includes the large majority of German exports and imports of goods at the firm-product-destination level on a monthly basis, and is available for the period 2011 to 2019. Each observation contains information, among others, on the unique firm identifier, the direction of trade, the product traded, the origin or destination country, as well as the value and physical quantity traded. Products are classified according to the EU's Combined Nomenclature (CN) at the 8-digit level, with the first 6 digits corresponding to the code of the Harmonized System (HS) administrated by the World Customs Organization.

In Germany, the Federal Statistical Office is in charge of collecting information about trade in goods.[7] For international trade with other member states of the EU, it receives information on the cross-border movements of goods directly from firms required to provide this information via the EU "Intrastat" reporting system. International transactions with countries outside the EU are recorded by the customs administration ("Extrastat" system"). While the universe of extra-EU trade transactions is recorded, there are annual threshold values below which a business is not required to report information on their trade activity when it comes to intra-EU trade. The reporting thresholds are chosen such that 97 percent of the export volume and 93 percent of the import volume is covered. Accordingly, since 2012 intra-EU exports are only reported by businesses exceeding an annual export value of 500,000 euros.[8] Another caveat is that the reporting unit in the "Intrastat" system is not always a firm but it can also be the corporate group in the case of VAT groups. In that case, the Federal Statistical Office redistributes the reported foreign trade turnover by the

[5] A full list of sanctioned and embargoed products can be found in the appendix.

[6] The data will be made available as AFiD-Panel Außenhandelsstatistik (AFiD-Panel Foreign Tade Statistics) in the Research Data Center of the Federal Statistical Office.

[7] Data about trade in services are collected by the Bundesbank and are not analysed in this paper.

[8] For lower values, the Federal Statistical Office does provide estimates based on tax records. These do not include a break down by products, however, and therefore are not used herein.

VAT group to the individual firm level using VAT data. Kruse et al. (2021) provide more information on the methodology used.

In this paper, we use monthly data on exports from January 2013 through December 2015 to analyse the short-term reaction to the Crimea conflict and the associated sanctions. In our empirical analysis, we study the exports of a given firm to Russia in comparison to the exports of the same firm to other destinations. Therefore, we restrict our sample to firms that export to Russia at least once in 2013 or 2014. We aggregate all trade flows to the 6-digit level of the HS product classification. Our main variables of interest are the export value and quantity reported at the firm-product-destination level. The export value is reported in euros. The physical quantity of the goods traded is reported by two variables. The first one measures the weight in kilograms; for a subset of products the quantity is also reported in a supplementary physical unit, for example, litres, number of parts or square meters. We construct a new variable for quantity which corresponds to physical units, when available, and the weight of the traded goods in kilos otherwise. We proxy the export price by the unit value, dividing the export value by the quantity. For our analysis on the intensive margin, we keep only trade flows for which both values and quantities are available. Following Fernandes and Winters (2021), we use log changes of these variables relative to the same month in the previous year to deal with potential seasonality in our data. Our final estimation sample consists of approximately 15,000 firms.[9]

To analyse the impact of the sanctions on firm performance, we link the foreign trade data to a database on firm statistics ("Structural Business Statistics") which is also provided by the German Federal Statistical Office. Such a link has hitherto not been possible. The dataset is based on the annual Structural Business Statistics and contains firm statistics such as turnover, value added, gross investment and the number of employees. It comprises a representative sample of firms active in the non-financial sector in Germany. For our analysis, we use data from 2011 to 2017, and only include those firms in our sample for which data is available for all years. Moreover, we concentrate on firms with strictly positive exports in all years. This leaves us with around 9,000 firms, one-third of which engage in exporting to Russia. We concentrate on three measures of firm performance. We use total sales as a general indicator of firm performance, and the number of employees in full-time equivalents as well as expenses for temporary employment to capture labour market effects.

[9]Note that the exact number of firms differs between the outcome variables under consideration and the fixed effects employed.

In addition to our data at the level of the firm, we use as control variables data on macroeconomic conditions in the export markets. We take quarterly data on GDP from the Global Economic Monitor database of the World Bank and compute year-over-year growth rates. Data on monthly inflation, measured by the consumer price index, comes from the IMF. Finally, we extract data on exchange rates using Refinitiv Datastream.

Table 1 presents descriptive statistics on all variables of interest for our estimation sample.

Table 1. Descriptive statistics for regression sample

	Mean	Median	Std.dev.	P10	P90
Firm-destination level, 2013-2015					
Δ ln(value)	0.02	0.02	1.46	-1.52	1.55
Δ ln(quantity)	-0.01	0.00	1.80	-1.88	1.84
Δ ln(unit value)	0.02	0.01	0.93	-0.84	0.91
Δ ln(# products)	0.02	0.00	0.62	-0.69	0.69
Firm-product-destination level, 2013-2015					
Δ ln(value)	0.04	0.03	1.44	-1.56	1.65
Δ ln(quantity)	0.01	0.00	1.54	-1.68	1.70
Δ ln(unit value)	0.03	0.01	0.83	-0.71	0.80
Firm level, 2011-2017					
ln(# employees in FTE)	4.79	4.76	1.57	2.83	6.75
ln(temporary employment expenses)	12.64	12.73	2.12	9.92	15.23
ln(sales)	17.59	17.66	1.72	15.34	19.65

Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, Structural Business Statistics, survey years 2011-2017, own calculations.

5 Empirical analysis: Impact on firms' export activity

We begin with an analysis of the short-term impact of the Crimea conflict and the sanctions imposed in response to it in 2014 on the export activity of German firms. More specifically, we study how firms' export volumes and prices as well as their export participation in the Russian market reacted to these events using monthly data from January 2013 to December 2015. For this purpose, we adopt a difference-in-differences (DID) approach, allowing us to compare the evolution of German exports to Russia relative to other export markets (first difference), before and after the start of the conflict (second difference).

The sanctions episode against Russia comprised of a sequence of events that are not easily separable from each other. We define two separate treatment periods to differentiate events of political unrest and conflict from episodes where – additionally – business is restricted due to sanctioning measures. Following Crozet and Hinz (2020), we define the month of December 2013 as the first month of increasing diplomatic tensions. Our first treatment period ranges from December 2013 through July 2014, the month before economic sanctions were implemented (denoted *Dec'13*). The second – and main – treatment period starts in August 2014 and lasts until the end of our sample period, i.e. until December 2015 (denoted *Aug'14*). On July 31, 2014, the Council of the European Union adopted trade restricting measures that were immediately accompanied by counter-sanctions by Russia. These measures have been in place since then (see section 3).

We use monthly observations to study changes in the extensive and intensive margin of German trade separately (i) at the firm-destination and (ii) at the firm-product-destination level. For our dependent variables, we use log changes relative to the same month of the previous year of different trade outcomes including the exported value, quantity and the price. Using year-over-year growth takes into account the seasonality of trade flows and absorbs firm(-product)-destination-specific time-invariant characteristics that may affect trade levels. The main variables of interest in our DID framework are the interaction terms denoted *Dec'13* $\times$ *Russia* and *Aug'14* $\times$ *Russia* identifying at the firm level export flows to Russia during the treatment periods. These interactions capture the differential impact of the Ukraine conflict and the 2014 sanctions on a firm's export activity to Russia relative to other destination. Our

methodology aims to quantify the collective impact of multiple sources of perturbation, such as political uncertainty, financial sanctions and trade restrictions. However, by defining two distinct treatment periods, we are able to distinguish between these shocks to a certain extent. Subsequently, we further refine our empirical approach to isolate the direct effect of trade restrictions from other factors.

Our empirical specification allows us to control for a rich set of fixed effects to minimise omitted variable bias and other sources of potential endogeneity. In our most restrictive specification, at the firm-product-destination level we include firm-product-destination and firm-product-time (i.e. year-month) fixed effects, absorbing any unobservable effects along these dimensions. As our treatment is defined at the country-time level, we cannot include fixed effects absorbing time-varying country-specific factors such as aggregate demand. Instead, we include several variables to control for macroeconomic conditions in the export markets. While macroeconomic fluctuations can occur as a result of conflict and economic sanctions, they also capture other factors driving German exports including aggregate demand and price competitiveness. Controlling for these macroeconomic conditions helps us capture the impact of the conflict and the sanctions instead of the general effect of economic developments. Thus, we include the year-over-year growth rates of GDP, consumer prices and the exchange rate as control variables.

The identifying assumption is that the interaction terms of interest are uncorrelated with the error term – conditional on the fixed effects and other control variables included in the regression. This is arguably a reasonable assumption in our context, as the conflict as well as the sanction measures that were taken as a result can be assumed to have been unexpected and exogenous to German firms. This assumption is also made in the related literature on firm level studies of sanctions. Another assumption necessary for the difference-in-difference analysis is that of parallel trends. In other words, there should be no significant differences in the pre-treatment trends of the dependent variable between treated and control group observations. We checked this in an event study design and report the results for our most demanding specification (at the firm-product-destination level with firm-product-destination and firm-product-time fixed effects) in the appendix. While there are some differences between treated and control group observations about a year before the first treatment happens, these have all but disappeared about six months or so before treatment.

5.1 Extensive margin estimations

We begin by analysing the extensive margin of German trade with Russia at the firm level. Both political uncertainty and actual trade restrictions due to the sanctions and surrounding conflict may lead to lower export profits and hence lower export participation rates. Export participation can drop due to a reduction in entry rates and/or an increase in exit rates of firms that do not find it profitable anymore to serve the Russian market.[10]

We investigate these different margins by estimating the probability of firm f to serve or stop serving destination country d in time t. Therefore we aggregate the data across products and time. To account for irregularities in shipments, i.e. the "lumpiness of trade", we aggregate the data to the half-yearly level.[11]

Our empirical specification takes the form:

$$\begin{aligned} Ex_{fdt} =& \beta_1(\text{Dec'13} \times \text{Russia}) + \\ & \beta_2(\text{Aug'14} \times \text{Russia}) + \gamma X_{ct} + \delta_{ft} + \delta_{fd} + \epsilon_{fdt}, \end{aligned} \tag{1}$$

where Ex_{fdt} is a measure of the export status of a firm. More specifically, it represents a dummy variable taking the value 1 in time t if

- firm f is exporting to destination country d at time t, and 0 otherwise.
- firm f enters destination country d at time t, and 0 otherwise. We exclude firms already serving d in t.
- firm f exits destination country d at time $t+1$ and 0 otherwise. We exclude firms not serving d in t.

Additionally, we account for the frequency of exporting by investigating the log number of months per half year in which firm f trades with destination country d.

As discussed above, our main coefficients of interest are the coefficients on the interaction terms *Dec'13* $\times$ *Russia* and *Aug'14* $\times$ *Russia*, i.e. β_1 and β_2. We add further control variables (X_{ct}) to account for macroeconomic developments in the destination

[10] Our empirical specification allows us to track a firm before, during and after the policy shock. However, investigating entry rates provides no further value added to the analysis in this setting.

