ESSAYS IN INTERNATIONAL TRADE AND RUSSIAN TRADE POLICY

by

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DISSERTATION ABSTRACT

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In this dissertation I investigate the evolution of the current Russian foreign trade policy from trade liberalization following the accession to the World Trade Organization in 2012 to protectionism in the form of the retaliatory embargo in 2014. I focus on estimating the effects of each individual policy on Russian international trade, as well as the interconnection of these two opposing policies as parts of a broader strategy. First, I undertake an empirical analysis to estimate the impact of the embargo on Russian aggregate foreign trade. I find that the embargo was not fully effective in shutting down the imports of embargoed goods from the sanctioning countries. Next, I use a triple difference estimation strategy to identify the effect of the retaliatory embargo on the extensive and intensive margins of firm-level trade. I find an increase in the exit rate of Russian firms

importing goods targeted by the embargo from the sanctioning countries, with the larger firms switching to trading with non-sanctioning countries (extensive margin effects). Intriguingly, not all firms cut their trade relations with the sanctioning countries, which suggests that the embargo was not fully enforced. I find no evidence of unintended consequences of the embargo on the imports of other product categories. Taken together, Russia has been able to mitigate some but not all the costs to trade resulting from the self-imposed embargo. Finally, I analyze the impact of Russia's accession to the WTO on firm-level foreign trade dynamics. Russia's accession to the WTO had positive effects on Russian exporters and importers along several margins, including an increase in the number of partner countries for exporters and importers, and a significant increase in the number of imported products. The evidence of the effects of the WTO membership on the average export and import flows of firms is mixed. Additionally, I find evidence in support of the claim that the retaliatory embargo could have been conceived as a protectionist impulse to shield Russian producers in vulnerable industries (e.g., agriculture) from the increased competition following the accession to the WTO, rather than a purely retaliation instrument to the sanctions.

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CHAPTER I

INTRODUCTION

The current Russian trade policy is quite conflicting - after Russia underwent a significant trade liberalization episode by joining the World Trade Organization (WTO) in 2012, it rolled back straight to protectionism by imposing an agricultural embargo in response to the economic sanctions imposed on Russia in 2014. In this dissertation I analyze the impacts of each individual trade policy on Russia's foreign trade, and investigate how these two seemingly opposing policies fit together as parts of a broader strategy.

Large economies bound together over the past few decades by globalization are turning on each other. Trade wars and protectionist policies are gaining support among increasing portions of population in developed countries. Recent cases of tariff wars between the US and China, the UK's desire to leave the customs union with the other European countries, and the never-ending stream of sanctions and counter-sanctions between Russia and the OECD countries illustrate how trade policies are used to further the political agendas of large economies. What will happen if this trend continues? What happens if large countries, whose economies heavily rely on each other, initiate embargoes or trade wars? In my dissertation I analyze how embargoes and sanctions impact a large economy,

Russia, and provide several general predictions about the effectiveness of this type of non-tariff trade barriers.

A major world political event occurred in 2014 when the Russian government was accused of violating Ukraine's sovereignty and of contributing to the ongoing civil unrest in the country by invading the Crimean peninsula. Over the last four years intense political conflict broke out between Russia and the majority of the OECD countries, who opposed the annexation of Crimea by Russia. The international community typically responds to governments' behaviors that they deem problematic by employing an array of economic, political and financial sanctions, including arms ban, visa restrictions, exports ban and other measures. Currently Russia is sanctioned by 37 countries, including the 28 EU countries (counting the United Kingdom), the U.S., Canada, Australia, Norway, Iceland, Lichtenstein, Albania, Montenegro and Ukraine. Being a large country with a substantial degree of economic power, Russia retaliated against these economic sanctions by imposing a partial embargo[1] on imports from the sanctioning countries. Because it is rare that sanctions are imposed on a large economy that has market power to retaliate (like Russia), this incident presents an excellent opportunity to study the direct and indirect impacts of sanctions and embargoes on the economies of the participating countries, focusing both on import and

[1]The embargo mostly covers consumer agricultural goods, such as dairy products, fresh and frozen fruits and vegetables, fish and meat.

export flows. In Chapters II and III of my dissertation I analyze the impacts of this conflict on Russian aggregate trade and Russian firms, respectively.

Presumably, Russia's goal in retaliating was (1) to punish the sanctioning countries while (2) limiting the costs to itself. Regarding (1), the embargoed goods are agricultural products on which the smaller countries of the EU rely heavily. Regarding (2), one would expect that in order to limit costs, the embargo would target products that are relatively easy to substitute by redirecting the import flows towards non-sanctioning countries. My estimation strategy in chapters 1 and 2 examines evidence for these two hypotheses. The embargo's impact will vary conditional on the type of goods being traded (embargoed versus non-embargoed good) and the origin of the trade flow (sanctioning versus non-sanctioning country). To capture this heterogeneity, I analyze three effects of interest. Trade flows of embargoed goods from the sanctioning countries are likely to be the most impacted by the embargo, and I denote these responses as the main effect. The substitution effect will be experienced by firms that trade in embargoed goods and attempt to switch the source of their import goods to countries that are not targeted by the embargo. The last effect of interest is denoted the spillover effect and refers to the effect of the embargo on firms which trade with the sanctioning countries in non-embargoed goods. This approach of separating the embargo

impact into main, substitution and spillover effects is a novel, and it reduces the incidence of omitted variable bias[2].

In chapter II, I estimate a structural logged gravity equation that uses monthly data on bilateral product-specific trade flows to calculate the impact of the embargo in the three categories of interest. My findings suggest a total decrease in Russian imports of the embargoed products from the sanctioning countries of more than 80%. On the aggregate scale, the estimated substitution effect points to an increase in imports of embargoed goods from non-sanctioning countries by about 40%; the magnitude of the substitution effect towards non-sanctioning countries is not large enough to compensate for the embargoed imports. I also find that the Russian embargo had the largest impact on the smaller sanctioning countries. My findings point to the fact that Russia indeed was able to inflict significant damage on the economies of the smaller European countries, but was not able to mitigate the trade losses from these decisions by switching the sources of embargoed goods towards the sanctioning countries. These results are robust to a number of different tests - country and product heterogeneity, dynamics and falsification exercise.

The self-imposed Russian food embargo, which has been in place since August 2014, had significant negative impacts on aggregate Russian trade flows. However, little is known about this policy's effect at the micro level, on Russian

[2]When estimating the embargo's effect on trade flows, omitting the substitution effect leads to downward bias in the main coefficient of interest - main treatment effect.

firms. In Chapter III, I use a novel customs level dataset sourced from the Russian customs agency, that contains information on Russian firms' imports and exports to fill this gap in the economic literature. Utilizing a difference-in-difference estimation technique embedded into a gravity equation framework, I examine the variety of responses across firms in the intensive and extensive margins, focusing on differences by firm size, export status and number of products traded. The extensive margin of firms in the context of my study refers to the number of firms that import or export a particular HS-8 level product code. The intensive margin refers to the size of a firm's average trade flow.

Methodologically, the effect of the embargo on firms' extensive margin is modeled as the change in the number of importers or exporters per HS-8 code, using a Poisson count model. The estimation of the firms' intensive margin utilizes a difference-in-differences estimation of the gravity model in its multiplicative Pseudo-Poisson Maximum Likelihood (PPML) form (standard procedure in trade literature). Per my findings, on average, the number of firms importing an HS-8 level product decreases by about 14 firms for embargoed goods. Quite intuitively, the number of firms importing embargoed goods from the sanctioning countries experiences a large and statistically significant decline, which is not fully offset by an increase in the number of importers importing the embargoed products from the non-sanctioning countries. These results are the strongest for the small importers, while larger importers are able to leave the affected markets and

substitute towards non-sanctioning countries more efficiently. I also find evidence of an increased market exit and decreased entry for the importers, who trade in embargoed goods. The importers that choose to stay in the market for the embargoed products after the embargo are more likely to switch source partners to the non-sanctioning countries. At the intensive margin, surprisingly, I find that firms experience a 13% decline in their imports of embargoed goods from the sanctioning countries, which is significantly smaller than my estimates at the aggregate level. This loss is mitigated by an increase in imports of the embargoed goods from the non-sanctioning countries (an average firm is able to mitigate the negative effect of the embargo by finding new partner countries). There is significant degree of heterogeneity among the responses of different firm types to the imposition of the embargo, at both the extensive and intensive margins. Overall, I find that although Russian imports experience a significant decline after the embargo, these effects are driven by the extensive margin of firms. Importers abandon the markets for the embargoed goods, preferring to switch to the non-sanctioning countries. I find no significant evidence of spillover effect (firms keeping ties with the suppliers in the sanctioning countries, but switching to a different subset of products).

In Chapter IV, written in co-authorship with Dr. Anca Cristea, we examine the impact of Russia's WTO accession on trade patterns at the firm level. A large literature of cross-country studies examines the long run trade effects of

GATT/WTO membership and generates surprisingly conflicting results. Our study contributes to this literature by bringing micro-level evidence from the experience of a large trading country. Using customs level data on the import and export transactions of Russian firms over the period 2011-2015, we investigate the firms' short-run trade responses along the intensive and extensive margins following Russia's WTO accession in 2012. Our results indicate an increase in the number of exporters following the accession, an increase in the number of foreign countries that Russian firms import from or export to, and a significant increase in the number of imported products. The evidence of the effects of WTO accession on the intensive margin of firm level trade is mixed. Although it is hard to extend our findings to other countries or longer time periods, they nevertheless bring support in favor of countries' efforts to seek WTO membership.

Finally, we also uncover a disproportionate positive impact of the WTO on agricultural imports, which could serve as evidence that the embargo was intended as a protectionist policy and targeted a very specific sector whose imports benefitted significantly from the WTO accession (agriculture) in order to help the vulnerable domestic industry. Because the protectionist policies are against the WTO provisions, the embargo could have been a convenient way to kill two birds with one stone - retaliate against the embargo and protect domestic agricultural production.

CHAPTER II

THE EFFECTIVENESS OF EMBARGOES: EVIDENCE FROM RUSSIA

Introduction

Trade policies such as sanctions and embargoes have always been popular instruments of foreign policy (United Nations Security Council (2017)). These tools are used to induce behavioral changes in non-complying agents (countries) without military actions, which tend to be extremely costly and involve human casualties. Understanding their impacts on trade, welfare, growth and other economic outcomes for both sending and target countries is crucial.

One of the most recent examples of these foreign policies being enacted is the economic sanctions that were imposed on Russia in the aftermath of the Crimean conflict in 2014. The political conflict escalated quickly due to several unpopular decisions made by the Russian government and resulted in the imposition of sanctions by the majority of the OECD and several other European countries on Russian individuals and businesses. The sanctioning measures included diplomatic, financial, and economic restrictions such as freezing assets in foreign banks, visa bans, and interruption of any cooperation with the businesses who supported the annexation of Crimea, both in Russia and Ukraine. These measures have been in place since March of 2014 and no change is expected in the foreseeable future. In fact, several new rounds of sanctions have been applied to Russia since then, but

most of them are in response to the alleged interference of the Russian hackers in the U.S. 2016 elections.

