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Mathias Juust

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Trade effects of a negative export shock on direct exporters and wholesalers

Mathias Juust*

Abstract

This paper examines the effects on the exports of Estonian firms of the Russian export shock of 2014, which was a multifaceted negative market-wide income shock. The dataset covers all the Estonian exporters that exported to Russia in 2013 and the empirical analysis uses a difference-in-difference method in combination with the coarsened exact matching method to account for heterogeneities between the treatment and control groups. I find that the wholesalers affected were able to show better export performance after the shock than direct exporters were. The trade performance after the shock was lower for both wholesalers and direct exporters that had lower initial productivity levels.

JEL Codes: F13, F14, F23

Keywords: export shock, firm-level trade effects, trade effects, trade policy

* Author's affiliation and email: Mathias Juust: University of Tartu, School of Economics and Business Administration, mathias.juust@ut.ee.

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Non-technical summary

How well exporting firms are able to adapt to a fall in demand in one of their export markets can greatly vary between firms with different characteristics like productivity, export experience or size. When firms are faced with a sudden drop in sales in one market, they may try to redirect their exports to other markets or adjust the products being exported. This means the ability of the firm to cope can depend on its business model and whether it exports goods that it produces itself, or acts as an intermediary and exports goods produced by other firms.

The expected effect of a negative demand shock in one export market on the export value of a firm can depend on the assumptions about how sales in different markets are related. Various theoretical models and prior empirical findings have shown that a firm's sales in different markets can be complementary, substitutable, or independent.

This paper studies how the Russian demand shock that began in 2014 affected the exports of Estonian firms that had previously exported to Russia. The study focuses on exporters that had exported non-embargoed products and were affected most by the economy-wide income shock. The dataset includes all Estonian exporters and spans from 2010 to 2018, allowing both the short and medium-term effects of the trade shock to be studied.

The Russian demand shock of 2014 was multifaceted and evolved in stages. Western countries first imposed various sanctions against Russia in response to Russia's annexation of Crimea, then Russia responded by imposing an embargo on selected Western food products. In the second part of 2014 the Russian economy entered a recession as global oil prices fell and inflation rose high. A year before these events, the Russian market was an important export market for Estonian firms and exports to Russia were 11.5% of total Estonian exports. By the end of 2017 the value of exports from Estonia to Russia had fallen by around a third.

The empirical results of the study indicate that Estonian wholesalers who were affected by the Russian shock were better able to adapt and channel their exports to other markets than Estonian direct exporters were. Wholesalers who initially sent a large share of their exports to Russia experienced the largest immediate aggregate collapse in exports but adapted in the medium term by refocusing on other markets. Wholesalers sending a smaller initial share of exports to Russia were the most successful at redirecting the product groups previously exported there to other markets. The direct exporters considered saw their exports fall at the product level, but they protected their aggregate trade value somewhat by switching export products.

Firm-level productivity before the shock proved to be a good indicator of export performance after it. The exports of the wholesalers and direct exporters with the lowest initial productivity levels declined more than did those of exporters with higher levels of productivity. The export performance of the wholesalers with the lowest productivity remained better than that of the direct exporters with the lowest productivity.

The results shed more light on the firm-level effects of political and economic tensions between the West and Russia, and highlight the differences between and within direct exporters and wholesalers. They show that policy tools to help mitigate the adverse effects of such an economy-wide demand shock should be targeted separately at wholesalers and direct exporters. They also show that it is important to realise how much the capacity of firms to adapt to a demand shock can vary, and that productivity levels can be a good indicator of how able firms are to absorb reduced demand.

Contents

1. Introduction

How well exporters are able to react to a negative exogenous demand shock in one of their export markets depends on both the nature of the shock and firm-specific capabilities like productivity or size. With a macro-level negative demand shock that affects all sales in a given market, maintaining former export revenue levels would require some trade flows to be diverted, which may also entail product switching. One potential factor that could affect how easy it is to adjust after an export shock is whether firms export their own production or act as an intermediary for other producers.

International trade theories provide contradictory predictions for what happens to the sales of firms that experience a fall in export revenues in one destination market. In the models of monopolistic competition (Krugman 1980), sales in different markets have complementary effects because of increasing returns to scale. In contrast, the basic heterogeneous firms models (Melitz 2003) assume constant returns to scale since sales in different markets are independent of each other in the short run. It has also been argued that sales in different export markets can act as substitutes when there are intra-firm capacity constraints (Vannoorenberghe 2012; Soderbery 2014). This means the potential effects of an exogenous negative demand shock on firm-level export decisions remain ambiguous from a theoretical perspective.

This paper examines the trade effects of the negative export shock that Estonian exporters to Russia faced following the Russian demand shock of 2014. Estonian exporters to Russia were affected through two main channels. The first was that Russia established a formal embargo on selected Western food products like fruit, vegetables, dairy products, meat and fish, and the second was a devaluation of the Russian rouble and a country-wide drop in purchasing power that resulted from a combination of a drastic fall in the world oil price and Western sanctions. This paper focuses on the latter channel and investigates how Estonian exporters that had exported non-embargoed goods to Russia in 2013 adapted to the economic shock in the Russian market in 2014–2018.

The fall in bilateral trade flows between the West and Russia that followed the introduction of sanctions is well known, but the effect on individual firms among Western exporters has received less scrutiny. Estonia is of special interest in this as it shares historical economic ties with Russia, but has integrated into the EU and West since the 1990s. Prior to 2014 the European market received a majority of Estonian exports, but Russia still remained the third largest export destination and took 11.5% of total Estonian exports, making Estonia one of the leaders among EU member states for the share of exports that went to Russia. By 2017, the value of Estonian exports to Russia had fallen by around a third, indicating that significant changes had occurred in the export behaviour of Estonian exporters.

The empirical analysis applies firm-product level data on the full population of Estonian wholesalers and direct exporters over the period 2010–2018. The dataset is compiled from export data from Statistics Estonia, and the firm-level performance indicators from the Estonian Business Register. To determine the effect of the Russian demand shock, the analysis uses an empirical difference-in-difference model where firms that exported to Russia in 2013 are the treatment group. Each exporter treated is matched to suitable controls among firms that did not export to Russia in 2013 by applying the coarsened exact matching method (CEM), which allows the causal effects of the trade shock to be identified and measured. The matching procedure is based on the characteristics of export performance for each firm like the number of export markets and value added per employee.

The results show that the trade effects for firms affected by the Russian demand shock are different for wholesalers and for direct exporters. Wholesalers were generally more successful than direct exporters at diverting goods previously exported to Russia to other markets instead. Among the firms affected, those that had lower initial productivity levels generally experienced larger export contractions than firms with higher productivity did. Export performance after the shock was worse for direct exporters with low productivity than it was for wholesalers with low productivity.

This paper relates to the literature on exporter-level destination and product switching in response to demand shocks. Earlier work on the trade effects of demand shocks has found mixed results as firm-level sales in different export markets have variously been found to be complementary (Berman et al. 2015; Bardaji 2019), substitutable (Almunia 2018) and independent (Aranguren 2020). An increasing amount of literature shows that firms react to an exogenous demand shock by adjusting their basket of export products (Bernard et al. 2010; Bernard et al. 2011; Mayer et al. 2014). The case of the Russian demand shock of 2014 has previously been studied by Crozet and Hinz (2018), who find that non-embargoed goods played a major role in the short-term decline of Western exports to Russia.