[11] Firms do not necessarily trade every month in a year and, hence, defining exporter status on a monthly basis might, for example, erroneously identify a firm-destination combination as an exit if trade occurs irregularly.

markets, i.e. year-over-year growth of GDP, inflation and exchange rates. We employ firm-time (δ_{ft}) and firm-destination (δ_{fd}) fixed effects. The former account for trends over time at the firm level, such as employment growth or an increase in productivity over time. Firm-destination fixed effects control for time-invariant factors specific to a firm-destination pair. Standard errors are clustered at the firm level.

Table 2 columns 1 to 3 presents the results from a linear probability model of equation 1. The estimated coefficients give the marginal effects of each regressor on the probability of a firm exporting to, or exiting the Russian market relative to other destinations (columns 1 to 2). In column 3 we estimate a log-linear model to measure the percentage change in the number of months in which a firm trades with a specific market in the respective half-year.

Table 2. Firm-destination level estimations, extensive margin, 2013-2015

	(1)	(2)	(3)
Dependent variable	Export	Exit	Frequency
Dec'13 × Russia	-0.067***	0.028***	-0.101***
	(0.004)	(0.003)	(0.008)
Aug'14 × Russia	-0.126***	0.054***	-0.140***
	(0.003)	(0.003)	(0.008)
Controls	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes
δ_{ft}	Yes	Yes	Yes
# observations	2,402,364	1,550,797	1,427,574
# firms	15,192	14,473	13,750
R^2	0.731	0.494	0.943

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

The probability of exporting to Russia relative to other destinations dropped significantly during the Crimea conflict (column 1). Following the first signs of political unrest in December 2013, firms were 6.7 percent less likely to export to Russia. With the imposition of sanctions and counter-sanctions in August 2014, the size of the negative impact rises to 12.6 percent. The reduction in probability to serve the Russian market is partly driven by an increase in exit rates (column 2). In addition, incumbents reduced the frequency of exporting to Russia relative to other markets by 10 percentage points after December 2013 and by 14 percentage points after the

imposition of trade restrictions.

5.2 Intensive margin: Firm-destination level estimations

Next, we turn to the intensive margin of trade at the firm-destination level. This allows us to investigate how firms' values, quantities and prices of total exports to Russia adjusted to the sanctions. For this purpose, we aggregate across products the values and quantities exported. We use a trade-weighted average of the product-specific unit values as our measure for the export price at the firm-destination level.

The regression equation takes the form:

$$\begin{aligned}\Delta lnY_{fdt} =& \beta_1(\text{Dec'13} \times \text{Russia}) + \\ & \beta_2(\text{Aug'14} \times \text{Russia}) + \gamma X_{dt} + \delta_{ft} + \delta_{fd} + \epsilon_{fdt}.\end{aligned} \tag{2}$$

Our dependent variable, ΔlnY_{fdt}, is the year-over-year log change in either the export value, the export quantity or the price of firm f and destination d at time t. In addition, aggregating across products to the firm-destination level allows us to use the year-over-year log difference in the number of distinct products traded per firm-destination (as defined by the HS 6-digit product codes) as the outcome variable. Our main coefficients of interest are again the coefficients on the interaction terms *Dec'13* $\times$ *Russia* and *Aug'14* $\times$ *Russia*, i.e. β_1 and β_2. We include firm-destination (δ_{fd}) and firm-time (δ_{ft}) fixed effects. The former control for everything that is specific to a firm-destination pair and grows at a constant rate over the time period considered, while the latter control for trends in the growth at the firm level. Note that time-invariant firm-destination specific factors are absorbed by using growth rates in our estimation. In other words, we control for trends at the firm level and at the firm-destination level, given the differenced equation. X_{ct} includes the macroeconomic control variables GDP, inflation and exchange rates. ϵ_{fdt} is the error term. We cluster standard errors at the level of the firm.

Table 3 presents our baseline results on the intensive margin at the firm-destination level. We find that firm level export value, quantity and product scope were all negatively affected by the Crimea conflict and the sanctions, while export prices increased. β_1 and β_2 are statistically significant at the 1 percent level for all trade outcomes. More specifically, firms' export growth to Russia dropped by 7.5 percentage points relative to other destination countries in the first period of increased political

Table 3. Firm-destination level estimations, 2013-2015

	(1)	(2)	(3)	(4)
Dependent variable	Δln(value)	Δln(quantity)	Δln(uv)	Δln(#products)
Dec'13 $\times$ Russia	-0.075***	-0.096***	0.021***	-0.020***
	(0.014)	(0.016)	(0.007)	(0.006)
Aug'14 $\times$ Russia	-0.169***	-0.190***	0.020***	-0.049***
	(0.013)	(0.016)	(0.007)	(0.006)
Controls	Yes	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes	Yes
δ_{ft}	Yes	Yes	Yes	Yes
# observations	5,232,421	5,232,421	5,232,421	5,232,421
# firms	11,940	11,940	11,940	11,940
R^2	0.194	0.184	0.173	0.225

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

tensions starting (column 1). As soon as trade-restricting measures were put in place in August 2014, the drop of growth in exports to Russia became even larger (-17 percentage points). The contraction in growth of exported quantities was even more pronounced, with -9.6 percentage points in our first treatment period and -19 percentage points in the second treatment period, respectively (column 2). Relative prices of exports to Russia increased somewhat after December 2013, and the effect does not change after the actual imposition of sanctions (column 3). Finally, we find that firms reduce the number of products exported to Russia relative to other destinations (column 4). Unsurprisingly, the effect on the product scope becomes larger once the sanctions prohibit trade with a range of goods.

By comparing German exports to Russia versus all alternative destinations we ignore that our comparison group is potentially affected by the shocks itself (Crozet and Hinz, 2020). Consequently, we repeat our analysis from above with different sub-samples. We start by distinguishing the control group by whether transactions relate to other sanctioning countries or to non-sanctioning countries. Other sanctioning countries are likely to also be affected by the treatment due to two opposing effects. On the one hand, there may be increased competition. Firms that are directly affected by the sanctions might redirect their excess supply to other countries. The same applies to firms in other sanctioning countries. Hence, increased competition makes it harder

for German firms to divert their excess exports to other destinations, in particular to countries that are affected by the sanctions themselves. On the other hand, as other sanctioning countries may be regarded as close allies, trade with these countries may actually increase as a result of sanctions against Russia. Both of these effects may bias our findings, with the overall direction of the bias being unclear. These issues are likely to be less important in the case of export destinations that remained "neutral" in the conflict. Moreover, as an additional check we only consider sanctioning countries from Europe with close proximity to Russia as control group.[12] This might provide a more homogeneous comparison group than looking at all sanctioning states.

Table 4 shows the results for the value of exports.[13] Firms' export growth towards Russia relative to other sanction senders (column 1) dropped significantly more than relative to non-participating countries (column 2). This is in line with the idea that allied countries become comparatively more important trading partners as a result of the sanctions against Russia. Interestingly, when restricting the control group to sanctioning eastern European countries, we do not find strong differences in the size of the effect between both treatment periods. This could suggest that exports to these eastern European countries were also impacted negatively when the conflict escalated, as the region may have been considered more risky.

The results presented so far compare the change in exports to Russia relative to other destination countries in the event of the Crimea conflict and the sanctions. Our specification of treatment status, however, does not allow us to distinguish the direct effect of the trade-restricting measures from other, "indirect" effects that could hamper exports through other channels, such as financial sanctions, heightened policy uncertainty or potential reputational damages for firms continuing to do business with Russia.

We disentangle these two effects by redefining our treatment in equation 2 to include an additional component that distinguishes firms exporting at least one product to Russia in 2013 that is subject to sanctions from August 2014 onward (direct effect) from those exporting any other product to Russia (indirect effect), i.e. *Dec'13* $\times$

[12] These countries include Romania, Bulgaria, Greece, Finland, Norway, Sweden, Estonia, Latvia, Lithuania, Poland, Hungary, Czechia, Slovakia, Slovenia, Croatia

[13] We conduct the same analyses for all other trade outcomes, i.e. quantity, unit value and number of products traded. The results can be found in the appendix and display similar patterns as those presented in table 4. An exception are the results for unit values, for which we find much smaller coefficients and no statistically significant effect when the control group consists of non-sanctioning countries only.

Table 4. Firm-destination level estimations, Δln(value), 2013-2015, subsamples

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(value)	Δln(value)	Δln(value)
Dec'13 × Russia	-0.098***	-0.042***	-0.079***
	(0.015)	(0.016)	(0.017)
Aug'14 × Russia	-0.155***	-0.126***	-0.082***
	(0.017)	(0.016)	(0.021)
Controls	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes
δ_{ft}	Yes	Yes	Yes
# observations	4,070,400	1,233,729	1,667,815
# firms	11,134	8,863	9,491
R^2	0.231	0.241	0.298

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Russia × *Sanction* and *Aug'14* × *Russia* × *Sanction*. The triple interactions capture the differential effect of exporting sanctioned products to Russia compared to exporting only non-sanctioned products to Russia. Table 5 gives the results.

While we find that political unrest – our first treatment period – negatively affected the growth in value, quantity and number of products exported to Russia, this negative effect does not differ between exports of firms that are directly affected by sanctions and those that are not; we find statistically insignificant coefficients on the triple interaction *Dec'13* × *Russia* × *Sanction*. This is in line with our expectations, given that the sanctions were only imposed in August 2014 and accordingly, the entire effect observed must be due to "indirect" factors. In the second treatment period, we continue to observe a statistically significant negative effect on the growth of exported value, quantity and the number of products for firms not directly exposed to the sanctions. However, growth in export value of firms exporting sanctioned products to Russia dropped by 10 percentage points *more* compared to firms exporting non-sanctioned products to Russia (column 1). Similarly, the decrease in export quantities and the number of products is much more pronounced for directly affected firms (columns 2 and 4). The differences are statistically significant at the 1 and 5 percent level, respectively. Growth in export prices increased by an additional

Table 5. Firm-destination level estimations, 2013-2015, by sanction status

	(1)	(2)	(3)	(4)
Dependent variable	Δln(value)	Δln(quantity)	Δln(uv)	Δln(#prod.)
Dec'13 × Russia	-0.067***	-0.085***	0.019**	-0.018***
	(0.014)	(0.017)	(0.008)	(0.006)
Dec'13 × Russia × Sanction	-0.058	-0.075	0.017	-0.016
	(0.046)	(0.055)	(0.023)	(0.021)
Aug'14 × Russia	-0.154***	-0.170***	0.015**	-0.039***
	(0.014)	(0.016)	(0.007)	(0.006)
Aug'14 × Russia × Sanction	-0.101**	-0.135***	0.034*	-0.069***
	(0.042)	(0.050)	(0.020)	(0.020)
Controls	Yes	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes	Yes
δ_{ft}	Yes	Yes	Yes	Yes
# observations	5,232,421	5,232,421	5,232,421	5,232,421
# firms	11,940	11,940	11,940	11,940
R^2	0.194	0.184	0.173	0.225

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

3.4 percentage points, being statistically significant at the 10 percent level (column 3).