On August 6, 2014, Russia imposed an embargo on a number of agricultural products from the sanctioning countries, including dairy products, meat, fish, fruits, and vegetables. This was done in response to the further intensification of the sanctions, which followed the shooting down of flight MH17 on July 17th of 2014 over the territories controlled by a pro-Russian separatist military group.[1] This is the first incident in modern history in which sanctions have targeted a large country like Russia that has market power to *retaliate against the sanctions*, unlike when sanctions were imposed on smaller countries like Iran, North Korea, or South Africa. This power dynamic makes this setting unique.

Russia's retaliation has the potential to create a significant impact (at least in the short run) on its own bilateral trade flows as well as on total world trade, [2] which is an important setting to evaluate. In this study I conduct a comprehensive analysis of the effect of the embargo on *Russian* trade with a focus on the effectiveness of the embargo and Russia's ability to mitigate the import losses from the embargo by finding new source countries for the affected goods.

[1]The new sanctioning measures included restrictions on lending to Russian state banks, an arms embargo, an export ban on oil technology and services that could be used for Arctic or deep-sea drilling or shale oil projects, and an export ban on dual-use goods equipment, such as specialist computers or heavy engineering vehicles that could be used for military purposes.

[2]According to the World Trade Organization (2017), Russia is one of the largest countries in the world, accounting for 1.99% of the world's merchandise exports and for 1.32% of the world's merchandise imports in 2017.

Presumably, Russia's goal in retaliating was to punish the sanctioning countries while limiting the costs to itself, i.e., the set of embargoed goods was chosen optimally.[3] The embargoed goods are agricultural products on which the EU countries with lower GDP per capita rely heavily. For example, more than 90% of Lithuania's total exports of tomatoes (HS-4 code 0702), cabbages (HS-4 code 0704), and lettuce (HS-4 code 0705) in 2013 was traded with Russia. Among other smaller countries that rely on exports to Russia heavily are Albania, Estonia, Latvia, and Poland. Thus, the Russian retaliatory embargo had the potential to put enough pressure on the European economy to stimulate the removal of the anti-Russian sanctions. Strategically, one would expect that in order to limit costs to itself, the Russian embargo would target products that are relatively easy to substitute by redirecting the import flows towards non-sanctioning countries.[4] Several Russian food markets significantly depend on imports. For example, about 50% of all dairy products or fruits and vegeTablesare imported, and almost 74% of pork is imported.[5] The embargo has been extended multiple times and is currently in place until the end of 2019.

[3] "Putin: Russian counter-sanctions hurt the sending countries' trade. Fact check from *Meduza.io*".
`https://meduza.io/feature/2016/10/17/putin%2Drossiyskie%2Dkontrsanktsii%2Dsilno%2Dnavredili%2Dzapadnym%2Dstranam%2Da%2Dna%2Dsamom%2Ddele%2Dfaktchek%2Dmeduzy`

[4] Some of the embargoed products (HS-codes 0202: meat of bovine animals frozen, 0406: cheese and curd) were among the top 20 Russian import shares in 2013, so the sheer amount of substitution needed might be too large for Russian firms to be able to mitigate the shock from embargo completely, which is why I separate the main and substitution effects of the retaliatory embargo in my analysis.

[5] According to statistics provided by Central European Financial Observer `https://financialobserver.eu/cse-and-cis/russia/the%2Dembargo%2Dhas%2Dtransformed%2Dthe%2Drussian%2Dfood%2Dmarket/`

I build an empirical model of Russian bilateral trade flows in embargoed and non-embargoed goods with sanctioning and non-sanctioning countries.[6] This allows me to (1) measure the ability of the embargo to negatively impact the sanctioning countries, i.e., quantify the drop in imports of the affected goods from the sanctioning countries, which is labelled the main effect of the embargo, and (2) analyze the optimality of the chosen set of embargoed products by measuring the increase in imports of the embargoed goods from the non-sanctioning countries, which I call the substitution effect. Separation of the embargo impact into main and substitution effects is a novel approach that reduces the incidence of omitted variable bias. The main and substitution effects are estimated with a standard multiplicative form of the gravity equation and Pseudo Poisson Maximum Likelihood (PPML). The triple difference estimation strategy allows me to compare the impacts of the embargo along the interaction of three margins: embargoed versus non-embargoed goods, sanctioning versus non-sanctioning countries, and the pre-embargo and post-embargo time periods. Additionally, I examine the impact on the extensive margin of trade, which I define as a number of partner countries per product, and the intensive margin, defined as an average

[6]Even though the terms "sanctions" and "embargoes" are used interchangeably in the literature, it is important to distinguish between them for the purposes of this paper. The term "sanctions" refers to the restrictive financial and economic measures imposed on Russia by several European countries, the U.S., Canada, and Australia in March 2014. The goal of sanctions is to coerce Russia into giving up control over the Crimean peninsula. The term "embargo" refers to the Russian embargo imposed in August 2014 on the sanctioning countries as a retaliation. Russia's objective is to persuade the sanctioning countries to lift the sanctions.

import or export flow of a product of a certain type from a sanctioning or non-sanctioning country.

I find that the embargo was not fully effective in shutting down the imports of embargoed goods from the sanctioning countries. My estimates suggest that the average import flow of embargoed goods from the sanctioning countries decreased by 51%, while the number of source sanctioning countries per embargoed good fell from 11 in the pre-embargo period to 5 after the imposition of the embargo (a fall of 55%). I find that the main effect is driven by the extensive margin, which translates to about 7.07 billion USD lost in imports one year after the embargo, which is roughly 30% of the total imports of embargoed goods in 2013 (or 3% of total Russian imports in 2013). At the intensive margin the losses are about 6 billion USD or about 2% of total Russian imports in 2013. There are several reasons for the ineffectiveness of the embargo. First, the observations in the COMTRADE data are recorded as HS-4 level codes and even though the embargo is imposed at the HS-4 digit level, some exceptions to the list of embargoed goods are present in Russian law at the HS-8 and HS-10 digit levels. Thus, the embargoed goods can still be admitted through customs even though they are technically under the embargoed HS-4 code. Second, there are specific exemptions made for the goods that are imported for production of some strategic goods, such as baby food or food for athletes - these goods are allowed to be imported. Third, customs officials are allowed to determine the set of embargoed goods not only

using the HS-4 digit code but the *name of the good* as well. Thus, there are several ways available to circumvent the embargo, which reduces its efficiency.

Regarding the optimality of the chosen set of goods, I find that the main effect losses are not completely offset by substitution to other import sources. I estimate that only about 56% of the lost imports of embargoed goods from sanctioning countries are recovered by switching sources towards non-sanctioning countries. Given the data, I am unable to account for two caveats in my estimations of the substitution effect: import substitution through domestic production and possible smuggling of the embargoed goods through non-sanctioning countries, for which some anecdotal evidence exists. For example, according to several Russian news sources (by24.org and Novaya Gazeta),[7] shrimps and pineapples allegedly produced in Belarus were found in several Russian stores in 2014. Belarus does not have access to the sea or climate warm enough to grow pineapples, which raised suspicion towards the possibility of smuggling of embargoed goods through Belarus. Thus, although some substitution was available, Russia was not able to fully mitigate the losses resulted from the imposition of the embargo. This points to the fact that the set of embargoed goods was not chosen optimally and rather than minimizing its own losses, the Russian government prioritized negatively impacting the sanctioning countries in hopes of

[7]Shrimp from Belarus to Russia: `http://by24.org/2014/08/19/belarusian_shrimps_goes_to_hungry_russia/`
Mussels from Mogilyov: `https://www.novayagazeta.ru/articles/2014/08/11/60696-nou-hau-mogilevskie-ustritsy-fin-de-kler`

alleviating the sanctions. These results are robust to a number of different tests: country and product heterogeneity, dynamics, and a falsification exercise.

Major trade shocks like the embargo can also have unanticipated impacts on the dimensions of trade not directly impacted by it. Thus, I also explore the possible impact of the embargo on the trade flows that are not directly impacted by the embargo: imports of non-embargoed goods from the sanctioning countries and Russian exports. I find evidence for an unexpected spillover effect of the embargo on Russian exports: after the imposition of the embargo, the average Russian export flow of non-embargoed goods to the sanctioning countries[8] declined by about 75 billion USD (cumulative loss of the extensive and intensive margins). I cannot attribute this chilling effect to dropping oil prices as the effect is driven by goods other than oil and gas. I also find some evidence that Russian exports of intermediate embargoed goods fall, either due to redirection of these goods to domestic production or the political or logistical motivations of the partners in the sanctioning countries. These spillovers offer a very important takeaway for policy makers: the embargoes will significantly decrease trade in affected goods, but also have spillover effects onto goods that are not directly targeted by sanctions by increasing the uncertainty of trade policy and the political and logistical misalignment of the partners in the sending and target countries.

[8]Both non-embargoed goods and sanctioning countries are incredibly important in the structure of Russian exports

The unanticipated economic sanctions and the Russian food embargo had a significant negative effect on the Russian economy, which had already been weakened by declining oil prices at the end of 2013 and the beginning of 2014,[9] causing a deficit of production inputs, which in turn led to rapid inflation.

Although I mostly find significant negative impacts of the embargo on Russia's foreign trade in that the substitution effect does not offset the trade losses from the imposition of the embargo, my analysis does not capture any shifts in internal domestic production. In that sense, the embargo had several unexpected positive effects. For example, it allowed Russian agricultural producers to increase production of grain (mostly wheat) and other important staples (Banse et al. (2019)). However, domestic substitution did not go as well for all products. Russian producers had to increase domestic production while cutting costs by substituting towards cheaper production inputs (for example, substitution of cow milk with powdered milk). Domestically produced goods are often of lower quality relative to imported goods. According to the opinion poll conducted by the Russian Research Holding Romir, almost 33% of respondents remarked on the lower quality of dairy products in December of 2015.[10]. Another positive side of the embargo was that Russia was able to strengthen its diplomatic connections and

[9] 40% of Russian total exports and more than 50% of its budget revenues depend on oil and gas, which makes the Russian economy especially vulnerable to volatile oil prices, causing the exchange rate between the Russian ruble and foreign currencies to increase significantly after the oil price shock. The oil price shock combined with the sanctions and drop in trade lead to a deep recession in 2015, characterized by a negative GDP growth rate (-2.8%), and inflation of almost 15%, according to the World Bank Indicators.

[10] See `http://romir.ru/studies/711_1443646800/`

increase its sphere of political influence among countries that have similar "anti-American" and "anti-EU" world views as Russia in the post-sanctions period, e.g., Egypt, Turkey, countries on the African continent (Foy (2020)).