This paper complements the literature by studying how the trade effects of a demand shock are different for exporters with different key characteristics. First I investigate how the process of adjusting after the shock is different for direct exporters and wholesaler exporters that have previously been found to possess distinct characteristics for firm performance and exports (Bernard et al. 2011; Crozet et al. 2013). Secondly, the trade effects of the exporters treated are also differentiated by their earlier value added per employee, which allows the importance of productivity in determining how well the firm can adapt to a demand shock to be examined. Thirdly, I address the issues of trade diversion and product switching in the short and medium terms. Trade diversion is studied by comparing the total export levels of the firms after treatment with their exports to all destinations except Russia. This procedure is performed with firm-level exports and with firm-product level exports, allowing conclusions to be drawn about the product switching dynamics of the firms treated. To the best of my knowledge, this is the first study to address all these firm heterogeneities simultaneously in a comprehensive manner.

The rest of the paper is organised as follows. Section II describes the Russian demand shock of 2014 and provides key information on it. Section III reviews the related literature. Section IV describes the dataset and data sources. Section V describes the empirical research strategy. Section VI presents and discusses the empirical results. Section VII concludes and provides recommendations for future research.

2. Description of the case and the sequence of events

Before the Russian demand shock in 2014, Estonia's main export partners were neighbouring Sweden, which took 16.8% of exports, Finland, which took 16.1%, Russia with 11.5%, and Latvia with 10.4%. The most prominent exports from Estonia to Russia were machinery and electrical equipment, which were 35.6% of the total, products of chemical or allied industries with 13.4%, prepared foodstuffs with 11.5%, and animal products with 4.9%. The share of these product groups in exports to Russia were relatively similar to the structure of Estonian exports

to all destinations, in which machinery and electrical equipment were 28.3%, chemicals and allied industries 5.7%, prepared foodstuffs 4.2%, and animal products 3.8%.

The negative export shock for Estonian exporters to Russia was multifaceted and evolved in stages. There were already signs of increased policy uncertainty in November 2013, when Russia imposed import bans on two Estonian fish processing companies on the orders of the Russian Veterinary and Phytosanitary Oversight Service. In January 2014, nine more dairy and fish producers were added to the import ban list, among them some of the largest local producers in those industries. In the same month Russia banned imports of pork products from the EU, justifying it by pointing to cases of swine flu in Lithuania and Poland. This measure was later deemed by the WTO panel to be in breach of international trade rules (WTO 2020). All these measures can be seen as part of a broader Russian strategy that aimed to reduce its strategic dependence on food imports from Western countries and strengthen its local agro-food industry (Wegren & Elvestad 2018).

The annexation of Crimea and the start of the Ukrainian crisis in March 2014 were initially followed by rounds of targeted sanctions between the Western countries and Russia that consisted of measures like asset freezes and travel bans. Economic tensions intensified in July when the West enforced sectoral sanctions in finance, energy and armaments, including export restrictions on arms, dual-use goods and sensitive technologies. In August 2014, Russia responded with an embargo on a wide array of Western agricultural products and foodstuffs like meat and dairy products, vegetables and fruit[1]. Both sides have renewed these measures on a consistent basis and they remain in place to this date.

The start of the trade restrictions overlapped with another negative shock to the Russian economy, which is highly dependent on exports of mineral fuels. In July-December 2014, the world price of oil fell by around 50% and the Russian rouble depreciated by 46% against the US dollar, resulting in inflation of 14.7% over the year by January 2015 (Grant & Hansl 2015). The response of the Central Bank of Russia was to raise the interest rate, and this combined with the Western financial sanctions to increase vastly the cost of borrowing for the real economy (Viktorov & Abramov 2020). As a result, Russia entered a recession that lasted from 2014 to 2016, during which GDP fell by 44% in current US dollars (World Bank 2020).

The combination of a financial crisis and economic tensions with the West was also apparent in Russia's total imports from Estonia (Figure 1). The nominal value of Estonian exports to Russia fell by around 16% in 2014 alone, and by 45% between 2013 and 2016. The relative importance of Russia as an export market also halved as the share of Russia in the total exports of Estonia fell from around 12% in 2013 to 6% in 2018. The foreign demand shock for the exporters of non-embargoed goods was compounded by changes in the exchange rate and in purchasing power in Russia, but the broader political context may also have increased the overall level of uncertainty towards the Russian market. These macro-level trade dynamics indicate that notable changes can also be expected in Estonian exports to Russia at the level of individual firms.

[1] The product lines sanctioned were defined at the HS 4-digit level; the full list of embargoed goods can be found on the website of the European Commission (2020).

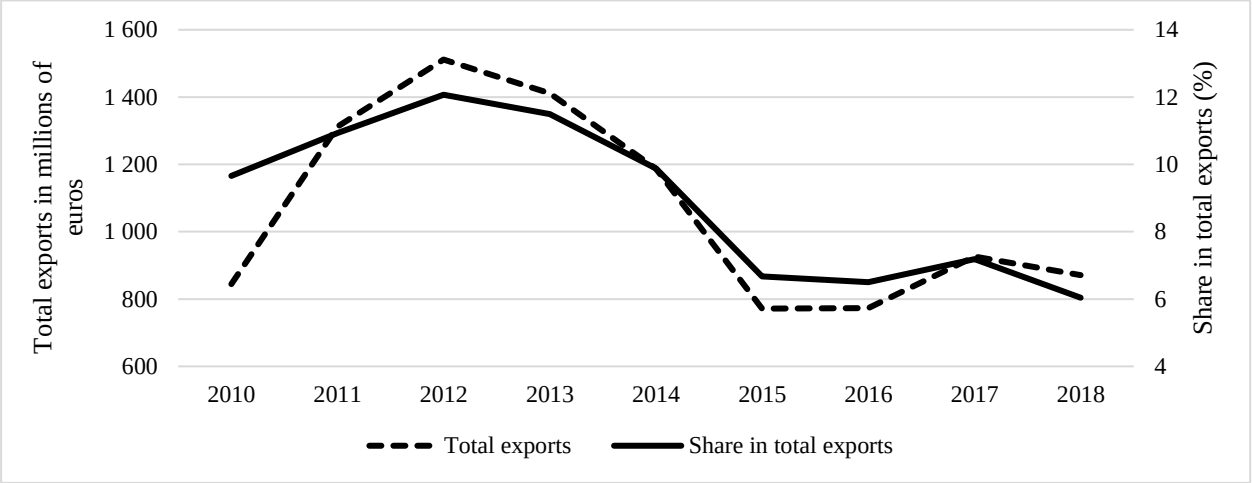

Figure 1. Total value of exports from Estonia to Russia and Russia's share in Estonian total exports in 2010–2018

Source: Statistics Estonia 2020.

3. Literature review

This section reviews the literature on the destination and product switching channels through which exporters can adapt after a negative demand shock in one of their export markets. It also reviews studies on trade shocks and the heterogeneity between direct exporters and wholesalers.