Our finding that sanctions not only affect trade with explicitly targeted products is in line with the literature. Crozet and Hinz (2020) show that the drop of Western exports to Russia was mainly driven by products not directly affected by sanctions, an unintended effect they call "friendly fire". Using firm level data for France, they explore the channels through which "friendly fire" occurs and provide evidence that the availability of trade finance for firms decreased as a result of heightened political uncertainty and financial sanctions, hampering trade with non-sanctioned products.[14] A vast literature also investigates the negative consequences of trade policy uncertainty (see Handley and Limão (2022) for a recent overview of the literature). Accordingly, German firms might have reduced their business activity in Russia due to heightened uncertainty over the future political and trade relationship between the EU and Russia, given the diplomatic tensions and sanctions imposed.

[14]Unfortunately, we do not have any data on firms' use of trade finance and cannot investigate whether this channel is also of importance for German firms.

5.3 Intensive margin: Firm-product-destination level estimations

In the previous section, our findings at the firm-destination level reveal that diplomatic tensions and sanctions, in response to the Ukraine conflict, have had an adverse impact on the growth of firms' exports to Russia via multiple channels. Although firms that were directly affected by trade restrictions suffered the greatest decline, our research corroborates previous studies that suggest there is an indirect effect of economic sanctions. We will now move our analysis to the firm-product-destination level, as the analysis at the firm-destination level may obscure heterogeneities at the product level. Therefore, we take a more detailed view by repeating our intensive margin estimations from the previous section at the firm-product-destination level. Since the EU sanctions and Russia's embargo prohibit trade in certain goods, our analysis in this section focuses solely on non-sanctioned products. In other words, we concentrate on the "indirect" effect of the sanctions. Based on this sample, we estimate the following equation:

$$\begin{aligned} \Delta lnY_{fpdt} = & \beta_1(\text{Dec'13} \times \text{Russia}) + \\ & \beta_2(\text{Aug'14} \times \text{Russia}) + \gamma X_{ct} + \delta_{fd} + \delta_{pt} + \epsilon_{fpdt} \end{aligned} \tag{3}$$

where ΔlnY_{fpdt} is the year-over-year log growth rate of the value, quantity or price, respectively, of product p exported by firm f to destination d at time t. Again, our main coefficients of interest are the coefficients on the interaction terms *Dec'13* $\times$ *Russia* and *Aug'14* $\times$ *Russia*, i.e. β_1 and β_2.

We estimate equation 3 with two alternative sets of fixed effects. First, we include firm-destination (δ_{fd}) and product-time (δ_{pt}) fixed effects. They control for trends at the firm-destination and the product level. Constant factors specific to the firm-product-destination level are captured due to our specification in growth rates. In an alternative specification (displayed in equation 3), we include an even more restrictive set of fixed effects: firm-product-destination (δ_{fpd}) and firm-product-time (δ_{fpt}) fixed effects. δ_{fpd} absorb any trends in export value, quantity or price at the firm-product-destination level, given the specification in growth rates. δ_{fpt} control for growth trends at the firm-product-level (e.g. changes in marginal costs). Again, standard errors are clustered at the level of the firm in all regressions.

Table 6 presents our baseline results at the firm-product-destination level employing

Table 6. Firm-product-destination level estimations, 2013-2015

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Δln(value)	Δln(quant.)	Δln(uv)	Δln(value)	Δln(quant.)	Δln(uv)
Dec'13 × Russia	-0.049***	-0.045***	-0.005	-0.033**	-0.021	-0.012*
	(0.013)	(0.013)	(0.006)	(0.016)	(0.015)	(0.006)
Aug'14 × Russia	-0.129***	-0.132***	0.003	-0.134***	-0.137***	0.003
	(0.015)	(0.015)	(0.005)	(0.018)	(0.018)	(0.006)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes			
δ_{pt}	Yes	Yes	Yes			
δ_{fpd}				Yes	Yes	Yes
δ_{fpt}				Yes	Yes	Yes
# observations	29,650,254	29,650,254	29,650,254	27,077,776	27,077,776	27,077,776
# firms	13,503	13,503	13,503	10,251	10,251	10,251
R^2	0.0515	0.0494	0.0282	0.305	0.301	0.283

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

firm-destination and product-time fixed effects in columns 1-3 and the more restrictive specification including firm-product-destination and firm-product-time fixed effects in columns 4-6. Within product categories and relative to other destinations, growth of firm exports of non-sanctioned products to Russia in terms of value and quantity dropped significantly in the beginning of the Ukraine crisis and even more so after the imposition of trade sanctions. The results show that export growth to Russia fell by 4.9 percentage points in the first treatment period (column 1). The imposition of sanctions in 2014 amplified the negative effect in product-specific export growth to almost 13 percentage points. Both effects are statistically significant at the 1 percent level. A similar pattern can be observed when considering the growth in quantities exported (column 2), while export prices in euro remained unaffected by the political and economic turmoil. Even after employing the more restrictive set of fixed effects, our results remain largely robust. The coefficients on the interaction term *Aug'14* × *Russia* remain almost unchanged for the export value (column 4) and quantity (column 5). The effects in the first treatment period, however, become somewhat smaller and lose significance when $\Delta ln(quantity)$ is the dependent variable. Instead, lower export value growth to Russia is also driven by somewhat lower prices (column 6).

The results are in line with our findings from section 5.2. However, the size of the

effects decreases. The coefficients are now identified based on continuing firm-product-destination triples. As we now exploit within-product variation, the smaller effects indicate that some of the reduction in values and quantities as well as the price increase observed in section 5.2 was driven by specific firms. In addition, our analysis at the firm-product-destination level is only based on products not subject to trade restrictions. Still, we find a statistically highly significant and economically meaningful effect on the value and quantity exported, highlighting the indirect effects of trade sanctions.

We continue our analysis of the indirect impact of sanctions by investigating whether the effects are heterogeneous across different products groups. In particular, we group products by Eurostat's end-use categories (Main Industrial Groupings, MIGs) and repeat the estimation of equation 3 on sub-samples of agricultural products, intermediate goods, investment goods, non-durable and durable consumer goods as well as energy goods. The results are presented in table 12. For all product categories but agriculture and energy (columns 1 and 6), the imposition of sanctions had a major negative effect on exports of non-sanctioned products to Russia relative to other destinations. Consumer goods – both durable and non-durable – experienced the highest losses after the imposition of sanctions, followed by investment and intermediate goods.

Table 7. Firm-product-destination level estimations, Δln(value), 2013-2015, product groups, fixed effects: δ_{fd}, δ_{pt}

	(1)	(2)	(3)	(4)	(5)	(6)
Product group	Agriculture	Intermediate	Investment	Non-durable	Durable	Energy
Dep. variable	Δln(value)	Δln(value)	Δln(value)	Δln(value)	Δln(value)	Δln(value)
Dec'13 × Russia	0.151	-0.034**	-0.043**	-0.055	-0.084***	-0.096
	(0.122)	(0.014)	(0.020)	(0.037)	(0.028)	(0.091)
Aug'14 × Russia	-0.066	-0.109***	-0.124***	-0.155***	-0.176***	-0.072
	(0.118)	(0.016)	(0.024)	(0.035)	(0.029)	(0.082)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes	Yes	Yes	Yes
δ_{pt}	Yes	Yes	Yes	Yes	Yes	Yes
# observations	80,297	15,056,955	8,189,860	1,083,869	4,562,208	123,415
# firms	387	9,346	8,859	2,769	5,332	911
R^2	0.128	0.0536	0.0612	0.0803	0.0654	0.123

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Finally, more recent developments in the literature focusing on firm heterogeneity show that firm exports are granular. Both firm- and firm-product-specific competencies shape firms' exports (Görg et al., 2012). In fact, the exports of multi-product firms are found to be dominated by their core products (Amador and Opromolla, 2013; Arnarson, 2020). In addition, evidence shows that the overwhelming majority of manufacturing firms export products that they do not produce and that these make up a substantial share of a firm's product range and overall export value (Bernard et al., 2019). The role of core competencies regarding the response to the uncertainty and trade policy shock is *a priori* unclear. Görg et al. (2012) demonstrates that exports of core products are more resilient with respect to shocks suggesting that they might not be affected much by the shock under study.[15] On the other hand, Arnarson (2020) provides evidence for one-sided complementarities between core and non-core products, where the latter react to the former. Consequently, the negative effect on firm-product level exports observed might be driven by shock propagation along the product lines of a firm.

To test these hypotheses we now take a closer look at the role of the firms' core competencies for the intensive margin of trade. To do so, we include in equation 3 an additional component for core competency products within a firm, i.e. *Dec'13* $\times$ *Russia* $\times$ *Core* and *Aug'14* $\times$ *Russia* $\times$ *Core*. We identify a core product as the product with the highest share in a firms' total export value in 2012. The triple interactions capture the differential response of a firm's core product compared to all other products traded with Russia before and after the sanctions. Table 8 gives the results.

Firms reduce exports to Russia of products of core competency more compared to all other goods. Interestingly, the additional drop both in value and quantity (columns 1 and 2) is stronger in the first treatment period when political uncertainty started to increase. While these results speak against empirical evidence provided above, evidence by Mayer et al. (2021), for example, leave room for interpretation. They investigate changes in the product mix of French multi-product firms due to positive demand shocks in export markets. While firms seem to shift their export sales towards core competency products in the case of positive demand shocks, we find that sales of

[15]Exports of products directly targeted by sanctions are expected to naturally drop irrespective of their position in a firms' product portfolio which would bias the results of that exercise. However, as explained before, we abstract from exports of products directly targeted by the sanctions in this section.

Table 8. Firm-product-destination level estimations, 2013-2015, by product rating

	(1)	(2)	(3)
Dependent variable	Δln(value)	Δln(quantity)	Δln(uv)
Dec'13 × Russia	-0.041***	-0.035**	-0.006
	(0.014)	(0.014)	(0.007)
Dec'13 × Russia × Core	-0.054***	-0.061***	0.007
	(0.018)	(0.019)	(0.009)
Aug'14 × Russia	-0.124***	-0.124***	0.000
	(0.017)	(0.017)	(0.006)
Aug'14 × Russia × Core	-0.038**	-0.053***	0.015**
	(0.018)	(0.019)	(0.008)
Controls	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes
δ_{pt}	Yes	Yes	Yes
# observations	29,487,188	29,487,188	29,487,188
# firms	13,486	13,486	13,486
R^2	0.050	0.048	0.028

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

core competency products drop more than other products in the presence of political uncertainty.