My research pertains to other studies on the effectiveness of trade policies such as economic sanctions, embargoes, and boycotts. Eaton and Engers (1992), Eaton and Engers (1999) and Kaempfer and Lowenberg (1988) establish a theoretical framework to study sanctions and their effectiveness. Bapat et al. (2013), Hufbauer and Schott (1985) and van Bergeijk and van Marrewijk (1995) conduct empirical analyses of sanctions' effectiveness. In general, sanctions are rarely effective and the effectiveness of the sanctions depends on the market power of the participants. Coulibaly (2009), Kuehnapfel (2015), Teegen et al. (2008) and Irwin (2005) study the effects of the South African embargo, Cuban embargo and Jeffersonian embargo, respectively. The boycott[11] of French goods after the beginning of the war in Iraq (2003) has been studied intensively. For example, Heilmann (2016), Chavis and Leslie (2009), Pandya and Venkatesan (2016), Ashenfelter et al. (2007). The intuitive conclusion that embargoes, sanctions, or boycotts hurt trade relations between countries, decreasing exports and imports, is confirmed by some authors (Heilmann (2016), Michaels and Zhi (2016), Chavis and Leslie (2009), Neuenkirch and Neumeier (2015)), while other papers find effects

[11]Typically, boycotts are carried out by consumers against a certain brand or brands originating in the boycotted country and are not officially enforced by governments. Embargoes and sanctions, on the other hand, are enforced by the imposing countries: they decide on what actions are included in the sanctions packet and for how long they will be carried out.

of trade bans to be insignificant (Hufbauer and Schott (1985), Hufbauer et al. (1997)).

The existing research on the Russian sanctions and retaliatory embargo can be divided in two groups: the first group of studies concentrates on the macroeconomic effects of these policies, such as effects on prices of Russian goods and GDPs of the sanctioning countries and Russia, while the second group concentrates on the effects of the sanctions and embargo on bilateral trade flows between Russia and the sending countries. The studies of the macroeconomic effects of the sanctions and the embargo include Dreger et al. (2016) and Kholodilin and Netsunajev (2016). The former analyze the impact of the sanctions on the exchange rate of Russian ruble to the US dollar and the latter examines the changes in consumer good prices after the sanctions. From the second group, the study most relevant to my work is the working paper by Crozet and Hinz (2019). I would like to emphasize that my study and the study by Crozet and Hinz (2019) were developed in parallel, and although there are some similarities between the two papers, my study focuses on quantification of the effects of the embargo for Russia, while Crozet and Hinz (2019) analyze the impact for the sending countries, using the analysis of French firm-level export data to study how the sending countries were affected by the sanctions. Interestingly, both studies find unintended consequences of the embargo. I find that even though the embargo targets a specific set of imported goods, there is a significant spillover onto Russian

exports in the form of a decrease in flows of non-embargoed goods, while Crozet and Hinz find that the total loss from the embargo for the French firms is not due to the embargo, but rather what they call the "friendly fire" effect. To my knowledge, my study is the first to examine this topic from the perspective of Russia, bridging the existing gap in the economic literature.

The paper is organized as follows. Section 2.2 outlines the testable hypotheses and the empirical model needed to test them, while section 2.3 describes data sources used in the empirical analysis. Section 2.4 provides the base results for the main and substitution effects. Section 2.5 presents heterogeneity and dynamics analysis, while results of the falsification check are recorded in section 2.6. Section 2.7 describes the spillover effects of the embargo on Russian exports. Section 2.8 concludes.

Testable Hypotheses and Empirical Model

Testable Hypotheses

In this section I outline the hypotheses about the impact of the embargo on several dimensions of trade. To summarize the mechanisms driving these effects, I introduce the concepts of *extensive* and *intensive* margins of trade. Extensive margin in this context refers to the number of countries exporting a particular HS-4 digit product code to Russia, and intensive margin refers to a product average import flow from a partner country.

One of the most interesting questions in the recent case of the retaliatory embargo regards its efficiency, i.e., if the embargo eliminates all imports of embargoed goods from the sanctioning countries. Ahn and Ludema (2019) find that the impacts of sanctions for the firms that are strategically important for the Russian government is smaller than on other firms, i.e., the Russian government does have the tendency to shield certain firms and enterprises they deem important for the economy. Thus, it is not unreasonable to expect that exceptions can be made from the embargo, which would decrease its efficiency. Several changes were made to the rules of the embargo within the first year of its imposition. For example, although HS-4 code 0301 (live fish) is embargoed, the fry used for aquaculture was exempt from the embargo in August of 2014, because many producers claimed that it was impossible to continue production without imports of fry. This points to the fact that although the Russian government is willing to sacrifice the wellbeing of certain producers, the protectionist impulses toward other industries are strong, which decreases the efficiency of the embargo. I measure the effectiveness of the embargo by analyzing the change in the imports of embargoed goods from the sanctioning countries, which I label the main effect.

The embargo's aim was to reduce the embargoed goods' imports in order to coerce the sanctioning countries to lift the sanctions. Thus, sanctioning countries will be dropping out of the embargoed goods' markets (extensive margin) and/or reducing the exports of the embargoed goods (intensive margin) if they stay in the

markets (quite possibly through the pre-existing contracts for sourcing the inputs for the domestic production channel). I test for the magnitude of these changes to determine which margin contributes to the fall in imports, whether it's the decline in the average trade flow or the number of source countries.

I assume that the Russian government chose the optimal set of goods with which to retaliate, for which substitution was readily available. A natural market response to a sudden reduction of the set of source countries of the embargoed goods would be an increase in trade in the targeted goods with the non-sanctioning countries. The increase in the imports of the embargoed goods from the non-sanctioning countries is labeled the substitution effect. There must be a reason why the set of the embargoed goods was initially sourced from the sanctioning countries: either they are of higher quality, less expensive, or more readily available. Thus, I do not expect that the substitution effect will be large enough to offset the losses from the embargo. It is also important to determine the channels of the substitution, i.e., whether it operates through an increase in the number of non-sanctioning countries that export embargoed goods to Russia, an increase in the average import flow of that type, or both.

Major trade shocks like the embargo can also have unanticipated impacts on the dimensions of trade not directly impacted by it. For example, there exists anecdotal evidence that the Iranian customers experienced shortages of medication and decreased access to medical services due to restrictions on money

transactions, proper insurance, and other factors that emerged as a result of the sanctions, although the humanitarian aid, medication and food staples are never directly targeted by the embargoes and sanctions(Cheraghali (2013)). Thus, I also explore the possible impact of the embargo on the trade flows that are not directly impacted by the embargo: imports of non-embargoed goods from the sanctioning countries and Russian exports. I call this possible impact of the embargo on goods that are not directly targeted a *spillover* effect. Some mechanisms that might factor into the spillover effect are political motivations and logistics. Markets in the sanctioning countries might respond to an embargo with a decision to boycott or drop out of Russian markets due to an increased uncertainty of trade policy. Alternatively, there may be economies of scale in shipping, i.e., the exporters of the embargoed goods in the sanctioning countries might also export non-embargoed goods. If the relative size of the latter in total exports is small, then the incentive to only trade in non-embargoed goods with Russia is small, potentially interrupting trade altogether. As for the exports, it might be the case that partners of Russian exporters chose to not conduct business with them after the embargo either due to logistical reasons, uncertainty, or political motivations. The macroeconomic conditions in Russia also deteriorated after the sanctions and embargo were imposed. For example, Kholodilin and Netsunajev (2016) show that the sanctions had a direct negative impact on Russian GDP growth, while Dreger et al. (2016) conclude that although the bulk of the depreciation of the Russian

ruble after 2014 is due to the falling oil price, the unanticipated sanctions matter for the conditional volatility of the exchange rate. These changes could also have a negative impact on exports.

To shed light on the mechanisms of the embargo on Russian trade, I build an empirical model. My identification strategy relies on the assumption that the imposition of the embargo was an exogenous shock to the bilateral trade flows. This is a plausible assumption because the imposition of the embargo was triggered by the shooting down of flight MH-17, which was a plausibly exogenous event.

Empirical Model

I utilize a triple difference estimation and a PPML estimator to analyze the changes in Russian trade flows (exports and imports) caused by the imposition of the Russian embargo on food imports. The estimation equation is derived from the standard gravity model, which has been widely used to estimate the responsiveness of trade flows to various economic factors. I follow Anderson and Van Wincoop (2003) and Feyrer (2009) in setting up the basic gravity relationship:

$$Trade_{ijt} = \frac{y_{it}y_{jt}}{y_{\omega t}} \left(\frac{\tau_{ijt}}{P_{it}P_{jt}} \right)^{1-\sigma} \tag{2.1}$$

where $Trade_{ijt}$ is bilateral trade between countries i and j at time t (I separate export and import flows); y_{it}, y_{jt} and $y_{\omega t}$ denote the incomes of the exporter

country, the importer country, respectively the world at time t. τ_{ijt} stands for bilateral resistance term; P_{it} and P_{jt} denote the country-specific multilateral resistance terms at time t. Taking logs of both sides of the equation (2.1), this can be re-written as:

$$ln(Trade_{ijt}) = ln(y_{it}) + ln(y_{jt}) - ln(y_{\omega t}) + (1-\sigma)\left[ln(\tau_{ijt}) - ln(P_{it}) - ln(P_{jt})\right] \tag{2.2}$$

We can think of the $Trade_{ijt}$ as the product of the two trade margins: the extensive margin, denoted by N (i.e. number of partners country ı trades with), and the intensive margin, denoted by $\overline{T}$ (i.e. an average value of a bilateral trade flow).

I make the following transformations to the equation (2.2) to arrive at the estimation equation to be taken to the data. Since the model applies to Russia's trade only, and Russia is always a trading partner, I drop the i subscript to simplify notation. The data allow me to add a product dimension, which is denoted by the k subscript. I model Russia's retaliatory embargo as a bilateral trade friction (i.e., part of τ_{ijt}), which reduces both, the number of partners who are willing to trade in the affected goods (N) and the average trade flow $\overline{T}$. In order to account for multilateral resistance terms P_{it}, P_{jt}, and for world income $y_{\omega t}$, I include country - year fixed effects, where I denote years by y subscript

(since the data are available monthly, I preserve the t index for the month-year periods) to model y_{jt} in equation (2.3).

To capture the embargo's impact on Russian imports and exports, I utilize the variables for the three effects as discussed in the prior section: main, substitution, and spillover. The omitted (i.e. reference) group consists of non-embargoed goods from non-sanctioning countries. As is standard now in the literature (beginning with Santos Silva and Tenreyro (2006)), I utilize the PPML estimator and the j, t, y, and k subscripts for partner country, month-year time period, year, and product, respectively, to construct the multiplicative form of the estimation gravity equation. In the end, I arrive at the following estimating equation:

$$Trade_{jkt} = exp^{\wedge}[\alpha + \gamma_{jk} + \gamma_t + \gamma_{jy} + \gamma_{ky} + \beta_1 \times Main\ effect_{jkt} + \beta_2 \times Substitution\ effect_{jkt} + \beta_3 \times Spillover\ effect_{jkt} + Tradecost_{jt})] + \varepsilon_{jkt} \tag{2.3}$$

The country-product fixed effects (γ_{jk}) account for the time-invariant determinants of bilateral trade such as bilateral distance, common borders, and common language. They also account for time-invariant product characteristics. The time period fixed effects (γ_t) account for any Russian macroeconomic factors that might affect trade (e.g. inflation, currency movements, etc). It is important

to account for these factors because of a dramatic devaluation of the Russian ruble due to the oil shock that took place in the beginning of 2014. The country-year fixed effects (γ_{jy}) allow me to control for the multilateral resistance terms, while the product-year fixed effects allow me to control for product-specific trends. $ln(Tradecost_{jt})$ is a time-varying trade cost variable in logs, which is constructed in the following fashion:

$$Trade\ cost_{jt} = distance_j \times oil\ price_t$$

where $distance_j$ is the distance between Russia and the partner country j and $oil\ price_t$ is the price of a barrel of oil at time t. This trade cost variable is a proxy for bilateral shipping cost.