How a demand shock in a single market might be expected to impact aggregate exports at the level of a firm depends on the assumptions in the particular theoretical framework being applied. Exports to different markets have complementary effects in the models of the New Trade Theory (Krugman 1980), with increasing returns to scale. This conclusion relies on the argument that adding export destinations increases total market size and lowers marginal costs. Some studies have also shown that exporting to one destination can have a positive effect on exports to similar markets (Morales et al. 2014) or can increase the productivity of a firm through learning by exporting (Martins & Yang 2009; Salomon and Shaver 2005, Atkin et al. 2017).

How sales in different markets complement each other has widely been associated in the empirical literature with the liquidity channel (Cooley and Quadrini 2001; Kohn et al. 2016). Erbahar (2019) uses data on Turkish exporters in 2005–2014 and relates complementary effects to spillovers within firms like increased liquidity, as foreign demand shocks affect employment, wages and investment at firms. Berman et al. (2015) find complementary effects between the foreign and domestic sales of French exporters, providing some evidence that this can be associated with increased short-term liquidity. Bardaji et al. (2019) also conclude that a positive domestic demand shock boosted the exports of French firms, especially smaller ones.

Opposing inferences can be drawn from models of heterogeneous firms, where firms face constant returns to scale in the short run, and the profits of firms are maximised in individual markets (Melitz 2003; Chaney 2008). Under these assumptions, firms see sales in different export markets as independent of each other, which means that a demand shock in one market does not affect short-term export performance elsewhere. In recent empirical work, the results

of Aranguren (2020) indicate that a negative demand shock in the top export destination of Spanish firms did not affect their export destination choices or their revenues in other markets.

A third body of literature challenges the insights of the models of monopolistic competition and of heterogeneous firms by assuming that firms face increasing marginal costs. This assumption means that a demand shock in one destination affects business decisions in all export destinations and that sales in different markets act as substitutes (Vannoorenberghe 2012; Soderbery 2014; Ahn and McQuoid 2017). Short-term capacity constraints are one channel that can push marginal costs up in practice. Blum et al. (2013) model the rising costs for firms of trading in one market as the reason they switch to other export markets where revenue losses can be compensated. Almunia (2018) examines the substitution effects for the Spanish manufacturers whose domestic sales were hit the hardest during the Great Recession and finds that the export growth experienced by these firms was above the average for other similar firms.

Demand shocks can also lead firms to adjust which products they export to different markets. Many papers have highlighted how adjustments at the product level inside firms enhance performance and productivity (e.g. Bernard et al. 2010; Mayer et al. 2014; Mayer, Melitz & Ottaviano 2016). Ladu et al. (2020) study Italian exporters with multiple products and relate positive trade shocks to reallocations in the product line and the effective use of inputs, which then results in increases in productivity. Bernard et al. (2011) show that a fall in trade barriers can alter the product baskets of exporters by making them concentrate on a more selective and profitable range of goods. However, the results of Berthou and Fontagne (2013) indicate that the introduction of the euro and the resulting fall in trade costs actually increased the number of goods exported by multi-product EU exporters.

The capabilities of the individual firm are among the key factors that can affect how exporters adjust to a demand shock in one market. The literature has emphasised the importance of firm heterogeneity in international trade, as a small number of multi-product exporters are typically responsible for a majority of the total value of trade (Bernard et al. 2007). Heterogeneous productivity between firms has been shown to produce compositional effects inside firms, industries, and countries after trade barriers change (Bernard et al. 2007; Bernard et al. 2011; Bernard et al. 2018). One umbrella term for the ability of a firm to adapt and learn is absorptive capacity, as established by Cohen and Levinthal (1989; 1990), which can be related to Kim's (1980) argument of firms using technological change to gain an edge over their competitors. Adjustments by firms can also be found in the literature on dynamic capabilities, which explains how firms are able to adapt to sudden changes in their business environment (Teece et al. 1997; Teece 2014).

Important differences in export behaviour at the level of firms can also arise between direct exporters and non-direct exporters. Prior works recognise that wholesalers are a major share of all exporters and generally differ from firms that export their own production. Direct exporters have been found to be more productive than wholesalers on average (Dhyne & Rubinova 2016), while wholesalers are typically smaller and more focused on smaller markets (Bernard et al. 2010). Wholesalers also provide export opportunities for less efficient producers and help them enter markets where trading costs are higher, thereby increasing the overall number of product lines exported (Crozet et al. 2013). Bernard et al. (2011) argue that it is easier for wholesalers to cover the fixed costs of products and destinations, which leads to adjustments in the mix of products exported and a smaller total contraction in exports if there is an exogenous shock like a change in the exchange rate. It has also been highlighted that export products can vary

depending on how customised they are for a given client, which is called relationship-specificity (Rauch 1999; Nunn 2007). Higher levels of relationship-specificity are in turn seen to make it more difficult to divert the same goods from one market to another (Kokko et al. 2014). Since wholesalers typically ship standardised products in bulk, the average level of relationship-specificity should be expected to be higher at direct exporters.

In the literature on the effects of trade sanctions, Haidar (2017) studies the impact of recent Western sanctions against Iranian exporters. Iranian exporters diverted trade to countries that did not apply the sanctions and were on better political terms with Iran, and larger firms diverted trade more. Adjustments also occurred at the product level as exporters increased quantities and reduced unit prices. Tanaka (2019) examines the 2012 East China Sea conflict and its effect on Japanese exporters to China, finding that it had negative effects for Japanese exports and employment. Japanese exporters were not found able to substitute the lost revenue by diverting trade flows to other countries, while the negative effect on employment caused the number of temporary workers to rise.

The Western trade sanctions on Russia and the broader effects of the Russian demand shock are the focus of a paper by Crozet and Hinz (2018), which studies both the macro effects on EU countries and the micro effects on French manufacturers. Their findings indicate that French exports to Russia at the level of firms contracted for both embargoed and non-embargoed goods in the short term, and that the reduction in exports on both trade margins was related to increased country risk. However, their study only uses short-term monthly trade data until 2015 and does not include any data on firm characteristics or performance indicators, so the gradual dynamics of firms adapting to the demand shock cannot be examined.

4. Data

The empirical analysis is based on detailed firm-level data covering the full population of Estonian exporters during the period 2010–2018. The sample excludes firms that had previously exported embargoed products to Russia because there were only a few such exporters and the specific nature of this kind of trade shock is different to a general demand shock. The export data come from the customs statistics provided by the database of Statistics Estonia. The export statistics for individual firms are available at the level of the HS 8-digit code and destination country but are aggregated as total firm-year exports and yearly firm-product exports at the Harmonised Commodity Description and Coding Systems (HS) 4-digit level.