6 Empirical analysis: Impact on firm performance

An important question we want to look at now is whether the estimated trade effects are also mirrored by changes in firm performance. For this purpose, we link the foreign trade data to the firm statistics dataset that provides information for a sample of German firms on an annual basis. We focus on the years 2011 to 2017 and employ an event study design. This allows us to compare the dynamics of firm performance before and after the the Crimea conflict and the imposition of sanctions in 2014, for firms directly exposed to the Russian market and the sanctions, and those that are not. More specifically, we estimate the following equation:

$$lnY_{ft} = \sum_{\tau=2011}^{2017} \beta_c^{\tau} Time_{\tau,t} \times Treated_f^c + \delta_f + \delta_s + \delta_t + \epsilon_{ft}, \tag{4}$$

with Y_{ft} being a measure of performance of firm f at time t. We use total sales and the number of employees (in full-time equivalents). In addition, we look at the impact on expenses for temporary employment as another indicator capturing labour market effects. $Time_{\tau,t}$ is a dummy equal to 1 τ periods before/after the baseline period. We use the year before the the annexation of Crimea, i.e. 2013, as our baseline. $Treated_f^c$ is a dummy equal to 1 if a firm is in the treatment group. We classify a firm as treated if it exports to Russia in 2013. Taking into account different aspects of treatment heterogeneity, we distinguish between various treatment categories c when estimating the effect.

First, we allow for heterogeneous effects based on firms' dependence on Russia as an export market. Firms selling only a very small share of their total exports to Russia are likely to be less affected by the sanctions than firms highly specialised on Russia as an export market. To exploit these heterogeneities in treatment intensity across firms, we distinguish three different treatment groups based on the 2013 share of Russia in total sales of firm f. Firms in category 1 are firms exporting to Russia but for which the country accounts for less than 2 percent of total sales (2,532 firms). For firms in category 2, Russia's share in total sales is between 2 and 5 percent (419 firms), and for firms in category 3, Russia accounts for more than 5 percent of total sales (283 firms). The control group consists of firms not exporting to Russia but to other destinations (4,859 firms).[16]

Second, we consider exposure to the sanctions as a source of treatment heterogeneity. The results in section 5 showed that firms that were directly affected by the sanctions experienced a more pronounced decrease in exports to Russia than those indirectly impacted by the sanctions. Accordingly, we anticipate stronger effects on the performance of firms directly restricted in their export activity by the sanctions. We classify firms as directly exposed to the sanctions if they sell a product to Russia in 2013 that is subject to trade restricting measures from August 2014 onward. In the dataset used for the analysis of firm performance, there are 341 firms with direct sanction exposure. Firms are indirectly exposed if they export other products to Russia (2,893 firms). Again, firms exporting to other countries than Russia are in the control group.

Any difference in firm-level characteristics that is constant over time is captured by

[16]By only including exporters in our regression, we reduce potential endogeneity arising from selection into exporting (Wagner, 2007).

the firm fixed effects δ_f. In addition, δ_s absorbs time-invariant sector-specific factors and δ_t are year dummies, controlling for everything affecting all firms equally in a given year. Standard errors are again clustered at the firm level.

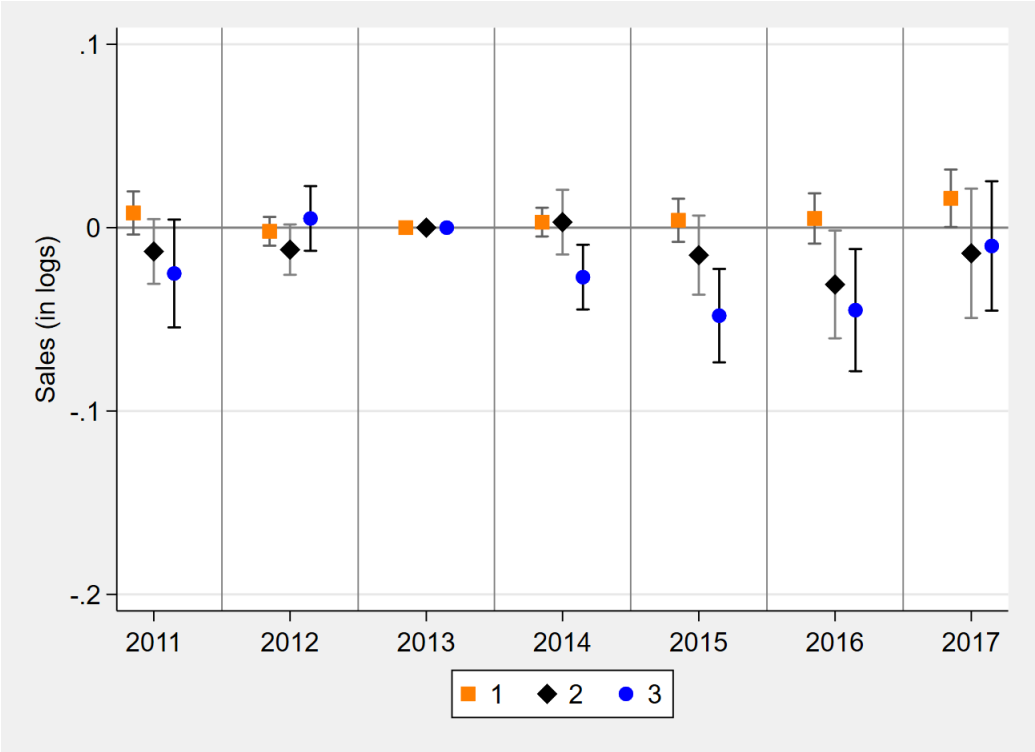
Figures 1, 2 and 3 display the results of the event study analysis, allowing for heterogeneous effects based on the importance Russia holds as an export market for a particular firm.[17] Overall, we do not find any striking differences between the four treatment categories and the control group, i.e. exporters not active in Russia, before 2014. The coefficients for the years preceding our assigned time of treatment are mostly not statistically significantly different from 0. Importantly, no significant pre-trends are visible for the treatment categories for any of the indicators of firm performance analysed.

The results show that firms exporting to Russia experience a decrease in total sales following the 2014 conflict and sanctions (Figure 1). However, the negative effects are concentrated among firms for which Russia is a comparatively important export market and take some time to fully materialise. While firms highly dependant on Russia (treatment category 3) already see a drop in sales in 2014, the negative effect reaches its peak in 2015, with total sales of highly exposed firms 4.8 percent lower than total sales of those exporters not active in the Russian market. The effect for both years are statistically significant at the 1 percent level. Given that official sanctions were only introduced in August 2014, the dynamics of the effect are reasonable. The difference remains almost unchanged in 2016 but becomes considerably smaller in 2017 and loses its statistical significance, suggesting that the negative impact is temporary. The estimated coefficients for firms in treatment category 2 display similar dynamics but are mostly not statistically different from zero at conventional levels. At the same time, firms generating less than 2 percent of their sales in Russia in 2013 (treatment category 1) do not see any drop in total sales in response to the 2014 sanctions in comparison to the control group, indicating that they are able to divert their sales destined for Russia either to other destination countries or to the domestic market.

Moreover, our analysis reveals moderate labour market effects of the 2014 conflict and sanctions. In contrast to the effect on sales, not only firms highly dependent on Russia as an export market reduce their workforce. Instead, firms in the treatment categories 1-3 reduce their number of employees (measured in full-time equivalents) by 1.7 to 2.4 percent in 2014, relative to the control group (Figure 2). The impact increases

[17] Table 21 in the appendix shows the corresponding regression results.

Figure 1. Effects on total sales by exposure to Russia, 2011-2017

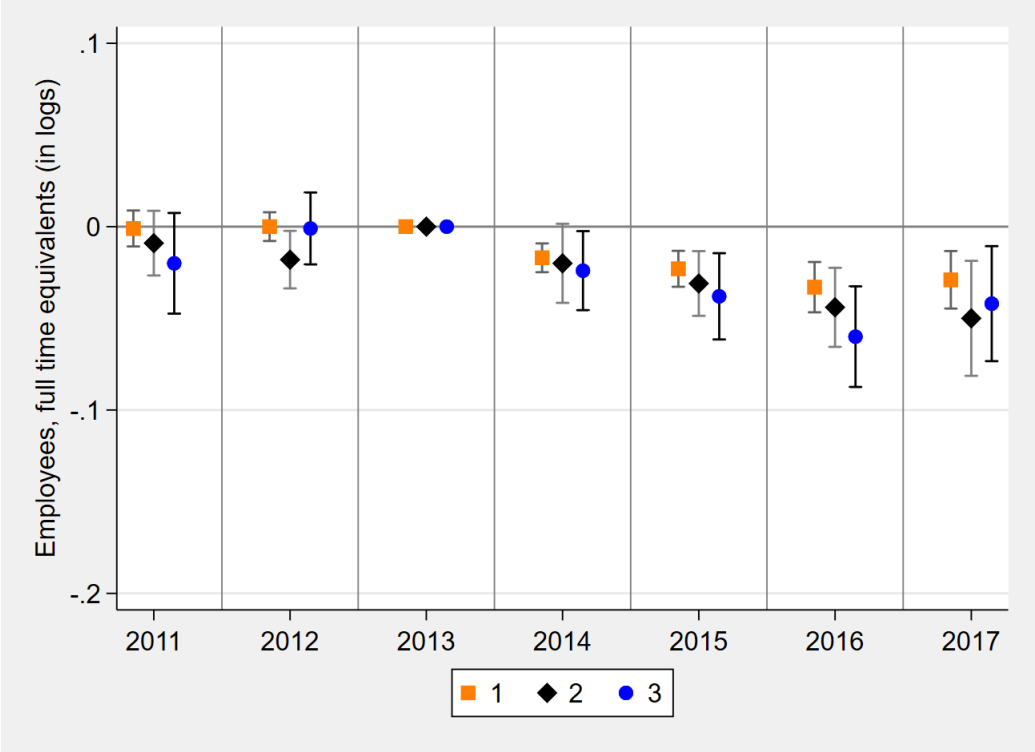


The figure plots the coefficients β_c^τ from equation 4, where categories c are based on firm level exposure to Russia as an export market. The regression includes firm, sector and year fixed effects. The vertical lines reflect the 95% confidence intervals. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, Structural Business Statistics, survey years 2011-2017, own calculations.

somewhat over the years 2015 and 2016 but stays relatively stable thereafter and seems to be of a more permanent nature in comparison to the effect on sales. A reason for the broader response of employment could be related to an adjustment of the product mix of firms. In section 6 we provide evidence that firms particularly reduce the exports of core competency products to Russia. Production and distribution of these main products are likely to tie up a large part of the workforce – which is reduced in light of a drop in sales of the core products. Still, similar to our results for total sales, the size of the effect increases with the high dependence on Russia as an export market. We also find evidence that firms highly involved in Russia respond by reducing their expenses for temporary employment (Figure 3).