I will next describe the three variables of interest and cost variables in further detail.

1. $Main\ effect_{jkt}$ captures the direct effect of the retaliatory embargo on trade in embargoed products with the sanctioning countries. This variable reflects whether the Russian food embargo targets a particular product k imported from country j at time t. It is constructed as follows:

$$Main\ effect_{jkt} = D_{S\ country} \times D_{E\ product} \times D_{Post}$$

where $D_{S\ country}$ is a dummy that takes the value of 1 if the partner country is sanctioning Russia, and 0 otherwise; $D_{E\ product}$ is a dummy that takes the value 1 if the product is embargoed by Russia as a retaliation, and 0 otherwise; D_{Post} is a dummy that takes the value of 1 in all the months following August 2014, i.e. the period when the embargo was imposed. For the imports sample I expect that the coefficient β_1 on $Main\ effect$ to be negative. I do not expect to find a significant main effect for the exports.

2. $Substitution\ effect_{jkt}$ measures the substitution effect of the embargo. This dummy variable reflects how the trade flows in embargoed good k with the non-sanctioning country j at time t were affected by the embargo. It is constructed as follows:

$$Substitution\ effect_{jkt} = D_{NS\ country} \times D_{E\ product} \times D_{Post}$$

where $D_{NS\ country}$ is a dummy that takes the value of 1 if the partner country is not sanctioning Russia and 0 otherwise; $D_{E\ product}$ and D_{Post} are as described above. The coefficient β_2 for the substitution effect should have a positive sign for the imports sample because I expect Russia to import more embargoed products from the non-sanctioning countries. For the exports, similarly to the main effect, I do not expect to find a significant impact.

3. $Spillover\ effect_{jkt}$ is a dummy variable that takes a value of 1 if a sanctioning country j trades in a non-embargoed good k at time t and 0 otherwise. The justification to include this variable is the possibility that sanctioning countries voluntarily reduce trade with Russia in other product categories as well. This variable is constructed as:

$$Spillover\ effect_{jkt} = D_{S\ country} \times D_{NE\ product} \times D_{Post}$$

where $D_{S\ country}$ and D_{Post} are as defined above and $D_{NE\ product}$ is equal to 1 if a product is not embargoed, and 0 otherwise. My prior is that the coefficient β_3 on $Spillover\ effect$ will be negative, but not necessarily significant for both samples, exports and imports.

I use a similar approach to equation (2.3) to analyze the impact of the embargo on the extensive margin. The dependent variable for the extensive margin becomes the number of countries from which Russia imports a particular good. To introduce the country type dimension, I count the number of sanctioning and non-sanctioning countries per HS-4 digit product k in a given period t. The estimation equation for the extensive margin also utilizes the PPML estimator, and is of a following form:

$$Number\ of\ countries\ per\ product_{jkt} = exp^{\wedge}[\alpha + \gamma_{jk} + \gamma_t + \gamma_{jy} + \gamma_{ky} + \beta_1 \times Main\ effect_{jkt} + \beta_2 \times Substitution\ effect_{jkt} + \beta_3 \times Spillover\ effect_{jkt} + Tradecost_{jt}] + \varepsilon_{jkt} \tag{2.4}$$

Equation (2.4) is estimated separately for the sanctioning and non-sanctioning countries; thus the subscripts are modified slightly from equation (2.3) . j now refers to the country type: sanctioning or non-sanctioning. Thus, γ_{jk} refers to the product - country type time invariant trends, γ_{jy} refers to the country type - year fixed effects, to control for the multilateral resistance terms common across the sanctioning and non-sanctioning countries. The expected signs on the coefficients for the imports' sample are in line with the expectations for the intensive margin: $\beta_1 < 0$, $\beta_2 > 0$, and $\beta_3 < 0$. If any effect is present in the exports' sample, I would expect it to be the negative spillover effect.

Data

To estimate the regression model described above, I use several data sources, including the UN COMTRADE, CEPII Gravity and World Bank Global Economic Monitor databases. The UN COMTRADE data are available at product (HS-4 digit) and monthly level over the period January 2010 to December 2016. I analyze the impact of the Russian embargo on both its exports and imports. The dataset on Russia's imports is assembled from foreign countries' reported exports

to Russia, while the Russian export dataset is assembled from countries' reported imports from Russia.[12]

The CEPII (Centre d'Etudes Prospectives et d'Informations Internationales) Gravity database provides information on the geographic distance between Russia and its trading partners. It also provides the information on common language and common border, on trade agreements, and other controls typically used as regressors in the gravity equation. Data on the partner countries' GDP and GDP per capita are taken from the World Bank Global Economic Monitor database, and are recorded on a yearly basis. I use these measures to conduct country heterogeneity analysis. Monthly time series data on the oil price are provided by St. Louis FRED. I use the price of BRENT oil in US dollars for the calculation of trade costs.

After combining all these data sources I obtain a panel dataset of Russia's import and export trade flows by country, by product and by month of transaction. The import sample contains 1,587,216 observations, while exports' sample has 965,894 observations. Table 1 reports the summary statistics for the pre-embargo sample for imports in panel A, and for exports in panel B. There are 120 countries in the imports sample, and 130 in the exports sample, of which 37 are countries sanctioning Russia. The total number of unique HS-4 digit product

[12]This approach is chosen because in the COMTRADE database Russia starts reporting trade at monthly level starting in January 2012, while other countries' reports are available earlier. In order to increase the number of observations, I proceed using other countries' reports. In UN COMTRADE, imports are recorded cif (cost insurance and freight) while exports are fob (free on board).

codes is similar across the two samples - around 1240 HS-4 digit product codes, of which 49 are embargoed.[13]

It is worth pointing out that most of the sanctioning countries are EU members, and they trade with Russia extensively due to the geographical proximity and historically established connections. This is among the main reasons why the share of the sanctioning countries in both imports' and exports' sample is on average 76% versus 24% for the non-sanctioning countries in the pre-embargoed periods. The embargoed products consist of different food groups, including fruit and vegetables, meat and dairy products. The share of the embargoed products in Russia's imports is 8% of the sample, which signifies that this category of goods is significant for Russia. The share of these goods in the exports' sample if below 1%, which is intuitive once we take into account that Russia's major exports are natural resources, such as crude oil, gas, coal. On average the unit value of the imported embargoed products is lower than that of the non-embargoed products (embargoed good's unit value is 77 USD versus 447 USD for the non-embargoed good); similar pattern is observed for exports, although the exported embargoed goods are cheaper than imported ones on average (comparative advantage confirmed). The disparity of unit values between the imported and exported embargoed intuitive considering that only non-durable food items were

[13]The lists of sanctioning countries and embargoed products are provided in the Appendix, Tables A.1 and A.2, respectively. Both lists are compiled from the Russian laws and the Russian President's Executive Orders, which contain the detailed description of the countries and products to be embargoed. The embargoed products are listed at the HS-4 digit level, which dictates the use of HS-4 digit level COMTRADE data.

embargoed, while the expensive, durable goods were not affected by the embargo. On average, from a sanctioning country Russia imports 81 distinct HS-4 digit product codes; from a non-sanctioning country Russia imports 42 distinct HS-4 codes.

Base Results

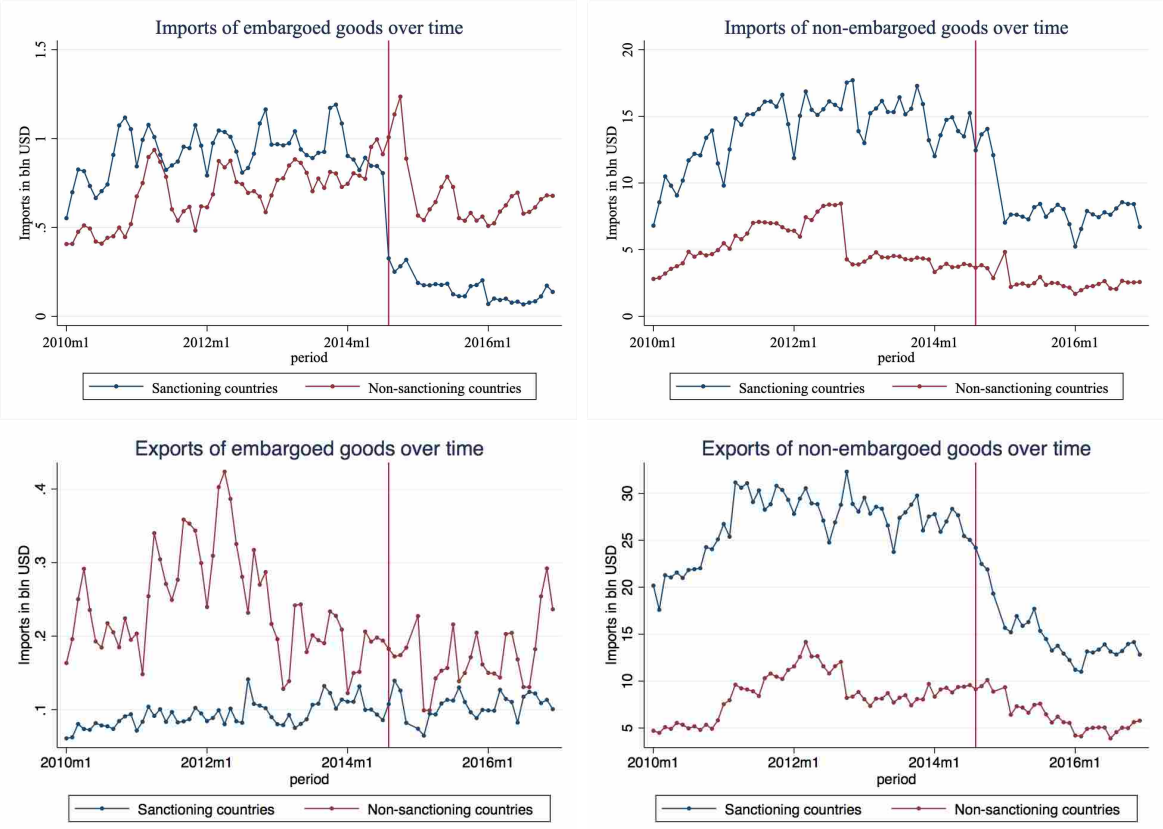
In this section I present the estimation results based on equations (2.3) and (2.4). I then analyze the effects' dynamics and conduct several robustness exercises. I exploit the variation in Russian import and export trade flows created by the exogenous shock of the Russian embargo imposed in August of 2014 to identify its effect. As my analysis of the Russian and foreign news sources in the weeks preceding the imposition of the retaliatory embargo shows, the imposition of the embargo was unanticipated by both Russian and foreign firms, thus the shock was truly exogenous. I make an important identifying assumption that no other shock happened at the same time and targeting the same set of countries and commodities as the embargo, and that my estimations are picking up solely the effect of the embargo.

The Effectiveness of the Embargo: Main Effect

Interestingly, although the absolute value of imports fell significantly (by about 50% in comparison to the pre-embargo trend) after the embargo (1), the structure of imports remained fairly consistent: about 6-8% of total import value

is attributed to the embargoed goods. The same can be said about the structure of imports based on the country type. Even after the sanctions and the retaliatory embargo Russia maintains the import and export shares of the sanctioning countries at about 68-75%. Thus, the margins of trade are very interesting to analyze.