The data on export flows are combined with firm-level statistics for exporters and performance indicators from the database of the Estonian Business Register for the number of employees each year, total revenue, number of export markets, employment costs, cash and bank account assets, total assets, depreciation and value loss of fixed assets, and earnings before taxes[2]. The sample includes firms that had a positive value of exports in 2013 and excludes firms with missing values for the number of employees, employment costs or revenue in 2013, exporters with fewer than five employees in 2013, and exporters that had in 2013 exported any

[2] Other firm-level variables used in the empirical part are created from the indicators: total value added per employee ((employment costs + depreciation and value loss of fixed assets + earnings before taxes)/number of employees), ratio of reserves to assets (cash and bank account assets/total assets), and ratio of exports to total revenues (export value/total revenues).

products embargoed by Russia. The top and bottom 1% of firms by total export value in 2013 are excluded before the subsequent matching procedure was conducted. Yearly trade flows are set to zero for firms that cease to export or exist after 2013. Data from the Business Register are included to serve as the basis for the matching procedure, which is used to find similar controls for the firms treated, and is discussed further in the next section.

The statistics from the Commercial Register also contain information on the NACE code[3] of the firms, which is used to identify direct exporters and wholesalers. Direct exporters are defined as exporting firms in NACE sections A (Agriculture, forestry and fishing) and C (Manufacturing). Wholesalers are defined as firms in section G (Wholesale and retail trade; repair of motor vehicles and motorcycles). Basic descriptive statistics for the sample firms in 2013 can be found in Appendixes 1 and 2.

Some generalisations about the differences between the types of firms can be made from Appendix 1. There are almost twice as many direct exporters as wholesalers in the full sample, but wholesalers export more HS 4-digit product lines than direct exporters do, which means there are fewer firm-level observations for wholesalers than for direct exporters, but more firm-product level observations. Exporters to Russia were on average larger and exported more product lines to more markets than other exporters did. Appendix 2 summarises the exports of the firms treated and their market exit after the trade shock. The share of firms exiting is similar among the wholesalers and direct exporters treated, but the share of wholesalers ceasing to export is larger than the share of direct exporters.

5. Empirical model and methodology

The aim of this paper is to investigate how the negative demand shock affected the exports of Estonian firms that had exported non-embargoed products to Russia in 2013. I first apply the coarsened exact matching (CEM) method to find appropriate controls for each firm treated and then run regressions using a standard difference-in-difference model with different fixed effects. The treatment group consists of Estonian firms that exported to Russia in 2013, while the control group consists of Estonian firms that only exported to other countries during that year.

The individual characteristics of the firms in the treatment and control groups can vary greatly, and this can also affect their export behaviour and performance. To address this, I apply the CEM method, which allows the covariate imbalances between the observations for the control and treatment groups to be reduced (a more detailed description of this technique can be found in Iacus et al. 2012 and Blackwell et al. 2009). The matching procedure aims to group firms by size, performance characteristics and export capability in 2013, which is the year before the demand shock occurred. The full list of firm-specific variables from 2013 that are used in the CEM is: logarithmic total value added per employee, number of employees, number of export markets, ratio of export revenues to total revenues, and ratio of reserves to total assets. These variables account for the differences in key capabilities of firms like their size, export orientation, liquidity and productivity, which can affect an exporter's ability to react to a negative export shock.

[3] Statistical classification of economic activities in the European Community.

The matching procedure was conducted separately for direct exporters and for wholesalers, and firms that exported embargoed product groups in 2013 were excluded. A general picture of the statistics used in the matching procedure can be found in Appendix 3. Generally, applying the CEM weights reduced the multivariate distances between the control variables and made insignificant the differences between the control and treatment groups in the means of individual firm-specific variables, including the variable for the total value of exports from 2013, before treatment.

The following empirical analysis applies a difference-in-difference method that can determine how the trade flows of firms that exported to Russia in 2013 differed from those of other exporters after the trade shock occurred. The treatment group for this consists of Estonian firms that exported to Russia in 2013, while the control group consists of matched Estonian firms that only exported to other countries in that same year. All models are estimated by the Poisson pseudo-maximum likelihood method (PPML), which has become the preferred estimation technique in studies dealing with trade data because it can account for zero values in the dependent variable, which often arise in trade data (Santos Silva & Tenreyro 2006), especially at the level of firms.

The first empirical model focuses on export value at the firm-product level, which shows how the export value of the product groups defined at the HS-4 level that the treatment group exported in 2013, before treatment, changed. The specification of the firm-product level model is as follows:

$$X_{ijt} = exp\,(\beta_0 + \beta_1 RUx_{it} + \mu_{ij} + \delta_{jt})\; x\; \varepsilon_{ijt}, \qquad (1)$$

where the dependent variable X_{ijt} is firm i's total exports of good j (HS 4-digit level products that the firm had exported in 2013) in year t. The dummy variable RUx_{it} takes the value 1 if the firm had exported any goods to Russia in 2013 and the export flow takes place in 2014–2018. Firm-product and product-year fixed effects are represented respectively by the dummies μ_{ij} and δ_{jt}. The error term is ε_{ijt}.

The second specification uses similar logic to the first one but uses yearly aggregate firm-level export value, which essentially allows changes in the export value of goods that the treatment group did not export before the demand shock to be accounted for. This means that this specification shows the potential effect of product switching on trade flows.

$$X_{it} = exp\,(\beta_0 + \beta_1 RUx_{it} + \mu_i + \delta_t)\; x\; \varepsilon_{it}, \qquad (2)$$

where the dependent variable X_{it} is total exports of firm i in year t. The dummy variable RUx_{it} takes the value 1 if the firm had exported any goods to Russia in 2013 and the export flow takes place in 2014–2018. Firm and year fixed effects are represented respectively by the dummies μ_i and δ_t. The error term is ε_{it}.

Both of the models are estimated with data from two cumulative time periods of 2010–2015 and 2010–2018, and two subsets of firms comprising direct exporters and wholesalers. I first estimate the firm-product level models, allowing conclusions about the trade dynamics in the goods that firms exported in 2013, a year before treatment, to be drawn. Presenting the results over two cumulative time periods allows conclusions to be drawn about the timing of the trade effects. In additional specifications, the treated firms are divided for their share in 2013 of exports to Russia in total exports into three groups of 0%–33%, 33%–66%, and 66%–100%, which accounts for the heterogeneity in the export dependency of firms on the Russian market

before the shock. After this, I repeat the previous steps with firm-level trade data, which provide information on the changes in the aggregate exports of firms. Comparing the trade effects at the firm-product level with the aggregate firm-level ones allows conclusions to be drawn about whether the post-treatment trade effects are related to product switching.

In the last specifications, the wholesalers and direct exporters treated are divided into thirds with an equal number of firms for the value added in 2013 of the exporters treated. Distinguishing between treated firms by their pre-shock levels of value added can help to show whether productivity was a significant predictor of a firm's capacity to adapt to the negative demand shock, and provides further insights into firm-level heterogeneity.

6. Results

This section presents the empirical results for wholesaler exporters and direct exporters. For both of these groups, I first report the results of the models with firm-product level (HS-4) fixed effects, which are followed by the results of the models with total firm-level exports as the dependent variable. All the models also distinguish between exports to all destinations and exports to destinations other than Russia. Lastly I report the results for the models where the dummies for the wholesalers and direct exporters treated are divided into thirds using the value added per employee in 2013.