Figures 4, 5 and 6 show the results when we allow for heterogeneous effects based

Figure 2. Effects on the number of employees (FTE) by exposure to Russia, 2011-2017



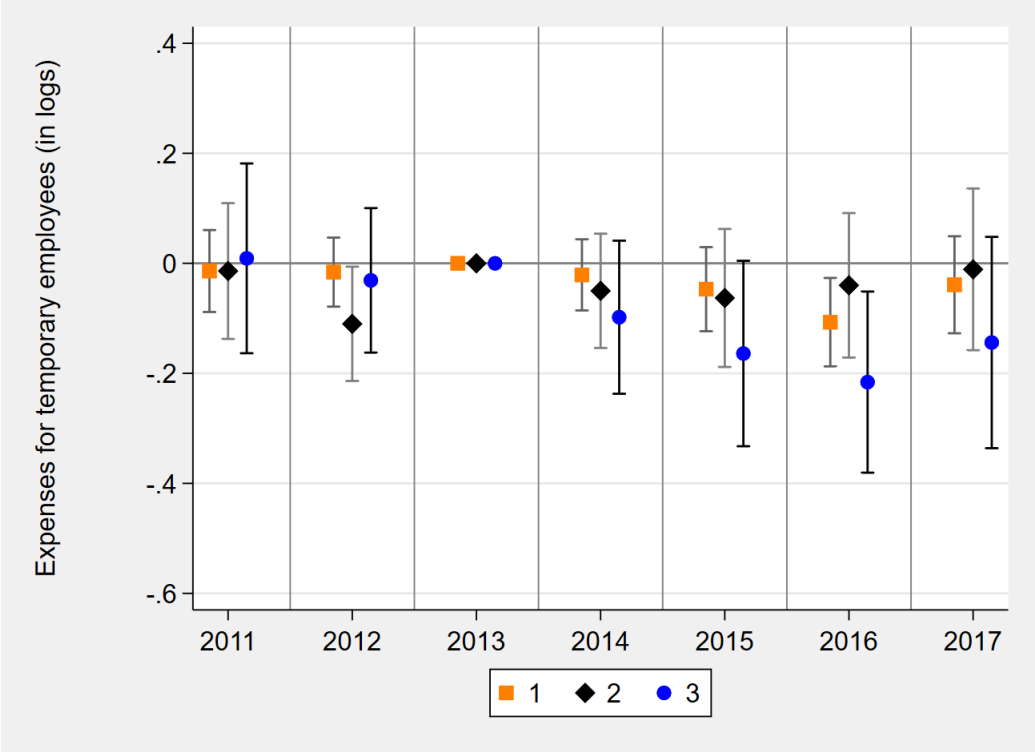
The figure plots the coefficients β_c^τ from equation 4, where categories c are based on firm level exposure to Russia as an export market. The regression includes firm, sector and year fixed effects. The vertical lines reflect the 95% confidence intervals. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, Structural Business Statistics, survey years 2011-2017, own calculations.

on whether a firm is directly or indirectly affected by the sanctions.[18] Again, the treatment groups are not statistically significantly different from the control group in the years preceding the sanctions, and no worrying pre-trends are observable for any of the indicators of firm performance.

The results confirm our expectation that firms directly affected by the sanctions experience stronger negative effects on their performance compared to firms only indirectly affected by the sanctions. In fact, firms exporting exclusively non-sanctioned products to Russia do not see a drop in total sales, suggesting that they can compensate for a potential loss in business with Russia by increasing sales elsewhere. Total sales

[18]The corresponding regressions are displayed in table 22 in the appendix.

Figure 3. Effects on expenses for temporary employees by exposure to Russia, 2011-2017



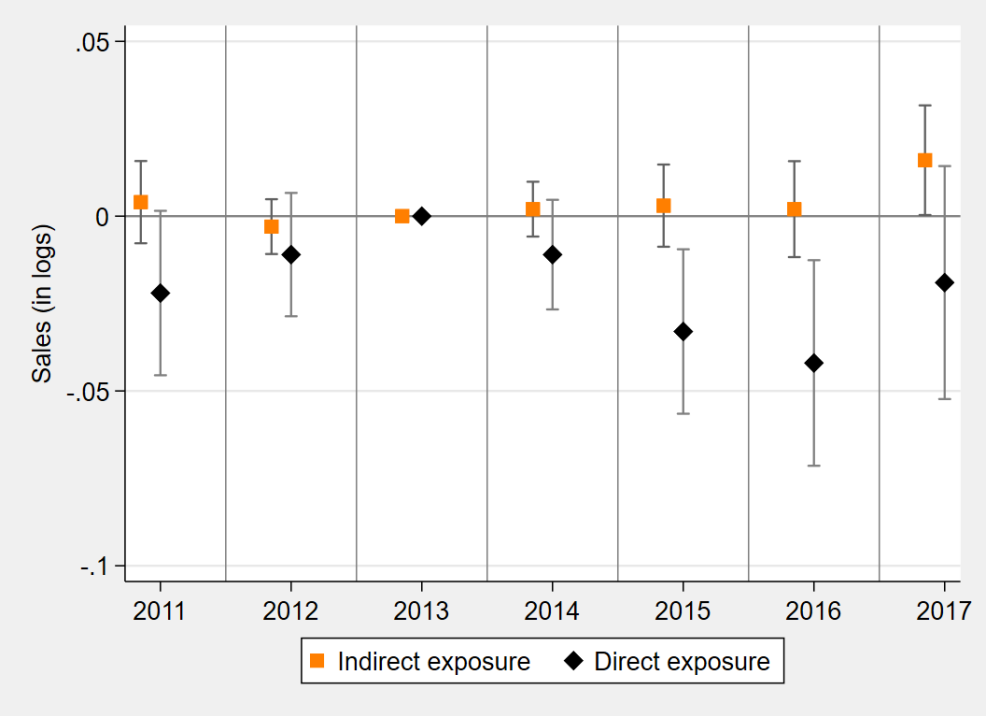
The figure plots the coefficients β_c^τ from equation 4, where categories c are based on firm level exposure to Russia as an export market. The regression includes firm, sector and year fixed effects. The vertical lines reflect the 95% confidence intervals. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, Structural Business Statistics, survey years 2011-2017, own calculations.

of firms directly affected by the sanctions, however, decrease significantly under the sanction regime. The dynamics are comparable to those observed for firms highly dependent on Russia as an export market: the negative effect takes some time to materialise but is statistically significant at the 1 percent level in 2015 and 2016. In 2016, total sales of firms directly restricted in their export activity by the sanctions are 4.2 percent below the sales of firms not exporting to Russia. By 2017, directly exposed firms seem to have adjusted to the sanction regime, as their sales are no longer statistically different to those of the control group.

Contrary to the impact on total sales, we find negative effects on employment for both directly and indirectly exposed firms. However, and again in line with our

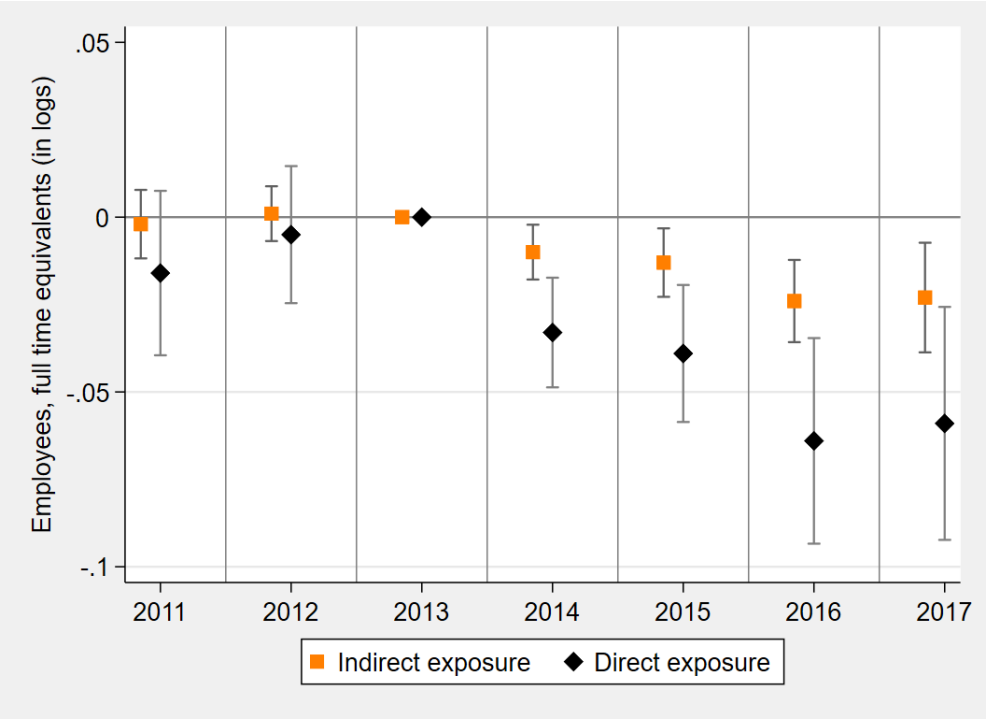
expectations, the impact is larger for firms directly restricted by the sanctions. In 2014, firms indirectly affected by the sanctions reduce the number of employees by 1 percent relative to the control group, while the impact is -3.3 percent for firms directly affected by the sanctions. As before, the negative effects are largest in 2016. In addition, we find evidence that firms with direct exposure to the sanctions reduce their expenses for temporary employees relative to the control group. The impact is not statistically different from 0 for indirectly exposed firms.