FIGURE 1.
Embargo Effects on Aggregate Trade Flows



Notes: This figure depicts the changes in Russian aggregate import and export flows (measured in billions USD) of embargoed and non-embargoed goods introduced by the Russian food embargo, imposed in August of 2014. Data source is UN COMTRADE. Each good in the original imports sample receives an indicator as an embargoed or non-embargoed good, depending on whether it is included in the embargoed products list by the Russian government. I the plot the aggregate log trade for each good category against month-year time periods.

TABLE 1.
Summary Statistics

Panel A: Imports

	Sanctioning country	Non-sanctioning country	Embargoed product country	Non-embargoed product
Log monthly trade flow per product per country	10.873 (2.852)	10.813 (2.941)	11.819 (2.812)	10.817 (2.869)
Log yearly trade flow per product per country	24.374 (1.461)	23.71 (1.089)	22.87 (0.292)	25.214 (0.656)
Log GDP of the partner country	26.834 (1.624)	26.741 (1.942)		
Unit value			76.774 (6985.021)	447.154 (83,859.57)
Trade shares	0.76	0.24	0.08	0.92
Number countries in sample = 120:	37	83		
Number of products in sample = 1240:			49	1191
Average number of products countries trade in	81	42		
Observations (total = 1,588,575)	1,207,011	381,564	59,654	1,528,921

Panel B: Exports

	Sanctioning country country	Non-sanctioning country	Embargoed product product	Non-embargoed
Log monthly trade flow per product per country	9.952 (3.274)	9.812 (3.297)	10.651 (2.966))	9.875 (3.29)
Log yearly trade flow per product per country	23.556 (2.99)	23.425 (1.931)	21.178 (0.573))	25.803 (0.679)
Log GDP of the partner country	26.638 (1.738)	25.445 (1.951)		
Unit value			40.056 (974.15)	530.252 (37,606.79)
Trade shares	0.768	0.232	0.008	0.992
Number of countries in sample = 130:	37	93		
Number of products in sample = 1237 :			49	1188
Average number of products countries trade in	81	45		
Observations (total = 965,894)	550,193	415,701	24,380	941,514

Notes: The table presents the sample summary statistics for selected variables prior to the imposition of the embargo or imports sample (Panel A) and exports sample (Panel B). Variable means; standard deviations in parentheses.

Table 2 provides the motivation for choosing the main estimating equation (2.3) as my benchmark specification for the intensive margin. I provide both,

PPML (columns 4-7) and OLS results for comparison (columns 1-3). Each column for both estimators contains different sets of fixed effects together with the three treatment dummy variables of interest; I compare the effects of the embargo across these specifications. In all specifications, I account for country - product fixed effects. The reference group for all of the specifications consists of non-sanctioning countries trading in non-embargoed products. In all of the specifications, the main coefficients of interest are: 1) the main effect, measured by β_1, which captures the impact of the embargo on the embargoed goods' flows sourced from the sanctioning countries? i.e., the effectiveness of the embargo; and 2) the substitution effect (β_2), which measures Russia's import substitution in embargoed products from sanctioning to non-sanctioning countries. I also consider the effect of the embargo on the sanctioning countries' trade in non-embargoed goods ($Spillover\ effect$), β_3.

The first thing to note is that across all specifications, with both OLS and PPML, the signs of the coefficients on the main and substitution effects are consistent with my hypotheses. The embargo had a significant negative impact on the embargoed products' flows from the sanctioning countries, while Russia attempted to substitute its import flows of embargoed goods towards non-sanctioning countries. However, the magnitudes of both, main and substitution effects coefficients, are very different across the specifications. The PPML estimates of the main coefficient are about twice as small as the OLS (-0.71 vs -

1.534), which is consistent with the results in Santos Silva and Tenreyro (2006): OLS in gravity equation overestimates the coefficients. However, I still find the expected sign and the high significance of the main effect, which assures me that these results are robust. The coefficients on the substitution effect variable are similar across the two estimators, but the relative sizes of the main and substitution effects vary significantly. For OLS, the coefficient of the substitution effect is about a third of the main effect, while for the PPML this relation is more of a 50%. Another thing to note is that the significance of the spillover effect disappears when using the PPML estimator, and switches the sign. This could be due to the fact that the embargo had a relatively smaller impact on this group of country-product interactions, and accounting for the zero trade flows, and an extensive set of fixed effects, removes the variation needed to identify this effect.

In column 7 of Table 2 I separately estimate the impact of Turkish sanctions, which Russia imposed in January 2016 as a result of the shooting down of the Russian military aircraft by Turkish air forces. Several of the embargoed goods are also embargoed from Turkey beginning in January 2016. I do not find that these sanctions have a significant impact on any of the effects of interest, and I do not report this coefficient in the future analysis. The main takeaway from the Table 2 analysis is that the main effect coefficient is negative and highly significant, and its magnitude is larger than the substitution effect, which is, as expected, positive. I proceed by interpreting the results of my benchmark specification; these

results are presented in column 7, in which I account for country - product, period, country-year and product-year fixed effects, and use the PPML estimator. This specification is the most conservative, which allows me to estimate all of the effects of interest and account for most of the unobserved variation.

The embargo imposed by the Russian government on a number of products from the sanctioning countries had a significant negative impact on trade with those countries. At the intensive margin, the average import flow decrease by 51% (i.e., $e^{-0.71} - 1 = -0.508$), i.e., the embargo was not completely efficient. The purpose of the embargo was to negatively impact the sanctioning countries by prohibiting exports of embargoed goods to Russia. I find that the imports in this category declined slightly more than by 50%, which means that embargo did not utilize its full potential and its main goal of inflicting the largest damage to the sanctioning countries was not reached.

Next I provide a "back of the envelope" calculation of losses due to the intensive margin. I calculate a decline of an average import flow of embargoed goods from the sanctioning countries and multiply this number by a monthly average number of country-product pairs of this type. The average monthly import flow of embargoed goods from sanctioning countries of 1,745,908 USD declines by 51%, which translates to 890,413.08 USD loss per average import flow of this type. On average there are 539 sanctioning country - embargoed product pairs in a given month (11 countries per product $\times$ 49 embargoed products), and thus the monthly

loss at the intensive margin is 890413.08 $\times$ 539 = 479.93 million USD. Thus, an estimated intensive margin average loss one year after the embargo is 5.76 billion USD, which translates to about 2% of total Russian imports in 2013. Cumulative loss in this category of imports is 7.07+5.76 billion USD = 12.83 billion USD, or about 60% of total imports of embargoed goods in 2013, and 5% total imports in 2013.

The embargo can also manifest at the extensive margin of trade, i.e., the number of importers per product. To calculate the impact of the embargo on the extensive margin, I estimate the equation(2.4). The results of this analysis are presented in Table 3, in panel A for the imports sample, and in panel B for the exports sample. I provide the description of the exports sample in section 6, and concentrate on imports' sample in this section.

Results in column 2 of Table 3 point to the fact that the number of sanctioning countries, from which Russia imports embargoed goods fell by approximately 58% ($e^{-0.868} - 1 = 0.580$) (the main effect). This corresponds to a decline of about 6 sanctioning countries per product. An average monthly import flow of embargoed goods from sanctioning countries in 2013 is 1,745,908 USD. Thus, the amount lost per embargoed product per month at the extensive margin is 6 $\times$1,745,908 = 12.03 million USD. There are 49 embargoed goods total, so the monthly import loss for all embargoed goods at the extensive margin is 12.03 $\times$ 49 = 589.44 million USD. Thus, conditional on average import flows,

Russian imports have declined by 7.07 billion USD one year after the embargo. This corresponds to about 30% of the total imports of embargoed goods in 2013 (or about 3% of total Russian imports in 2013).

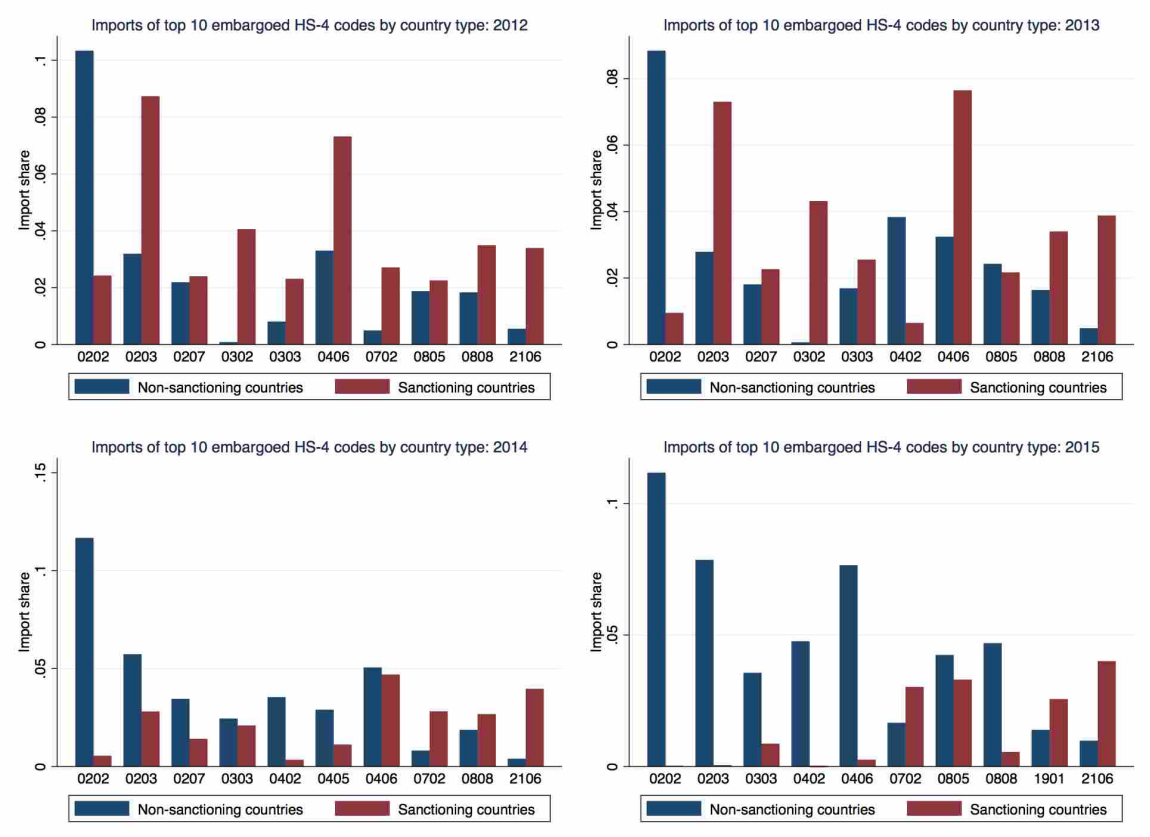
It is quite surprising that the embargo does not cause a 100% reduction in either margins, intensive or extensive. Although a clear decline in the average number of sanctioning source countries is evident from Table 3, some sanctioning countries continue exporting embargoed goods to Russia. It is also evident from Figure 2: although the import shares of the top 10 embargoed HS-4 digit products sourced from the sanctioning countries drops to almost zero for several top products, for certain goods these shares do not decline significantly (for example, HS-4 codes 0808 (apples, pears and quinces, fresh), 1901 (malt extract, flour, dairy preparations, low cocoa), and 2106 (food preparations, nested). Decrease in the the average imports of the affected good is about 50%. Granted, these are average effects, and there could be a lot of heterogeneity masked under these estimates. I conduct extensive heterogeneity analysis to uncover the driving forces behind this in subsection 4.2.