Table 1 shows the results for the wholesaler exporters. Firstly, the firm-product level model including all the wholesalers (RU) shows a statistically significant negative effect of 16.5% (calculated as exp (–0.185) –1)) on exports to destinations other than Russia in 2014–2015. The effect is similar for the wholesalers with the lowest share of Russia in their total exports in 2013 (RU share 0%–33%). Wholesalers with a medium share of exports to Russia in 2013 (RU share 33%–66%) show a positive effect of 163% (exp (0.969) –1)) in 2010–2018, which indicates product-level trade diversion from Russia to other markets.

The second part of Table 1 focuses on aggregate firm-level exports for the same wholesalers. Here, the effects for the full set of wholesalers remain statistically insignificant. Wholesalers with a medium share of exports to Russia in total exports before treatment demonstrate growth in exports to markets other than Russia of 28% in 2014–2015 and 124% in 2014–2018, with the growth in the second period translating into trade growth to all destinations of 52%. The exports of the wholesalers with the highest initial share of the Russian market declined by 19% in 2014–2015, but their exports to other destinations increased by 45% by 2018. Wholesalers with a medium share of Russia in total exports redirected the goods that they exported previously to other markets. The wholesalers that were most reliant on the Russian market were initially hit the hardest, but their medium term trade dynamics show signs of trade diversifying through product switching.

Table 1. Trade effects for wholesalers

	Firm-product exports							
	2010–2015				2010–2018			
	All destinations		w/o Russia		All destinations		w/o Russia	
RU	–0.054		–0.185*		0.028		0.046	
	(0.089)		(0.100)		(0.110)		(0.116)	
RU share 0–33%		–0.096		–0.205**		0.071		0.013
		(0.105)		(0.104)		(0.117)		(0.121)
RU share 33–66%		–0.095		0.121		0.485		0.969*
		(0.340)		(0.471)		(0.360)		(0.496)
RU share 66–100%		0.094		0.007		–0.162		0.223
		(0.171)		(0.349)		(0.147)		(0.386)
Observations	41635	41635	40352	40352	63001	63001	60835	60835

	Aggregate firm-level exports							
	2010–2015				2010–2018			
	All destinations		w/o Russia		All destinations		w/o Russia	
RU	–0.006		0.078		0.103		0.228	
	(0.116)		(0.133)		(0.134)		(0.147)	
RU share 0–33%		0.064		0.073		0.182		0.196
		(0.137)		(0.140)		(0.152)		(0.155)
RU share 33–66%		–0.034		0.247**		0.424***		0.805***
		(0.126)		(0.118)		(0.139)		(0.139)
RU share 66–100%		–0.210**		0.060		–0.200		0.370**
		(0.102)		(0.267)		(0.122)		(0.179)
Observations	2910	2910	2742	2742	4377	4377	4149	4149

Notes: All models are estimated using PPML. Firm-product exports models include firm-product and product-year dummies. Aggregate firm-level exports models include firm and year dummies. Statistical significance: *p<.1; **p<.05; ***p<.01. Robust standard errors clustered by firm and product in firm-product models and by firm in aggregate firm-level models in parentheses. All models use CEM weights based on matching all exporting wholesalers in the sample. Treatment starts in 2014 in all models.

Descriptive statistics in Appendix 4 on the wholesalers treated show that the firms with the largest initial share of exports to Russia in their total exports had the lowest mean values for productivity, number of export markets and number of product groups exported before the shock. These indicators of firm-level capabilities explain why wholesalers with a medium share of exports to Russia exhibited better export performance after the shock than the wholesalers with the highest share of Russia did. The wholesalers with the smallest share of exports to Russia were naturally less affected by the Russian demand shock and their trade flows remained largely unaffected.

The results for direct exporters are reported in Table 2. All the treated exporters taken together as a group (RU) show negative trade effects at the firm-product level of around 18% throughout the observable period both to destinations including Russia and to those excluding Russia, illustrating that there are negative export market complementarities at the product level.

This conclusion also applies for the exporters with the smallest initial share of Russia in their total exports. The direct exporters with the largest share of Russia record the largest product-level trade contraction of 35.6% in 2014–2018. Only direct exporters with a medium share of Russia manage to increase their product-level exports to markets other than Russia by 2018.

The firm-level export effects for direct exporters in the second part of Table 2 generally remain statistically insignificant, except for those for exporters with a medium pre-treatment share of exports to Russia, whose exports to other markets increase by 2018. That direct exporters generally saw their product-level exports decrease while the firm-level changes remain insignificant points to some degree of product switching being made to adapt to the negative demand shock in the Russian market.

Similarly to those for wholesalers, the descriptive statistics for the treated firms in Appendix 4 show that direct exporters with a medium share of exports to Russia had higher mean values for productivity and number of export markets than the direct exporters with the largest share of Russia did. These insights once again indicate that firm-level characteristics like export market experience and productivity can be informative about how able firms are to adjust to a negative demand shock in one important export destination.

Table 2. Trade effects for direct exporters

	Firm-product exports							
	2010–2015				2010–2018			
	All destinations		w/o Russia		All destinations		w/o Russia	
RU	–0.190**		–0.175**		–0.199**		–0.158*	
	(0.076)		(0.080)		(0.082)		(0.085)	
RU share 0–33%		–0.208**		–0.189**		–0.184**		–0.165*
		(0.082)		(0.082)		(0.088)		(0.088)
RU share 33–66%		0.321		0.293		0.360		0.580*
		(0.293)		(0.350)		(0.260)		(0.345)
RU share 66–100%		–0.138		–0.016		–0.441**		–0.329
		(0.163)		(0.297)		(0.191)		(0.202)
Observations	27087	27087	26836	26836	40797	40797	40232	40232

	Aggregate firm-level exports							
	2010–2015				2010–2018			
	All destinations		w/o Russia		All destinations		w/o Russia	
RU	0.011		0.008		–0.038		–0.036	
	(0.093)		(0.092)		(0.106)		(0.103)	
RU (0–33%)		–0.015		–0.010		–0.063		–0.057
		(0.092)		(0.093)		(0.104)		(0.104)
RU (33–66%)		0.039		0.190		0.129		0.382*
		(0.180)		(0.204)		(0.212)		(0.206)
RU (66–100%)		0.241		0.474		0.159		0.375
		(0.280)		(0.312)		(0.387)		(0.305)
Observations	4237	4237	4159	4159	6373	6373	6274	6274

Notes: All models are estimated using PPML. Firm-product exports models include firm-product and product-year dummies. Aggregate firm-level exports models include firm and year dummies. Statistical significance: *p<.1; **p<.05; ***p<.01. Robust standard errors clustered by firm and product in firm-product models and by firm in aggregate firm-level models in parentheses. All models use CEM weights based on matching all direct exporters in the sample. Treatment starts in 2014 in all models.

To address the firm-level heterogeneities inside the treated wholesalers and direct exporters further, I next divide the treated firms into three groups of equal size by their value added per employee in 2013. The results for wholesalers can be found in Table 3. There are clear negative effects of –25% on the product-level exports to destinations other than Russia and of –29.5% on firm-level exports to all destinations in 2014–2015 for the wholesalers with the lowest initial level of productivity. The changes in other initial productivity groups remain statistically insignificant.