Figure 4. Effects on total sales by sanction exposure, 2011-2017



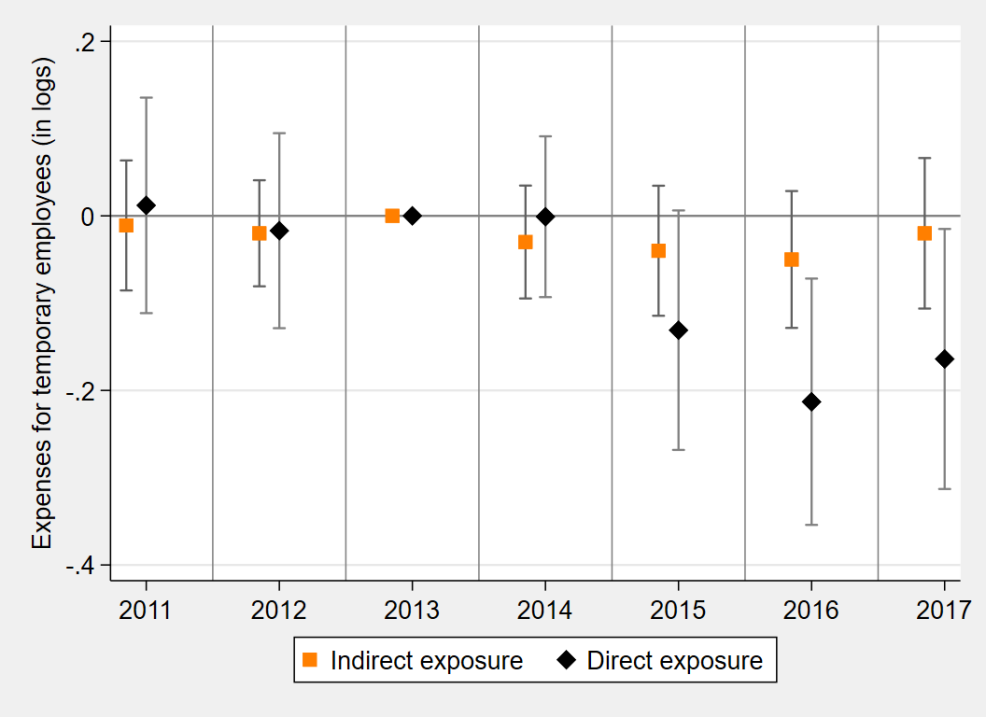
The figure plots the coefficients β_c^τ from equation 4, where categories c are based on firm level exposure to the sanctions. The regression includes firm, sector and year fixed effects. The vertical lines reflect the 95% confidence intervals. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, Structural Business Statistics, survey years 2011-2017, own calculations.

Figure 5. Effects on the number of employees (FTE) by sanction exposure, 2011-2017



The figure plots the coefficients β_c^τ from equation 4, where categories c are based on firm level exposure to the sanctions. The regression includes firm, sector and year fixed effects. The vertical lines reflect the 95% confidence intervals. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, Structural Business Statistics, survey years 2011-2017, own calculations.

Figure 6. Effects on expenses for temporary employees by sanction exposure, 2011-2017



The figure plots the coefficients β_c^τ from equation 4, where categories c are based on firm level exposure to the sanctions. The regression includes firm, sector and year fixed effects. The vertical lines reflect the 95% confidence intervals. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, Structural Business Statistics, survey years 2011-2017, own calculations.

7 Conclusion

Our paper quantifies the impact of the Crimea conflict and the sanctions imposed as a response to it – both by the EU and the countermeasures introduced by Russia – in 2014 on German firms. The foundation of our investigation is a novel firm level dataset on foreign trade for Germany covering a large majority of goods trade at the firm-product-destination level on a monthly basis. This allows us to analyse the short-term impact of the diplomatic conflict and the sanctions on various margins of German export activity. Combining the firm level trade data with annual information on firm outcomes we also explore the impact of the sanctions on general firm performance over time.

We find that Russia significantly lost importance as an export market for German firms after the onset of the conflict and – even more so – when trade restrictions were imposed. Adjustments occurred both in terms of general engagement on the Russian market, i.e. the extensive margin, but also in terms of the exported value, i.e. the intensive margin. The intensive margin adjustment is driven by lower quantities traded; the euro price of exports to Russia increases somewhat. Adding the product dimension to our analysis, we find that the negative effects are strongest for the relatively small number of firms exporting products subject to trade restrictions. However, also exports of products not explicitly targeted by the sanctions drop significantly, highlighting the relevance of the indirect effects of sanctions. In this regard, we find that firms particularly reduce exports of their core products to Russia. Overall, our results on the trade effects of sanctions are consistent with evidence on firms' export behaviour from other sanctioning states, such as Denmark (Jäkel et al., 2022), France (Hinz and Monastyrenko, 2022) and Sweden (Gullstrand, 2020).

We complement previous studies by analysing the consequences of trade sanctions for the overall performance of firms. While Besedeš et al. (2021) investigate the impact of financial sanctions on the performance of German firms covering several sanction episodes over 15 years and find no effects for the average firm, to the best of our knowledge, the consequences of trade sanctions for firm performance have not been evaluated so far. More specifically, we look at the development of total sales and labour market outcomes of firms exporting to Russia relative to firms not engaged on the Russian market, taking into account different aspects of treatment heterogeneity. Our results indicate that the negative impact of the shock was concentrated primarily among a small number of firms that were highly dependent on Russia as an export

market and those directly affected by the sanctions. These findings indicate that the indirect effects of sanctions observed for trade outcomes have a limited impact on broader indicators of firm performance. In summary, our study underscores the importance of considering heterogeneity both on the firm and on the firm-product level in assessing the costs of sanctions and suggests that adverse economic effects of trade sanctions are limited.

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A Appendix

A.1 Firm-destination level estimations: Sub-sample analysis

Table 9. Firm-destination level estimations, Δln(quantity), 2013-2015, subsamples

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(quantity)	Δln(quantity)	Δln(quantity)
Dec'13 × Russia	-0.129***	-0.052***	-0.098***
	(0.018)	(0.020)	(0.020)
Aug'14 × Russia	-0.192***	-0.135***	-0.105***
	(0.020)	(0.019)	(0.025)
Controls	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes
δ_{ft}	Yes	Yes	Yes
# observations	4,070,400	1,233,729	1,667,815
# firms	11,134	8,863	9,491
R^2	0.221	0.234	0.290

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Table 10. Firm-destination level estimations, Δln(uv), 2013-2015, subsamples

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(uv)	Δln(uv)	Δln(uv)
Dec'13 × Russia	0.031***	0.010	0.018**
	(0.008)	(0.009)	(0.009)
Aug'14 × Russia	0.037***	0.009	0.024**
	(0.009)	(0.009)	(0.012)
Controls	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes
δ_{ft}	Yes	Yes	Yes
# observations	4,070,400	1,233,729	1,667,815
# firms	11,134	8,863	9,491
R^2	0.205	0.237	0.277

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Table 11. Firm-destination level estimations, Δln(#products), 2013-2015, subsamples

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(#products)	Δln(#products)	Δln(#products)
Dec'13 × Russia	-0.026***	-0.016**	-0.023***
	(0.007)	(0.007)	(0.008)
Aug'14 × Russia	-0.051***	-0.037***	-0.034***
	(0.008)	(0.007)	(0.010)
Controls	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes
δ_{ft}	Yes	Yes	Yes
# observations	4,070,400	1,233,729	1,667,815
# firms	11,134	8,863	9,491
R^2	0.283	0.247	0.332

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

A.2 Firm-product-destination level estimations by product categories

Table 12. Firm-product-destination level estimations, Δln(value), 2013-2015, product groups, fixed effects: δ_{fd}, δ_{pt}

	(1)	(2)	(3)	(4)	(5)	(6)
Product group	Agriculture	Intermediate	Investment	Non-durable	Durable	Energy
Dep. variable	Δln(value)	Δln(value)	Δln(value)	Δln(value)	Δln(value)	Δln(value)
Dec'13 × Russia	0.151	-0.034**	-0.043**	-0.055	-0.084***	-0.096
	(0.122)	(0.014)	(0.020)	(0.037)	(0.028)	(0.091)
Aug'14 × Russia	-0.066	-0.109***	-0.124***	-0.155***	-0.176***	-0.072
	(0.118)	(0.016)	(0.024)	(0.035)	(0.029)	(0.082)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes	Yes	Yes	Yes
δ_{pt}	Yes	Yes	Yes	Yes	Yes	Yes
# observations	80,297	15,056,955	8,189,860	1,083,869	4,562,208	123,415
# firms	387	9,346	8,859	2,769	5,332	911
R^2	0.128	0.0536	0.0612	0.0803	0.0654	0.123

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Table 13. Firm-product-destination level estimations, Δln(quantity), 2013-2015, product groups, fixed effects: δ_{fd}, δ_{pt}

	(1)	(2)	(3)	(4)	(5)	(6)
Product group	Agriculture	Intermediate	Investment	Non-durable	Durable	Energy
Dep. variable	Δln(quant.)	Δln(quant.)	Δln(quant.)	Δln(quant.)	Δln(quant.)	Δln(quant.)
Dec'13 × Russia	0.093	-0.022	-0.044**	-0.054	-0.084***	-0.054
	(0.139)	(0.015)	(0.021)	(0.040)	(0.026)	(0.100)
Aug'14 × Russia	-0.038	-0.112***	-0.129***	-0.162***	-0.169***	-0.097
	(0.134)	(0.017)	(0.025)	(0.037)	(0.030)	(0.091)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes	Yes	Yes	Yes
δ_{pt}	Yes	Yes	Yes	Yes	Yes	Yes
# observations	80,297	15,056,955	8,189,860	1,083,869	4,562,208	123,415
# firms	387	9,346	8,859	2,769	5,332	911
R^2	0.126	0.0519	0.0577	0.0792	0.0644	0.123

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Table 14. Firm-product-destination level estimations, Δln(uv), 2013-2015, product groups, fixed effects: δ_{fd}, δ_{pt}

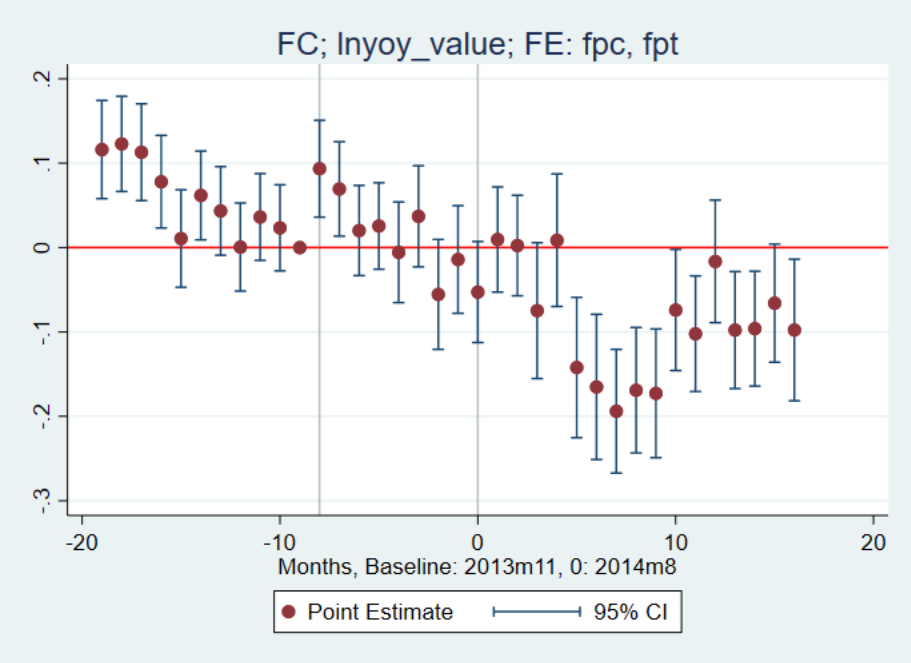
	(1)	(2)	(3)	(4)	(5)	(6)
Product group	Agriculture	Intermediate	Investment	Non-durable	Durable	Energy
Dep. variable	Δln(uv)	Δln(uv)	Δln(uv)	Δln(uv)	Δln(uv)	Δln(uv)
Dec'13 × Russia	0.058	-0.012	0.001	-0.001	-0.000	-0.043
	(0.049)	(0.009)	(0.008)	(0.016)	(0.009)	(0.047)
Aug'14 × Russia	-0.028	0.004	0.005	0.007	-0.007	0.025
	(0.048)	(0.007)	(0.008)	(0.016)	(0.010)	(0.032)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes	Yes	Yes	Yes
δ_{pt}	Yes	Yes	Yes	Yes	Yes	Yes
# observations	80,297	15,056,955	8,189,860	1,083,869	4,562,208	123,415
# firms	387	9,346	8,859	2,769	5,332	911
R^2	0.157	0.0344	0.0307	0.0574	0.0534	0.135