TABLE 2.
Total Trade: Specification Choice

Dependent variable:	Log of trade			Level of trade			
	OLS			PPML			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Main effect	-1.682***	-1.566***	-1.534***	−0.586**	−0.532**	−0.713***	−0.710***
	(0.295)	(0.292)	(0.229)	(0.242)	(0.233)	(0.241)	(0.249)
Substitution effect	0.271***	0.261***	0.438***	0.340***	0.336***	0.352***	0.350***
	(0.063)	(0.066)	(0.095)	(0.129)	(0.091)	(0.091)	(0.093)
Spillover effect	-0.161***	-0.062***	-0.047***	−0.074	−0.005	0.014	0.019
	(0.015)	(0.017)	(0.018)	(0.057)	(0.030)	(0.031)	(0.031)
Turkey sanctions							0.009
							(0.752)
Log of cost	-0.023	-0.137***	-0.138***	−0.078	0.005	−0.069	−0.150***
	(0.015)	(0.024)	(0.024)	(0.060)	(0.068)	(0.055)	(0.057)
Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-year FE	No	Yes	Yes	No	Yes	Yes	Yes
Product-year FE	No	No	Yes	No	No	Yes	Yes
Observations	1,583,856	1,583,844	1,583,768	1,565,568	1,565,557	1,565,483	1,565,483
R^2	0.76	0.764	0.77	0.816	0.841	0.861	0.861
Adjusted R^2	0.753	0.757	0.762	0.811	0.837	0.856	0.856

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. This table provides the motivation for choosing the main estimating equation (3) as the benchmark specification for the imports sample. Columns 1-3 present OLS results for comparison, while columns 4-7 present PPML results. Each column contains a different set of fixed effects along with the three treatment dummy variables of interest. The benchmark specification is in column 6. Main effect refers to the imports of embargoed goods from the sanctioning countries; substitution effect is imports of embargoed goods from the non-sanctioning countries; spillover effect refers to the imports of non-embargoed goods from the sanctioning countries.

FIGURE 2.
Yearly Import Shares of Top 10 Embargoed HS-4 digit Codes by Country Type



Notes: Figure 2 depicts trade shares in total Russian imports of top 10 embargoed HS-4 digit codes by country type. First, I calculate the trade shares of embargoed goods in the total imports of embargoed goods. Then I choose the top 10 HS-4 digit codes and plot their import shares in total Russian imports by country type: sanctioning vs. non-sanctioning. It is clearly shown that the top 10 HS-4 digit codes are fairly consistent across times. In 2015 (year after the embargo) the share of imports of embargoed goods from sanctioning countries for the top 4 HS-4 digit codes decreases significantly, and increases for the non-sanctioning countries. Short HS-4 digit codes descriptions are as follows: 0202 - Meat of bovine animals, frozen; 0203 - Meat of swine, fresh, chilled or frozen; 0207 - Meat and edible offal, of the poultry, fresh, chilled or frozen ; 0302 - Fish, fresh or chilled; 0303 - Fish, frozen; 0402 - Milk and cream, concentrated with/without sugar; 0405 - Butter and other fats and oils derived from milk; 0406 - Cheese and curd; 0702 - Tomatoes, fresh or chilled; 0805 - Citrus fruit, fresh or dried; 0808 - Apples, pears and quinces, fresh; 2106 - Food preparations.

Another reason why we do not see the trade in the embargoed goods from sanctioning countries disappearing completely could be that the dataset I use records the observations at the HS-4 level product codes, and even though

the embargo is imposed at the HS-4 digit level, some exceptions to the list of embargoed goods are present in the Russian laws at the HS-8 and HS-10 digit levels. Thus the embargoed goods can still be let through the customs even though they are technically embargoed. There are also specific exemptions for the goods that are imported for production of baby food or food for athletes - these goods are allowed to be imported. There is specific paperwork for these types of exceptions, unfortunately it is not available to the general public and it is impossible to estimate the true amount of imports of this type.

Additional explanation for why we do not see the 100% drop in the imports of embargoed goods from the sanctioning countries is the several language changes that have been introduced to the law on the embargo between the first time it was imposed in August of 2014 and its intensification in 2015. Namely, the customs officials are to determine the embargoed good not only using the HS4-digit but the *name of the good* as well. To me this suggests that the embargo is flexible for certain types of goods that are either of strategic interest to the Russian government, or other individuals with certain connections. Thus, the bulk of the embargoed goods will not be able to enter the country, while certain goods, which are exempt from the embargo through either the strategic interest or law loopholes will still cross the border. Some anecdotal evidence exists to support this claim. According to the BBC,[14] there are multiple cases of the public procurement of embargoed goods by certain state affiliated enterprises (Parmesan cheese for the

[14] `https://www.bbc.com/russian/features-36986348`

Russian federal Tax Service, Brie cheese for the Hematological scientific center of the Russian Ministry of Health, state University of civil aviation purchased Finnish cheese "Oltermanni" and many other cases). Given that these goods are specified in the public procurement, they classify as imports.

The Substitution Effect

Regarding the substitution, or the goal of the embargo to minimize the losses to the Russian economy while causing the most damage to the sanctioning countries, I find that there is indeed significant positive substitution effect at both the intensive and extensive margins of trade. Regarding the former from column 7 of Table 2, the substitution effect is an increase of 42% (i.e., $e^{0.350} - 1 = 0.419$) in an average import flow of embargoed goods from non-sanctioning countries. Regarding the latter I find that Russia starts importing embargoed products from more non-sanctioning countries (column 2 of Table 3). The number of non-sanctioning countries per product increased by approximately 38% ($e^{0.323} - 1 = 0.38$). Recall, from Figure 2, the import share of embargoed goods from sanctioning countries in many products decreases to almost zero, while the share of embargoed goods imports from the non-sanctioning countries increased for the same products.

Using similar methodology to calculating loss, I estimate the gains from substitution. The average number of non-sanctioning countries per embargoed product is 5, and the average import flow is 2,918,573. There are on average 245

non-sanctioning country - embargoed product pairs. I estimate the gains at the extensive margin to be approximately 3.67 billion USD, and 3.59 billion USD at the intensive margin. Thus, the total lost imports of embargoed goods one year after the embargo is estimated at 5.57 billion USD (i.e. 12.83 -7.3). This is, of course, an estimate, based on averages, and the actual losses to foreign trade might be larger. My findings point to the fact that the set of goods chosen for substitution was not optimal, because the substitution for these products was not readily available, and Russia bore losses as result of its own retaliatory embargo. My findings also do not reflect the fact that the domestic production of certain embargoed products increased.

TABLE 3.
Extensive Margin: Specification Choice

	Panel A: IMPORTS		Panel B: EXPORTS	
	W/o country dimension	With country dimension	W/o country dimension	With country dimension
	(1)	(2)	(3)	(4)
Embargoed good $\times D_{Post}$	-0.310^{***}		-0.015	
	(0.037)		(0.020)	
Embargoed good × S country $\times D_{Post}$		-0.868^{***}		-0.019
(Main effect)		(0.094)		(0.036)
Embargoed good × NS country $\times D_{Post}$		0.323^{***}		-0.028
(Substitution effect)		(0.035)		(0.032)
Non-embargoed good × S country $\times D_{Post}$		-0.00004		-0.029^{***}
(Spillover effect)		(0.006)		(0.007)
Period FE	Yes	Yes	Yes	Yes
Country type-product FE	Yes	Yes	Yes	Yes
Country type -year FE	Yes	Yes	Yes	Yes
Product-year FE	Yes	Yes	Yes	Yes
Observations	95,984	177,220	90,183	160,822
R^2	0.977	0.968	0.970	0.937
Adjusted R^2	0.974	0.966	0.966	0.933

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. Dependent variable: Columns (1) and (3) - number of countries from which Russia imports a particular good. Dependent variable: Columns (2) and (4) - number of countries by type (S or NS) from which Russia imports a particular good. I use PPML estimator to trace the changes in the umber of source countries for embargoed goods versus non-embargoed goods after the embargo.

Smuggling

Another point that relates to the substitution is smuggling. There is quite a lot of anecdotal evidence that the embargoed goods from the sanctioning countries were smuggled through the non-sanctioning countries. Among the two largest suspects of smuggling are Belarus and Kazakhstan, both countries being in a customs union with Russia. The most infamous examples of this are shrimps and pineapples found in Russian stores, and allegedly produced in Belarus, according to by24.org and Novaya Gazeta.[15]Belarus has previously been involved in a smuggling scandal with Russia. For example, in 2006 it became known that Belarus was exporting the Brazilian and Cuban cane sugar into Russia disguised as the beet sugar produced in Belarus. The government of Belarus gets certain fees and payments for these schemes, and given this precedent it is not unlikely that the embargo allowed Belarus to discover a new income source through the exports of embargoed goods, which originated in the sanctioning countries, to Russia. Currently the Russian Customs Service is engaging in several measures, including tightening of the control procedures of Belarus exports at the border and pushing the law of the total prohibition of exports of embargoed goods from Belarus into

[15]Shrimp from Belarus to Russia: http://by24.org/2014/08/19/belarusian_shrimps_goes_to_hungry_russia/

Mussels from Mogilyov: https://www.novayagazeta.ru/articles/2014/08/11/60696-nou-hau-mogilevskie-ustritsy-fin-de-kler

Belarus will import shrimps and ham to Russia: https://news.tut.by/economics/412058.html

Russia.[16] According to the Russian media reports, the smuggling happens either through simple repackaging and relabeling of goods, or through fake phytosanitary certificates of product origin (for example, Belarus re-exported apples from Malawi and Zimbabwe to Russia, even though these countries did not produce any apples). This narrative might significantly impact my estimates of the substitution effect, because part of the substitution effect might be attributed to the smuggling. To account for this I test for the presence of smuggling evidence in the estimates. Due to the illegal nature of smuggling and not having trustworthy production data for the smuggling countries, it is incredibly difficult to find any evidence of smuggling in the official data. I attempt to tease it out by comparing the suspect countries' imports of the embargoed goods from the non-sanctioning countries and their own exports of embargoed goods to Russia.