Table 3. Trade effects for wholesalers divided into thirds by value added per employee in 2013

	Firm-product exports			
	2010–2015		2010–2018	
	All destinations	w/o Russia	All destinations	w/o Russia
RU low productivity	–0.185	–0.288**	0.066	0.113
	(0.136)	(0.133)	(0.242)	(0.239)
RU medium productivity	0.012	–0.172	–0.164	–0.132
	(0.148)	(0.149)	(0.187)	(0.237)
RU high productivity	–0.030	–0.145	0.109	0.096
	(0.132)	(0.143)	(0.142)	(0.158)
Observations	41635	40352	63001	60835

	Aggregate firm-level exports			
	2010–2015		2010–2018	
	All destinations	w/o Russia	All destinations	w/o Russia
RU low productivity	–0.346*	–0.271	–0.189	–0.096
	(0.206)	(0.176)	(0.270)	(0.246)
RU medium productivity	0.068	0.173	0.105	0.243
	(0.166)	(0.191)	(0.149)	(0.163)
RU high productivity	0.014	0.097	0.178	0.300
	(0.159)	(0.181)	(0.196)	(0.218)
Observations	2910	2742	4377	4149

Notes: All models are estimated using PPML. Firm-product exports models include firm-product and product-year dummies. Aggregate firm-level exports models include firm and year dummies. Statistical significance: *p<.1; **p<.05; ***p<.01. Robust standard errors clustered by firm and product in firm-product models and by firm in aggregate firm-level models in parentheses. All models use CEM weights based on matching all direct exporters in the sample. Treatment starts in 2014 in all models.

Finally, Table 4 lists the results for direct exporters divided into thirds by their pre-treatment value added per employee. Here, the firms that are initially least productive in 2014–2015 experience a trade contraction in their product-level exports to all destinations, which eventually leads in 2014–2018 to a decline in aggregate exports to destinations both including and excluding Russia, hinting at their difficulties in adapting to the Russian demand shock. Product-level exports also decline for direct exporters with medium productivity, but the effects at the firm level remain statistically insignificant, indicating that these firms adapted to the shock by product switching. The exports of the firms with the highest productivity seem to remain relatively unaffected and show no significant effects after the Russian demand shock.

Table 4. Trade effects for direct exporters divided into thirds by their value added per employee in 2013

	Firm-product exports			
	2010–2015		2010–2018	
	All destinations	w/o Russia	All destinations	w/o Russia
RU low productivity	–0.219*	–0.198	–0.169	–0.139
	(0.128)	(0.134)	(0.142)	(0.145)
RU medium productivity	–0.266*	–0.241	–0.287**	–0.222
	(0.142)	(0.147)	(0.133)	(0.138)
RU high productivity	–0.124	–0.111	–0.143	–0.113
	(0.091)	(0.098)	(0.106)	(0.111)
Observations	27087	26836	40797	40232

	Aggregate firm-level exports			
	2010–2015		2010–2018	
	All destinations	w/o Russia	All destinations	w/o Russia
RU low productivity	–0.242	–0.246	–0.341*	–0.353*
	(0.153)	(0.156)	(0.202)	(0.203)
RU medium productivity	–0.040	0.000	–0.068	–0.001
	(0.093)	(0.082)	(0.105)	(0.090)
RU high productivity	0.156	0.135	0.112	0.087
	(0.113)	(0.117)	(0.128)	(0.123)
Observations	4237	4159	6373	6274

Notes: All models are estimated using PPML. Firm-product exports models include firm-product and product-year dummies. Aggregate firm-level exports models include firm and year dummies. Statistical significance: *p<.1; **p<.05; ***p<.01. Robust standard errors clustered by firm and product in firm-product models and by firm in aggregate firm-level models in parentheses. All models use CEM weights based on matching all direct exporters in the sample. Treatment starts in 2014 in all models.

As a robustness check, Appendix 5 shows the results for the firm-level models with two additional control variables for the logarithmic number of employees and logarithmic value added per employee. It must be noted that adding these two control variables reduces the number of observations because there is now additional missing data. Furthermore, the number of employees and value added can also be expected to be affected by the Russian demand shock and so by the exports of the treated firms. Even so, the models with the two additional control variables produce similar point estimates to those of the main specifications presented in Tables 1 and 2, providing evidence for the effectiveness of the matching procedure. A common feature is that the most substantial trade diversion effects occur for the exporters with a medium initial share of exports to Russia in their total exports.

7. Discussion

The main inference from the results presented here for direct exporters that exported to Russia before the Russian demand shock is that they experienced a decline in their product-level exports both to Russia and to other destinations.

The exporters with the smallest share of Russia in their total exports before the shock demonstrated negative complementarity effects between markets at the product level, while product-level exports contracted most for the firms with the largest initial share of exports to Russia. Direct exporters with a medium share of exports to Russia were able to divert the goods they had exported previously to other markets by 2018, which also translated into aggregate trade growth. The initial level of productivity seems to be a good predictor of post-shock trade performance, as aggregate exports only declined for the firms with the lowest productivity. Firms with medium productivity were able to compensate for the decline in product-level exports by product switching, leaving their aggregate exports unchanged.

Table 5 presents statistics on the export dynamics for direct exporters by destination country groups. It shows that the relative shares of other Western countries and of other distant markets increased most significantly after the Russian shock, while the share of exports to the EU remained fairly stable and even decreased slightly in 2018. The change in the relative importance of different export markets could also be a consequence of the exits of exports or firms, while trade diversion to the EU may have been affected by increasing competition between the European producers that had previously exported to Russia. As a result, firms that were able to refocus on more distant markets seem to have fared better after the Russian shock than other exporters did. Since products with greater value added and lower transportation costs can typically be considered more suitable for shipping to distant markets, these dynamics conform to the previous findings that the firms with lower initial productivity experienced worse export performance than firms with higher productivity.

Table 5. Export destination dynamics of direct exporters to Russia (%)

	Russia	EU	West	Ukraine	Other Europe	Asia	Other	All
Share in total exports 2013	12.2	69.2	6.9	1.5	1.9	5.2	3.1	100
Share in total exports 2014	10.7	71.0	7.8	0.9	1.8	4.8	3.0	100
Share in total exports 2016	7.5	73.0	9.5	0.9	1.2	5.0	3.0	100
Share in total exports 2018	7.3	65.8	12.3	0.7	0.9	6.6	6.4	100
Change in export value 2013–2014	–13.0	2.1	13.7	–38.5	–9.2	–8.5	–1.2	–0.4
Change in export value 2013–2016	–43.1	–2.1	27.8	–42.9	–44.4	–10.8	–10.1	–7.2
Change in export value 2013–2018	–51.1	–22.6	46.3	–63.6	–63.7	3.4	70.2	–18.6

The main results for wholesalers showed that their product-level decline in exports was less prominent than that for direct exporters. The wholesalers affected that had a medium share of exports to Russia were able to divert the products they exported previously to other markets and increase their aggregate exports by 2018. The aggregate exports of the wholesalers with the largest share of exports to Russia collapsed immediately after the demand shock in 2014–2015,

but they had managed to divert their exports to markets other than Russia by 2018. The wholesalers in the lowest third for productivity were the only ones to show clear signs of a decline in trade in the short term, and this effect disappeared in the intermediate term. This meant that the wholesalers affected exhibited fewer difficulties than direct exporters did during the period of adjustment after the shock.