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

A.3 Firm-product-destination level estimations: event study graphs

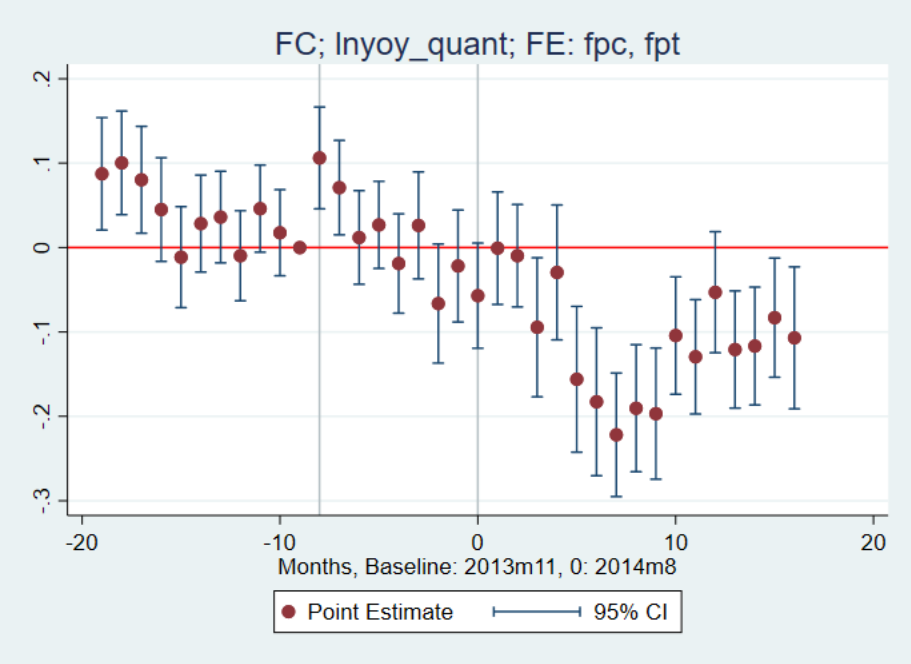
The following graphs show the results of an event study estimation based on the same data as used in section 5.3 and including the same control variables and fixed effects as displayed in equation 3. The first vertical line represents December 2013, the second line represents August 2014, the month in which the "main" treatment period starts.

Figure 7. Dynamic effects on $\Delta value$



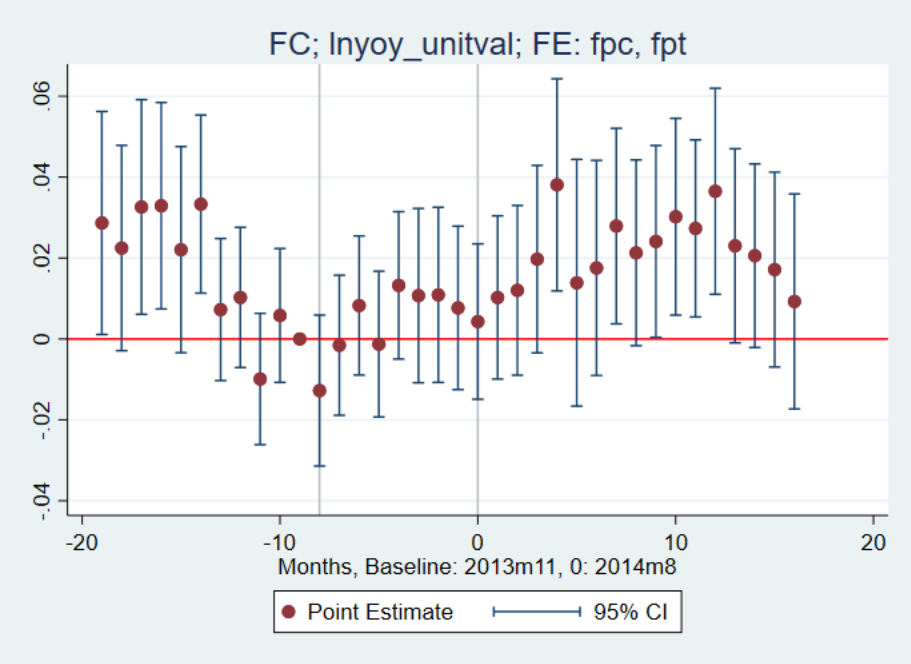
Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Figure 8. Dynamic effects on $\Delta quantity$



Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Figure 9. Dynamic effects on $\Delta unitvalue$



Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

A.4 Firm-product-destination level estimations: sub-samples analysis

Table 15. Firm-product-destination level estimations, Δln(value), 2013-2015, sub-samples, fixed effects: δ_{fd}, δ_{pt}

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(value)	Δln(value)	Δln(value)
Dec'13 $\times$ Russia	-0.060***	-0.010	-0.041**
	(0.014)	(0.012)	(0.017)
Aug'14 $\times$ Russia	-0.107***	-0.097***	-0.053***
	(0.018)	(0.013)	(0.020)
Controls	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes
δ_{pt}	Yes	Yes	Yes
# observations	25,052,692	5,562,860	9,399,922
# firms	13,263	12,920	12,877
R^2	0.0571	0.0476	0.0732

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Table 16. Firm-product-destination level estimations, Δln(value), 2013-2015, subsamples, fixed effects: δ_{fpd}, δ_{fpt}

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(value)	Δln(value)	Δln(value)
Dec'13 × Russia	-0.051***	0.009	-0.032
	(0.019)	(0.015)	(0.024)
Aug'14 × Russia	-0.123***	-0.093***	-0.084***
	(0.021)	(0.016)	(0.027)
Controls	Yes	Yes	Yes
δ_{fpd}	Yes	Yes	Yes
δ_{fpt}	Yes	Yes	Yes
# observations	22,693,699	4,282,720	7,786,943
# firms	9,772	7,162	8,267
R^2	0.339	0.303	0.390

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Table 17. Firm-product-destination level estimations, Δln(quantity), 2013-2015, subsamples, fixed effects: δ_{fd}, δ_{pt}

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(quantity)	Δln(quantity)	Δln(quantity)
Dec'13 × Russia	-0.058***	-0.019*	-0.030*
	(0.015)	(0.011)	(0.017)
Aug'14 × Russia	-0.141***	-0.093***	-0.057***
	(0.018)	(0.013)	(0.020)
Controls	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes
δ_{pt}	Yes	Yes	Yes
# observations	25,052,692	5,562,860	9,399,922
# firms	13,263	12,920	12,877
R^2	0.0546	0.0481	0.0699

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Table 18. Firm-product-destination level estimations, Δln(quantity), 2013-2015, subsamples, fixed effects: δ_{fpd}, δ_{fpt}

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(quantity)	Δln(quantity)	Δln(quantity)
Dec'13 × Russia	-0.043**	0.019	-0.016
	(0.019)	(0.015)	(0.024)
Aug'14 × Russia	-0.153***	-0.081***	-0.088***
	(0.021)	(0.016)	(0.028)
Controls	Yes	Yes	Yes
δ_{fpd}	Yes	Yes	Yes
δ_{fpt}	Yes	Yes	Yes
# observations	22,693,699	4,282,720	7,786,943
# firms	9,772	7,162	8,267
R^2	0.335	0.302	0.387

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Table 19. Firm-product-destination level estimations, Δln(uv), 2013-2015, subsamples, fixed effects: δ_{fd}, δ_{pt}

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(uv)	Δln(uv)	Δln(uv)
Dec'13 × Russia	-0.002	0.009*	-0.011*
	(0.007)	(0.005)	(0.006)
Aug'14 × Russia	0.034***	-0.004	0.004
	(0.006)	(0.005)	(0.007)
Controls	Yes	Yes	Yes
δ_{fd}	Yes	Yes	Yes
δ_{pt}	Yes	Yes	Yes
# observations	25,052,692	5,562,860	9,399,922
# firms	13,263	12,920	12,877
R^2	0.0279	0.0515	0.0378

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

Table 20. Firm-product-destination level estimations, Δln(uv), 2013-2015, subsamples, fixed effects: δ_{fpd}, δ_{fpt}

	(1)	(2)	(3)
Control group	Sanction countries	No sanction countries	Eastern Europe
Dependent variable	Δln(uv)	Δln(uv)	Δln(uv)
Dec'13 $\times$ Russia	-0.007	-0.010	-0.016**
	(0.007)	(0.006)	(0.008)
Aug'14 $\times$ Russia	0.031***	-0.013**	0.004
	(0.007)	(0.006)	(0.008)
Controls	Yes	Yes	Yes
δ_{fpd}	Yes	Yes	Yes
δ_{fpt}	Yes	Yes	Yes
# observations	22,693,699	4,282,720	7,786,943
# firms	9,772	7,162	8,267
R^2	0.307	0.332	0.361

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, own calculations.