If smuggling happens, it is most likely to happen through countries, with which Russia has established trade connections, and which themselves trade with the countries sanctioning Russia. I choose four such countries: Azerbaijan, Belarus, Georgia, and Kazakhstan. The choice of countries was based on several factors. First, for each of these countries there is anecdotal evidence of smuggling (reports or mentions in the media). Second, they are all members of the Commonwealth of Independent States (CIS), so they share common past and connections with Russia - they are all former USSR republics. Third, Belarus and Kazakhstan are

[16] According to gazeta.ru, Fruit wars at the border with Belarus. `https://www.gazeta.ru/business/2019/04/10/12294055.shtml?updated`

both members of a customs union with Russia. To investigate the possibility of smuggling, I analyze the response of these countries' imports of embargoed goods from the sanctioning countries. If the imports increase, it could serve as evidence of two things: (1) the sanctioning countries begin exporting the embargoed goods destined for Russia through Belarus in hopes of being able to smuggle them through the customs; (2) sanctioning countries search for new markets after they lose access to the Russian market and increase their exports of embargoed goods to all the other markets. To address the second concern, I account for the imports of embargoed goods from the non-sanctioning countries. If the former concern is true, we shouldn't see a change in the import flows of embargoed goods from the non-sanctioning countries. If the latter is true, there might be a decline in the trade of these countries with the non-sanctioning countries due to new sources of the embargoed goods, and the proximity to the sanctioning countries.

To complete the smuggling story, I analyze the exports of these four countries of embargoed goods to Russia. If these export flow increase, it could signify two things: (1) the suspect country increased domestic production and is a true substituting source for Russia; (2) the suspect country re-exports the embargoed goods from the sanctioning countries, provided that it also experienced a significant increase in its imports of these goods. The estimating equations are presented under (2.5) and (2.6). In (2.5) I estimate the impact of the interaction between sanctions and embargo on the imports of embargoed goods from the

sanctioning and non-sanctioning countries to the four countries of interest. In (2.6) I estimate the change in the exports of embargoed goods from these countries to Russia.

$$Imports_{ijkt} = \beta_1 D_{E\ good} \times D_{S\ ctry} \times D_{post} + \beta_2 D_{E\ good} \times D_{NS\ ctry} \times D_{post} + \gamma_t + \gamma_{jk} + \gamma_{jy} + \gamma_{ky} + \varepsilon_{ijkt} \tag{2.5}$$

$$Exports_{kt\ rus} = \beta_1 D_{E\ good} \times D_{Russia} \times D_{post} + \gamma_t + \gamma_{jk} + \gamma_{jy} + \gamma_{ky} + \varepsilon_{jkt} \tag{2.6}$$

I put the two hypotheses to the test, these results are presented in Table A.3 in Appendix. Two countries, Belarus and Georgia, increase their average exports of embargoed goods to Russia significantly, by 33% and 107%, respectively. However, I do not find a significant increase in imports of embargoed goods from the sanctioning countries for any of these countries. It also appears that for all of these countries their imports of embargoed goods from the non-sanctioning countries fell significantly. The smuggling story thus seems difficult to prove. Even though there exists anecdotal evidence for increase of Belarus exports of certain goods tenfold, conditional on the fact that Belarus consumption didn't experience any shocks in the past few years to warrant such an increase, on average it is difficult to prove that the numbers I see are the results of smuggling. This is most

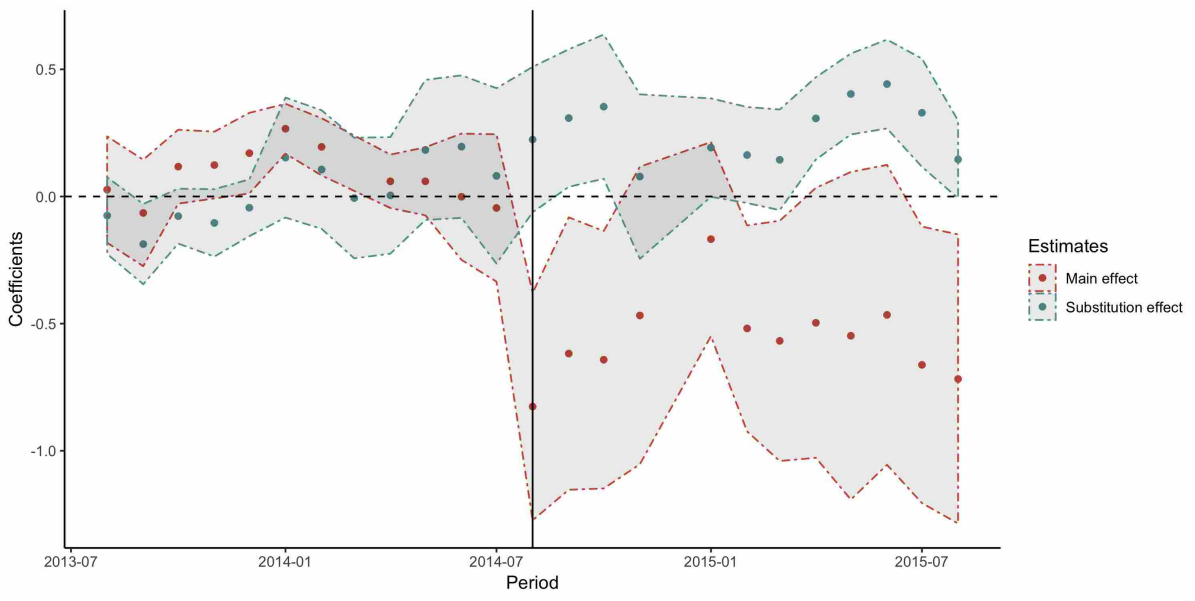
likely due to the illegal nature of smuggling, and the goods destined for smuggling not being labeled as originating from the sanctioning countries, and as a result, not registered by the customs. To conclude, I am not able to separate the true substitution effect and the smuggling of embargoed products through the non-sanctioning countries.

To conclude, Russian embargo was not successful in eliminating all imports of embargoed goods from the sanctioning countries, while inflicting losses to Russian imports, which Russia was not able to fully mitigate by switching to sourcing the embargoed goods from the non-sanctioning countries. Two important caveats of these estimations is that I am not able to estimate the amount of substitution towards the domestic production, or the smuggling of embargoed goods through the non-sanctioning countries. Thus, I estimate the cost of retaliation at roughly 5.57 billion USD in lost imports of embargoed products (about 3% of total Russian imports in 2013 or 30% of embargoed good imports).

Figure 3 illustrates the point of the inability to substitute towards the non-sanctioning countries well. The estimates are constructed by including interactions of 12 leads and 12 lags with the three coefficients of interest in equation (2.3). The significant drop in Russian imports of the embargoed goods from the sanctioning countries (main effect) happens in August 2014, precisely when the embargo was imposed by Russia and persists all the way to the end of the sample, although the significance of the coefficient declines by approximately 4 months after the

embargo. The negative trend, however, persists. This decline is offset by a smaller increase in the Russian imports of embargoed goods from the non-sanctioning countries in August 2014 (substitution effect), the month when Russian embargo was imposed.

FIGURE 3.
Main and Substitution Effects Over Time



Notes: Figure 3 depicts 12 leads and lags of the estimated impact of the embargo on Russian aggregate trade flows, comprised by the main (pink markers) and substitution effects (blue markers). The 95% CI are represented by the grey area around the coefficients. The average trade flows decrease significantly when the embargo is introduced in August of 2014. Trade flows do not experience significant deviations from trend in 12 months preceding the embargo.

Heterogeneity and Dynamics

In this section I explore the country, product, and time heterogeneity of the embargo's effects. Product heterogeneity analysis results are presented in Table 4 and include the analysis of the embargo on three product classes - consumption,

capital or intermediate. I also analyze how exclusion of oil and gas products from the dataset affects my estimates - in other words, I check whether assuming monopolistic competition biases the estimates. Tables 5 and 6 record the country heterogeneity analysis results, in which I inspect which countries lose the most from the embargo based on the country's income and spatial location relative to Russia. I conclude this section by disentangling the short and long term impacts of the embargo on the intensive margin of the Russian imports. These results are presented in Table 7.

Product Heterogeneity

To analyze the impact of the embargo on product heterogeneity, I use the Broad Economic Categories classification (BEC), which separates all goods into consumption, capital and intermediate goods. For the consumption goods, there is also a division into durable and non-durable goods. The BEC categories are applied to HS-6 digit code products, so there can be multiple BEC codes within a single HS-4 code. To ensure that the benchmark results presented in column 1 of Table 4 are comparable to the more disaggregated dataset, I estimate equation (2.3) using the disaggregated data (HS-6 digit level product codes) and using the HS-6 digit product code aggregated up to HS-4 digit code within the BEC

classification.[17] I find that the results are of similar significance and magnitudes for the aggregated dataset, and thus I proceed with the analysis.

In column 2 of Table 4 I analyze the impact of the embargo at the intensive margin for the consumption goods versus the capital and intermediate goods. To do so I include interaction terms between the main effect and indicator variables for capital and intermediate goods. The same procedure is done for the other two treatment variables - substitution and spillover effects. The reference group consists of consumption goods.

The embargo's impact on consumption goods (elasticity) is equal to β_i, (with $i = 1, 2, 3$), or $e^{\beta_i} - 1$ if translated into a percentage change. The effect on intermediate goods is the summation of the main coefficient and the coefficient on the interaction term (i.e., $\beta_i + \beta_i \times D_{intermediate}$); same procedure is applied to the interaction with capital goods.

Because no capital goods were embargoed, I can estimate the main effect for consumption and intermediate goods only. Consumption goods experience much stronger main and substitution effects than intermediate or capital goods. The main effect for the intermediate effects is significant at 10%,[18] and its magnitude relatively to the main effect is smaller (-0.545 vs -0.111). The smaller drop in

[17] I begin with the dataset with HS-6 digit product code level and merge it with the BEC conversion dataset. Each BEC code belongs to one of the three categories - consumption, intermediate or capital goods. As a result, I create an HS-6 digit code level product dataset, where each observation belongs to one of the three BEC categories. I then proceed by aggregating the dataset to the HS-4 digit product code by country and product. Each observation in this dataset is a HS-4 digit product code with BEC classification attached.

[18] Established using an F-test; H_0: $\beta_i + \gamma_i \times interaction\, term = 0$.

intermediate goods' imports may be attributed to a smaller share of those goods in the sample. Another reason for the smaller effect could be due to the fact that some embargoed goods from the sanctioning countries were allowed to cross the Russian border if they were intended to be used for production of special diet foods (eg. baby food, food for diabetic patients, food for athletes). Another reason for a smaller effect on intermediate goods might be due to the fact that the embargo could be less strongly enforced in vital intermediate goods that are key inputs for domestic production. My data do not allow me to disentangle the intermediate embargoed goods that are used for those specific types of production from all the other products, which could lead to the estimates being biased upward.

Interestingly, intermediate and capital goods do not experience a substitution effect at all, it is the strongest for the consumption goods. The spillover effect is not significant for any good type. This makes intuitive sense because the Russian government emphasized the importance of using domestically-produced inputs in the production process, so I would not expect the Russian firms to increase intermediate goods' imports significantly and instead try to use domestic inputs.

In column 3, I investigate whether the consumption goods heterogeneity is driven by durable or non-durable goods' margins. I limit the sample to consumption goods only and generate interactions between the three effects of interest and an indicator variable for non-durable goods. The omitted group

consists of durable consumption goods. Main and substitution effects are much stronger for the non-durable goods: a 74% decrease in an average import flow of non-durable consumption goods in comparison to a 40% decline for durable goods. Surprisingly, the substitution pattern for the non-durable goods is negative, signifying that the non-durable goods might be more difficult to source from the non-sanctioning countries. Among non-durable goods are live fish and crustaceans.