The general statistics for the exports of wholesalers in Table 6 show that the initial share of different export markets remained quite static immediately after the Russian demand shock. By 2018, the share of the Russian market had more than halved, and the share of EU and other Western countries had increased remarkably. Interestingly, the initial percentage decrease in the total value of the exports of wholesalers exceeds that for direct exporters, which can be explained by the faster exit from exports, but by 2018 this relationship had reversed. The surviving wholesalers seem in consequence to have succeeded in diverting their trade towards developed EU and Western markets.

Table 6. Export destination dynamics of wholesalers to Russia (%)

	Russia	EU	West	Ukraine	Other Europe	Asia	Other	All
Share in total exports 2013	21.9	53.0	1.8	1.5	3.6	1.9	16.3	100.0
Share in total exports 2014	24.2	55.0	1.4	1.6	3.7	2.3	11.7	100.0
Share in total exports 2016	15.7	59.6	1.6	2.6	2.4	2.0	16.2	100.0
Share in total exports 2018	10.4	71.2	5.9	0.7	1.5	4.0	6.2	100.0
Change in export value 2013–2014	–14.4	–19.6	–38.0	–17.9	–19.2	–8.7	–44.2	–22.6
Change in export value 2013–2016	–55.2	–29.6	–43.8	4.2	–58.5	–35.3	–37.8	–37.4
Change in export value 2013–2018	–58.5	17.3	191.9	–57.9	–63.8	80.8	–66.9	–12.8

All in all, the negative effect of the shock on the product-level exports of direct exporters is generally larger than that for wholesalers. The wholesalers treated were also more successful at diverting their exports to other markets than direct exporters were, and wholesalers with a medium initial share of Russia in their total exports were the only ones that managed to increase their aggregate exports in the intermediate term. This conclusion illustrates the difficulties direct exporters face in adjusting to an exogenous shock, and conforms to the results of Bernard et al. (2011).

For both direct exporters and wholesalers alike, the level of productivity before the shock is a good indicator for the performance of exports after it. Even so, the negative effect on trade for the direct exporters treated with the lowest productivity is larger and longer lasting than that for wholesalers with low productivity. That the firm-level trade effects for firms with higher productivity levels remained insignificant, even for medium productivity direct exporters whose product-level exports declined, demonstrates the resilience of the firms in adapting to the demand shock. The difference in trade effects given initial firm-level productivity reflects the logic of dynamic firm capabilities, where the most successful firms are able to adjust to a sudden shift in their environment (Teece et al. 1997; Teece 2014).

These findings complement the results of Crozet-Hinz (2020), who found that the Russian sanctions and demand shock had a negative effect on French firm-level exports to Russia in the

short run. My results show that the effects of this multifaceted demand shock vary greatly between wholesalers and direct exporters, and between firms with different levels of productivity. Exploring the potential impact channels of the Russian demand shock presents several outlets for future research. One is that it would be intriguing to examine how the Russian demand shock impacted the productivity of the firms affected. Another aspect that would require further inquiry in future research is whether the wholesalers found it easier to adjust to the demand shock because of the relationship-specificity of their export goods (Nunn 2007; Kokko et al. 2014).

The results of this study also present some caveats for policymakers. As the descriptive statistics show, the average wholesaler exports a lot of goods to selected markets, which can be explained by the importance of average logistical costs. Direct exporters export a narrower selection of goods to a larger number of markets, which comes from lower average production costs. In the event of an unexpected demand shock in one export market, it is easier for wholesalers to switch their export product portfolio and destinations simultaneously than it is for direct exporters. Policymakers should keep this in mind when trying to help exporters that are facing a negative export shock, especially if trade shocks are the result of foreign policy machinations. Public agencies can mainly help wholesalers with soft measures like business diplomacy and marketing in the target destinations. Direct exporters could additionally benefit from more targeted measures and funding to help them through the transition period during which they readjust their product lines and export destinations.

8. Conclusion

This study examined the effects of the Russian demand shock of 2014 on the exports of Estonian firms that had previously exported non-embargoed products to Russia. The Russian demand shock was multifaceted and was an economy-wide negative demand shock that came from the impact of Western sanctions against Russia and a national income shock caused by the fall in the world price of oil and a devaluation of the local currency. The empirical analysis differentiated the trade effects at the firm and firm-product levels between direct exporters and wholesalers with different initial shares of exports to Russia in their total exports, and with different initial levels of productivity.

The general results show that the wholesalers affected by the Russian demand shock were generally better at diverting their trade flows than direct exporters were. The wholesalers with a medium initial share of exports to Russia in their total exports were able to divert the products they exported previously to other markets, while the wholesalers with the largest initial share of exports to Russia experienced the largest immediate aggregate contraction in trade but managed to divert trade in the medium term. The direct exporters affected generally experienced a clear decline in product-level exports, while the impact on firm-level trade was mitigated by product switching.

Important differences also arose between firms with different levels of productivity before the shock. The trade performance after treatment was commonly worse for the wholesalers and direct exporters with lower initial levels of productivity. However, the wholesalers with lower productivity levels fared better after the Russian demand shock than their counterpart direct

exporters did. Direct exporters with medium levels of productivity were able to mitigate the negative effects on their product-level exports by product switching.

The results highlight the importance of accounting for the heterogeneities both between and within direct exporters and wholesalers when studying the effects of trade shocks. The business model and firm-level capabilities of the exporters affected clearly have an impact on the dynamics of how firms adjust after the shock. Moreover, firm-level trade effects occur over several years and simply looking at the short-run effects can distort the true nature of the adjustment process after the shock. Trade policy decisions, whether they are intended to provide support measures for domestic exporters that are negatively affected or to achieve foreign policy goals, should take these points into consideration when searching for effective trade policy tools. Future research could complement this study by examining the long-run effects of firm-level adjustment along similar dimensions. It would also be important to look more closely into the effects of similar multifaceted demand shocks on the dynamics of other firm-level performance indicators besides export value.

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Appendices

Appendix 1. Descriptive statistics of yearly firm-level variables for wholesalers and direct exporters in 2013

	Wholesalers not exporting to Russia		Wholesalers exporting to Russia		Direct exporters not exporting to Russia		Direct exporters exporting to Russia	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Number of employees	34	124	25	39	40	73	83	144
Revenue (000 000')	12.7	50.4	12.1	26.5	5.211	47900	10.7	22700
Value-added per employee	39207	51609	41804	53667	22850	17512	27977	21919
Ratio of export revenue to total revenue	0.703	0.393	0.689	0.393	0.900	0.263	0.905	0.250
Number of export markets in 2013	3.6	3.6	6.1	6.5	4.3	5.2	9.8	9.7
Number of HS-4 products exported	26.8	51.4	37.8	81.1	8.2	15.0	17.1	22.7
Export value (000 000')	27	108	43.4	150	59.6	721	97	235
Ratio of reserves to assets	0.151	0.170	0.149	0.172	0.211	0.235	0.195	0.219
Share of Russia in total exports	0	0	46.6	41.3	0	0	32.6	38.7
Observations	384		190		816		167	

Notes: Table includes observations for the firms with the top and bottom 1% export value, which were removed before the matching procedure and not used in the regressions.