A.5 Firm level estimations: firm performance

Table 21. Effect on firm performance by exposure to Russia, 2011-2017

Dependent variable	(1) $ln(sales)$	(2) $ln(\#employees)$	(3) $ln(temporary)$
Category1 × 2011	0.008	-0.001	-0.014
	0.006	0.005	0.038
Category1 × 2012	-0.002	0.000	-0.016
	0.004	0.004	0.032
Category1 × 2014	0.003	-0.017***	-0.021
	0.004	0.004	0.033
Category1 × 2015	0.004	-0.023***	-0.047
	0.006	0.005	0.039
Category1 × 2016	0.005	-0.033***	-0.107***
	0.007	0.007	0.041
Category1 × 2017	0.016**	-0.029***	-0.039
	0.008	0.008	0.045
Category2 × 2011	-0.013	-0.009	-0.014
	0.009	0.009	0.063
Category2 × 2012	-0.012*	-0.018**	-0.110**
	0.007	0.008	0.053
Category2 × 2014	0.003	-0.020*	-0.050
	0.009	0.011	0.053
Category2 × 2015	-0.015	-0.031***	-0.063
	0.011	0.009	0.064
Category2 × 2016	-0.031**	-0.044***	-0.040
	0.015	0.011	0.067
Category2 × 2017	-0.014	-0.050***	-0.011
	0.018	0.016	0.075
Category3 × 2011	-0.025*	-0.020	0.009
	0.015	0.014	0.088
Category3 × 2012	0.005	-0.001	-0.031
	0.009	0.010	0.067
Category3 × 2014	-0.027***	-0.024**	-0.098
	0.009	0.011	0.071
Category3 × 2015	-0.048***	-0.038***	-0.164*
	0.013	0.012	0.086
Category3 × 2016	-0.045***	-0.060***	-0.216**
	0.017	0.014	0.084
Category3 × 2017	-0.010	-0.042**	-0.144
	0.018	0.016	0.098
δ_f	Yes	Yes	Yes
δ_s	Yes	Yes	Yes
δ_t	Yes	Yes	Yes
# observations	63,573	63,230	33,517
# firms	9,082	9,043	5,610
R^2	0.988	0.987	0.863

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, Structural Business Statistics, survey years 2011-2017, own calculations.

Table 22. Effect on firm performance by sanction exposure, 2011-2017

Dependent variable	(1) $ln(sales)$	(2) $ln(\#employees)$	(3) $ln(temporary)$
Indirect × 2011	0.004	-0.002	-0.011
	(0.006)	(0.005)	(0.038)
Indirect × 2012	-0.003	0.001	-0.02
	(0.004)	(0.004)	(0.031)
Indirect × 2014	0.002	-0.010**	-0.03
	(0.004)	(0.004)	(0.033)
Indirect × 2015	0.003	-0.013***	-0.04
	(0.006)	(0.005)	(0.038)
Indirect × 2016	0.002	-0.024***	-0.05
	(0.007)	(0.006)	(0.04)
Indirect × 2017	0.016**	-0.023***	-0.02
	(0.008)	(0.008)	(0.044)
Direct × 2011	-0.022*	-0.016	0.012
	(0.012)	(0.012)	(0.063)
Direct × 2012	-0.011	-0.005	-0.017
	(0.009)	(0.01)	(0.057)
Direct × 2014	-0.011	-0.033***	-0.001
	(0.008)	(0.008)	(0.047)
Direct × 2015	-0.033***	-0.039***	-0.131*
	(0.012)	(0.01)	(0.07)
Direct × 2016	-0.042***	-0.064***	-0.213***
	(0.015)	(0.015)	(0.072)
Direct × 2017	-0.019	-0.059***	-0.164**
	(0.017)	(0.017)	(0.076)
δ_f	Yes	Yes	Yes
δ_s	Yes	Yes	Yes
δ_t	Yes	Yes	Yes
# observations	56,649	56,388	32,221
# firms	8,093	8,064	5,347
R^2	0.986	0.987	0.863

Robust standard errors clustered at the firm level are in parentheses. ***, ** and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Source: RDC of the Federal Statistical Office and Statistical Offices of the Federal States, Foreign Trade Statistics, Structural Business Statistics, 2011-2017, own calculations.

A.6 Data

Table 23. Products targeted by EU sanctions

HS 4-digit product code	Description	HS 6-digit product codes included
7304	Tubes, pipes and hollow profiles, seamless, of iron (other than cast iron) or steel	730411, 730419, 730422, 730423, 730429
7305	Iron or steel (excluding cast iron); tubes and pipes (e.g. welded, riveted or similarly closed), having circular cross-sections, external diameter of which exceeds 406.4mm, not seamless	730511, 730512, 730519, 730520
7306	Iron or steel (excluding cast iron); tubes, pipes and hollow profiles (not seamless), n.e.c. in chapter 73	730611, 730619, 730621, 730629
8207	Tools, interchangeable; for hand tools, whether or not power-operated, or for machine tools (pressing, stamping, punching, drilling etc), including dies for drawing or extruding metal, and rock drilling or earth boring tools	820713, 820719, 730411, 730419, 730422, 730423, 730429
8413	Pumps; for liquids, whether or not fitted with measuring device, liquid elevators	841350, 841360, 841382, 841392
8430	Moving, grading, levelling, scraping, excavating, tamping, compacting, extracting or boring machinery, for earth, minerals, or ores; pile drivers and extractors; snow ploughs and snow blowers	843049
8431	Machinery parts; used solely or principally with the machinery of heading no. 8425 to 8430	843139, 843143, 843149
8705	Special purpose motor vehicles; not those for the transport of persons or goods (e.g. breakdown lorries, road sweeper lorries, spraying lorries, mobile workshops, mobile radiological units etc)	870520
8905	Light-vessels, fire-floats, dredgers, floating cranes, other vessels; the navigability of which is subsidiary to main function; floating docks, floating, submersible drilling, production platforms	890520, 890590

Source: Council Regulation (EU) No 833/2014 of 31 July 2014 concerning restrictive measures in view of Russia's actions destabilising the situation in Ukraine.

Table 24. Products targeted by Russian embargo

HS 4-digit product code	Description	HS 6-digit product codes
0201	Meat of bovine animals; fresh or chilled	020110, 020120, 020130
0202	Meat of bovine animals; frozen	020210, 020220, 020230
0203	Meat of swine; fresh, chilled or frozen	020311, 020319, 020321, 020322, 020329
0207	Meat and edible offal of poultry; of the poultry of heading no. 0105, (i.e. fowls of the species Gallus domesticus), fresh, chilled or frozen	020711, 020712, 020713, 020714, 020725, 020727, 020742, 020745, 020752
0301	Fish; live	030191,030199
0302	Fish; fresh or chilled, excluding fish fillets and other fish meat of heading 0304	030211, 030214, 030224, 030284, 030285, 030289
0303	Fish; frozen, excluding fish fillets and other fish meat of heading 0304	030312, 030313, 030314, 030319, 030324, 030326, 030329, 030331, 030339, 030351, 030353, 030354, 030365, 030366, 030368, 030381, 030383, 030389, 030390
0304	Fish fillets and other fish meat (whether or not minced); fresh, chilled or frozen	030441, 030461, 030462, 030474, 030475, 030479, 030483, 030486, 030487, 030489, 030494, 030495, 030499
0305	Fish, dried, salted or in brine; smoked fish, whether or not cooked before or during the smoking process; flours, meals and pellets of fish, fit for human consumption	030520, 030532, 030539, 030541, 030543, 030559
0306	Crustaceans; in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked, cooked or not before or during smoking; in shell, steamed or boiled, whether or not chilled, frozen, dried, salted or in brine; edible flours, meals, pellets	030616, 030617, 030622, 030624, 030629
0307	Molluscs; whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked molluscs, whether in shell or not, cooked or not before or during the smoking process; flours, meals and pellets of molluscs, fit for human consumption	030711, 030729, 030739, 030749, 030759, 030799
0401	Milk and cream; not concentrated, not containing added sugar or other sweetening matter	040110, 040120, 040140, 040150
0402	Milk and cream; concentrated or containing added sugar or other sweetening matter	040210, 040221, 040229, 040291, 040299
0403	Buttermilk, curdled milk and cream, yoghurt, kephir, fermented or acidified milk or cream, whether or not concentrated, containing added sugar, sweetening matter, flavoured or added fruit or cocoa	040310, 040390
0404	Whey and products consisting of natural milk constituents; whether or not containing added sugar or other sweetening matter, not elsewhere specified or included	040410, 040490
0405	Butter and other fats and oils derived from milk; dairy spreads	040510, 040520, 040590
0406	Cheese and curd	040610, 040620, 040630, 040640, 040690

0701	Potatoes; fresh or chilled	070110, 070190
0702	Tomatoes; fresh or chilled	070200
0703	Onions, shallots, garlic, leeks and other alliaceous vegetables; fresh or chilled	070310, 070320, 070390
0704	Cabbages, cauliflowers, kohlrabi, kale and similar edible brassicas; fresh or chilled	070410, 070490
0705	Lettuce (lactuca sativa) and chicory (cichorium spp.) fresh or chilled	070511, 070519, 070529
0706	Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots; fresh or chilled	070610, 070690
0707	Cucumbers and gherkins; fresh or chilled	070700
0709	Vegetables; n.e.c. in chapter 07, fresh or chilled	070930, 070940, 070951, 070959, 070960, 070970, 070993, 070999
0710	Vegetables (uncooked or cooked by steaming or boiling in water); frozen	071021, 071022, 071040, 071080, 071090
0711	Vegetables provisionally preserved (e.g. by sulphur dioxide gas, in brine, in sulphur water or in other preservative solutions) but unsuitable in that state for immediate consumption	071140
0712	Vegetables, dried; whole, cut, sliced, broken or in powder, but not further prepared	071220,071231,071290
0713	Vegetables, leguminous; shelled, whether or not skinned or split, dried	071310, 071333, 071340
0801	Nuts, edible; coconuts, Brazil nuts and cashew nuts, fresh or dried, whether or not shelled or peeled	080111, 080119, 080122, 080132
0802	Nuts (excluding coconuts, Brazils and cashew nuts); fresh or dried, whether or not shelled or peeled	080211, 080212, 080222, 080232, 080251, 080252, 080290
0803	Bananas, including plantains; fresh or dried	080390
0804	Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens; fresh or dried	080410, 080420, 080430, 080440, 080450
0805	Citrus fruit; fresh or dried	080510, 080520, 080540, 080550, 080590
0806	Grapes; fresh or dried	080610, 080620
0807	Melons (including watermelons) and papaws (papayas); fresh	080711, 080719
0808	Apples, pears and quinces; fresh	080810, 080830, 080840
0809	Apricots, cherries, peaches (including nectarines), plums and sloes, fresh	080910, 080921, 080929, 080930, 080940
0810	Fruit, fresh; n.e.c. in chapter 08	081010, 081020, 081040, 081050, 081070, 081090
0811	Fruit and nuts; uncooked or cooked by steaming or boiling in water, frozen, whether or not containing added sugar or other sweetening matter	081110, 081120, 081190
0813	Fruit, dried, other than that of heading no. 0801 to 0806; mixtures of nuts or dried fruits of this chapter	081310, 081320, 081340, 081350
1601	Sausages and similar products of meat, meat offal or blood; food preparations based on these products	160100

1901	Malt extract; flour/groats/meal/starch/malt extract products, no cocoa (or less than 40% by weight) and food preparations of goods of headings 04.01 to 04.04, no cocoa (or less than 5% by weight), weights calculated on a totally defatted basis, n.e.c.	190190
2106	Food preparations not elsewhere specified or included	210690

Source: Global Trade Alert; President of Russia, Decree 560 dated 6.08.2014; Government of Russia, Decree N778 dated 7.08.2014.