Appendix 2. Number of post-treatment observations of treated firms

	2014	2015	2016	2017	2018
Wholesalers					
Observations	172	172	172	172	172
Number of firms exporting	139	120	112	116	107
Number of existing firms	170	165	160	161	157
Direct exporters					
Observations	156	156	156	156	156
Number of firms exporting	140	130	133	128	120
Number of existing firms	155	149	147	146	136

Note: Table only includes firms that were matched by CEM. The number of existing firms is taken from the firms that had a positive export value or an entry in the Commercial Register in a given year.

Appendix 3. Coarsened exact matching (CEM) descriptive statistics for wholesalers and direct exporters from 2013 data

Wholesalers

Variable		Mean treated	Mean control	Bias (%)	Reduction in bias after matching (%)	Test p>t
ln (Value added per employee)	Unmatched	9.921	10.065	–7.8	29.7	0.366
	Matched	9.921	10.022	–5.5		0.564
Number of employees	Unmatched	25.278	34.21	–9.6	21.3	0.343
	Matched	25.278	32.308	–7.6		0.501
Number of export markets in 2013	Unmatched	6.037	3.621	46.5	73.2	0
	Matched	6.037	5.3887	12.5		0.303
Ratio of reserves to assets	Unmatched	0.151	0.1501	0.6	77.4	0.944
	Matched	0.151	0.151	0.1		0.987
Ratio of exports to total revenue	Unmatched	0.689	0.718	–7.4	46.1	0.406
	Matched	0.689	0.705	–4		0.658
ln (Export value)	Unmatched	15.140	15.151	–0.5	–159.7	0.956
	Matched	15.140	15.112	1.2		0.891

Sample	Ps R2	LR chi2	p>chi2	Mean Bias (%)	Median Bias (%)	R
Unmatched	0.062	44.16	0	12.1	7.6	1.57
Matched	0.006	4.23	0.646	5.2	4.8	0.56

Number of strata	74
Number of matched strata	39
Matched observations	Control: 317 Treatment: 172
Unmatched observations	Control: 55 Treatment: 15
Multivariate distance	Unmatched: 0.654 Matched: 0.615

Direct exporters

Variable		Mean treated	Mean control	Bias (%)	Reduction in bias after matching (%)	Test p>t
ln (Value added per employee)	Unmatched	9.755	9.721	2.3	8.2	0.761
	Matched	9.755	9.724	2.1		0.829
Number of employees	Unmatched	63.075	37.888	37	96.7	0
	Matched	63.075	63.917	–1.2		0.905
Number of export markets in 2013	Unmatched	8.795	4.189	69.2	86.3	0
	Matched	8.795	8.163	9.5		0.371
Ratio of reserves to assets	Unmatched	0.200	0.2108	–4.7	39.4	0.595
	Matched	0.200	0.1933	2.8		0.73

Ratio of exports to total revenue	Unmatched Matched	0.902 0.902	0.9064 0.9057	–1.9 –1.6	16.3	0.827 0.86
ln (Export value)	Unmatched Matched	16.239 16.239	15.754 16.45	22.6 –9.8	56.5	0.007 0.318

Sample	Ps R2	LR chi2	p>chi2	Mean Bias (%)	Median Bias (%)	R
Unmatched	0.087	75.92	0	23	13.6	2.47
Matched	0.008	6.02	0.421	4.5	4.5	1.06

Number of strata	126
Number of matched strata	57
Matched observations	Control: 556 Treatment: 156
Unmatched observations	Control: 250 Treatment: 5
Multivariate distance	Unmatched: 0.856 Matched: 0.803

Appendix 4. Descriptive statistics of treated and matched wholesalers and direct exporters by share of exports to Russia in total exports in 2013

	RU share 0–33%		RU share 33–66%		RU share 66–100%	
	Wholesalers	Direct exporters	Wholesalers	Direct exporters	Wholesalers	Direct exporters
Value added per employee, 2013	39 876	28 823	31 809	27 354	24 600	24 356
Number of export markets	8.52	11.65	4.24	5.36	1.76	2.67
Number of HS-4 products exported	52.17	20.82	22.29	7.5	15.94	7.5
Number of firms	88	100	17	14	67	42

Appendix 5. Robustness check for wholesalers and direct exporters, firm-level data

Wholesalers

	2010–2015				2010–2018			
	All destinations		w/o Russia		All destinations		w/o Russia	
RU	0.014		0.087		0.1		0.201*	
	(0.108)		(0.122)		(0.107)		(0.121)	
ln(number of employees)	0.362***	0.357***	0.385***	0.385***	0.469***	0.456***	0.507***	0.509***
	(0.077)	(0.078)	(0.082)	(0.081)	(0.091)	(0.094)	(0.103)	(0.103)
ln(value added per employee)	0.360***	0.352***	0.383***	0.384***	0.367***	0.353***	0.388***	0.392***
	(0.068)	(0.068)	(0.077)	(0.077)	(0.068)	(0.073)	(0.086)	(0.087)
RU share 0–33%		0.068		0.083		0.148		0.170
		(0.127)		(0.129)		(0.125)		(0.129)
RU share 33–66%		-0.072		0.204		0.115		0.500***
		(0.118)		(0.110)		(0.111)		(0.124)
RU share 66–100%		-0.110		0.076		–0.024		0.456**
		(0.100)		(0.300)		(0.124)		(0.207)
Observations	2607	2607	2444	2444	3816	3816	3608	3608

Direct exporters

	2010–2015				2010–2018			
	All destinations		w/o Russia		All destinations		w/o Russia	
RU	0.036		0.033		0.028		0.038	
	(0.051)		(0.053)		(0.047)		(0.049)	
ln(number of employees)	0.727***	0.722***	0.698***	0.695***	0.804***	0.804***	0.778***	0.777***
	(0.126)	(0.127)	(0.133)	(0.133)	(0.098)	(0.099)	(0.102)	(0.102)
ln(value added per employee)	0.154	0.153	0.146	0.145	0.230**	0.230**	0.225*	0.224*
	(0.094)	(0.093)	(0.091)	(0.091)	(0.116)	(0.116)	(0.117)	(0.117)
RU share 0–33%)		0.018		0.018		0.028		0.029
		(0.051)		(0.053)		(0.048)		(0.049)
RU share 33–66%		0.078		0.246***		0.029		0.324***
		(0.090)		(0.088)		(0.090)		(0.106)
RU share 66–100%		0.178		0.344		0.024		0.164
		(0.160)		(0.316)		(0.143)		(0.168)
Observations	3908	3908	3835	3835	5696	5696	5611	5611

Notes: All models are estimated using PPML. Firm-product exports models include firm-product and product-year dummies. Models include firm and year dummies. Statistical significance: *p<.1; **p<.05; ***p<.01. Robust standard errors clustered by firm in parentheses. All models use CEM weights based on matching all direct exporters a wholesalers in the sample.

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