Finally, I investigate whether the results so far are sensitive to the inclusion of oil and gas products. Russia is one of the largest oil and gas exporters in the world (though not an importer). I rely on an assumption that the prices in all goods' markets is set according to the same mechanism (monopolistic competition). However, oil markets do not follow the monopolistic competition assumption because there are few producers with large market power (oligopoly), so the prices of these goods are set differently, which impacts their supply and demand. I test whether including oil and gas products in the dataset might be affecting the estimates. To test this assumption, I drop the HS product codes for oil and gas products from the main sample; the results are presented in column 4. The results from both estimations - with and without oil and gas products in the sample - are very close in magnitude for all effects - β_1, β_2 and β_3 are very similar in magnitude and significance (columns 1 and 4). The results hold for performing this procedure with the dataset containing BEC-classification. Thus, including oil and gas products in the imports sample has no impact on the estimates.

TABLE 4.
Product Heterogeneity

	Benchmark	Intermediate, Consumption and Capital goods	Consumption: Durable vs Non-durable goods	No oil/gas goods
	(1)	(2)	(3)	(4)
Main	−0.713***	−0.545***	−0.591***	−0.702***
	(0.241)	(0.198)	(0.206)	(0.239)
Main × Intermediate		0.434**		
		(0.184)		
Main × Capital		-		
Main × Non-durable goods			−0.837***	
			(0.189)	
Substitution	0.352***	0.293***	0.200**	0.357***
	(0.091)	(0.096)	(0.082)	(0.093)
Substitution × Intermediate		−0.262		
		(0.707)		
Substitution× Capital		−0.204		
		(0.633)		
Substitution × Non-durable goods			−1.471***	
			(0.261)	
Spillover	0.014	0.056	0.084	0.017
	(0.031)	(0.065)	(0.060)	(0.032)
Spillover × Capital		−0.025		
		(0.087)		
Spillover × Intermediate		−0.090		
		(0.077)		
Spillover × Non-durable goods			−0.077	
			(0.099)	
Log of cost	−0.069	0.012	0.009	−0.118**
	(0.055)	(0.052)	(0.115)	(0.056)
Period FE	Yes	Yes	Yes	Yes
Country-product FE	Yes	Yes	Yes	Yes
Country-year FE	Yes	Yes	Yes	Yes
Product-year FE	Yes	Yes	Yes	Yes
Observations	1,565,483	3,751,003	1,158,565	1,560,320
R^2	0.861	0.343	0.367	0.866
Adjusted R^2	0.856	0.334	0.358	0.862

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. In column 2 the effect of the embargo is disentangled by the good type (as per Broad Economic Categories (BEC) classification): consumption, intermediate, and capital goods. The imports are regressed on the interaction between dummy variables for intermediate and capital goods and the three main variables of interest (main, substitution, and spillover effects). The omitted category consists of consumption goods. The "-" means that there are no observations in this category (it cannot be identified). In column 3 I explore the effect of the embargo within the consumption goods, for durable and non-durable goods. The omitted category consists of durable goods. In column 4 all oil and gas HS-4 codes are removed to test the monopolistic competition assumption.

Country Heterogeneity

The analysis of country heterogeneity is twofold: first I analyze the impacts of the embargo on countries of varying income levels proxied by the GDP per capita, then I concentrate on the embargo's effects on countries by their geographic proximity to Russia. These results are presented in Tables 5 and 6.

To analyze income heterogeneity, I utilize the existing World Bank classification of countries by income: low, lower-middle, upper-middle and high income.[19] To simplify the analysis, I combine the lower-middle and upper-middle income countries into one income bin, the middle income countries. I use these guidelines and the GDP per capita as a measure of income to construct indicator variables for the three income bins. Next, I create interaction terms with the three effects of interest: main, substitution and spillover effects. These interaction terms are then included in my benchmark specification for the intensive margin (3). These results are presented in Table 5. As usual, column 1 provides the benchmark specification results for comparison. The reference group in column 2 is comprised of the high-income countries.

There are no sanctioning countries that fall into the low income bracket, so the main or spillover effects cannot be estimated for this group. This analysis provides some unexpected findings: while the main impact has the expected sign and high significance for the high income countries (a decline of 71% for an average

[19]See `https://blogs.worldbank.org/opendata/new-country-classifications-income-level-2017-2018`

import flow of embargoed goods for high income sanctioning countries), the main effect is actually positive for the middle income countries (Bulgaria, Turkey and Ukraine). Thus, after the imposition of the embargo Russian imports of embargoed goods increased from these countries before the intensification of the embargo. The strongest substitution effect (significant at 5%) is also driven my middle income countries, such as Belarus, Moldova, China, Brazil and others. Interestingly, there is a significant decline of non-embargoed goods from middle income sanctioning countries.

There is strong evidence that Russia uses the embargo to strategically target smaller countries. The largest effect of the embargo (a drop of almost 100%) is registered for the lower-middle income countries, while the substitution effect for this group is statistically insignificant and a significant negative spillover effect is present. I conclude that the embargo was placed to ensure the largest losses to smallest sanctioning countries (who would not be able to mitigate losses easily by themselves) in order to impact the sanction decision.

TABLE 5.
Country Heterogeneity by Income

	Benchmark specification	By income bracket
	(1)	(2)
Main	-0.713^{***}	-1.243^{***}
	(0.241)	(0.331)
Main × Low		-
Main × Middle		1.585^{***}
		(0.323)
Substitution	0.352^{***}	0.130
	(0.091)	(0.174)
Substitution × Low		-0.110
		(0.235)
Substitution × Middle		0.292^{*}
		(0.162)
Spillover	0.014	0.030
	(0.031)	(0.031)
Spillover × Low		-
Spillover × Middle		-0.117^{***}
		(0.041)
Log of cost	-0.069	-0.067
	(0.055)	(0.055)
Period FE	Yes	Yes
Country-product FE	Yes	Yes
Country-year FE	Yes	Yes
Product-year FE	Yes	Yes
Observations	1,565,483	1,565,483
R^2	0.861	0.861
Adjusted R^2	0.856	0.857

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. The income brackets are defined based on an average GDP per capita over the years prior to the embargo using the World Bank classification; to simplify the analysis, I combine lower-middle and upper-middle income countries into one income bin, the middle income countries. Interaction terms between the three effects of interest: main, substitution and spillover effects and the dummy variables for the low and middle income brackets are included in the benchmark specification (3). The reference group in column 2 is comprised of the high-income countries.

Finally, I conduct a spatial heterogeneity analysis to understand how the embargo impacts countries based on their proximity to Russia. I classify countries as neighboring if the recorded weighted distance between them and Russia is less than 4,000 kilometers (most of these countries share a common border with Russia). The midrange countries' weighted distance is between 4,000 and 10,000 kilometers; countries that are more than 10,000 kilometers away from Russia are classified as distant countries. Similarly to the procedure described for the country income heterogeneity analysis, I generate indicator variables for each of the three distance bins, and interact them with the three variables of interest and include them in my benchmark specification. These results are recorded in Table 6, in which the reference group consists of the far-range countries.

The far-range countries experience the strongest main effect of the Russian retaliatory embargo ($e^{-2.066} - 1$), which can be interpreted as a 87% drop in Russian imports of embargoed goods from far-range sanctioning countries. Both, neighboring and mid-range countries still experience a negative main effect, but for the mid-range countries it is statistically significant only at 10%. These findings are quite intuitive - sanctioning countries are in Europe, North America and Australia, and are classified as neighboring, midrange or far-range countries. It is interesting that the main effect is driven by the far-range countries, which include the US, Canada, Spain and Portugal. The majority of the European sanctioning countries are classified as mid-range, which explains why we see the strongest

impact for those countries. Counterintuitively, the substitution effect is the largest in magnitude and with expected sign for the far-range countries. I would expect Russia to try to substitute towards the neighboring countries, but it could be the case that neighboring countries cannot satisfy Russia's demand for embargoed goods. The neighboring countries and mid-range countries actually experience a decline in their average exports of embargoed goods to Russia. It could be explained by the fact that logistically substitution towards far-range countries requires withdrawal from neighboring and mid-range countries in order to cut costs.

To conclude there is quite a lot of heterogeneity at the intensive margin of trade along both margins, product and countries. The three surprising findings are: (1) substitution is stronger for the far-range countries; (2) middle income countries experience a positive, although statistically not significant main effect; (3) both main and substitution effects are driven by consumption goods.

TABLE 6.
Country Heterogeneity by Distance

	Benchmark specification	By distance bracket
	(1)	(2)
Main	−0.713***	−2.066***
	(0.241)	(0.598)
Main × Neighbor		1.337*
		(0.693)
Main × Mid-range		0.916
		(0.713)
Substitution	0.352***	0.551***
	(0.091)	(0.169)
Substitution × Neighbor		−0.244
		(0.209)
Substitution × Mid-range		−0.790***
		(0.204)
Spillover	0.014	−0.087
	(0.031)	(0.298)
Spillover × Neighbor		0.112
		(0.297)
Spillover × Mid-range		0.110
		(0.289)
Log of cost	−0.069	0.027
	(0.055)	(0.056)
Period FE	Yes	Yes
Country-product FE	Yes	Yes
Country-year FE	Yes	Yes
Product-year FE	Yes	Yes
Observations	1,565,483	1,565,483
R^2	0.861	0.861
Adjusted R^2	0.856	0.856

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. Neighboring countries: recorded weighted distance ≤ 4,000 km (most of these countries share a common border with Russia); midrange countries: weighted distance between 4,000 and 10,000 km; distant countries: weighted distance > 10,000 km. I generate indicator variables for each of the three distance bins, and interact them with the three variables of interest and include them in the benchmark specification (3). The omitted group consists of far-range countries.

Dynamics

Table 7 presents the results of the dynamics exercise, in which I disentangle the short and long term impacts of the embargo on the intensive margin of the Russian imports. The short run spans the first five months of the embargo (August 2014 till December 2014), while the long run includes periods from January 2015 to December 2016. I construct an interaction term with the long-term indicator variable for each of the three effects, and compare the long and short term effects (the control group consists of the short term effects). The benchmark model is provided in column 1 for comparison.

The main effect of the embargo has a larger magnitude and significance in the short run - Russian imports of embargoed goods from sanctioning countries decrease by 48%. The long run impact is smaller and individually insignificant. This is feasible since the embargo was an exogenous shock which was imposed unexpectedly for all economic agents. Thus, the largest portion of the decline in the imports of the embargoed products from the sanctioning countries happened in the first 5 months after the embargo was imposed. The overall long-run impact of the embargo on Russian imports estimated in column 2 is $-0.665 - 0.120 = -0.544$ or a 54% decline. This shows that in the long run, the imports decrease less than in the short run, i.e. the effectiveness of the embargo decreases over time. This may indicate either a relaxation of embargo or an increase in domestic production.

The substitution pattern presents interesting dynamics: it has the expected sign and is highly statistically significant in the short run, a 42% increase in average imports of the embargoed goods from non-sanctioning countries, while the long run coefficient is statistically insignificant and has a negative sign. This could serve as evidence that in the long run domestic production makes searching for the new foreign trade partners less needed, and thus decreases the magnitude and significance of the long run interaction term.

Both, the main treatment and substitution effects are the strongest in the short run, as evidenced by the individual coefficients, β_1 and β_2, which have the expected signs and high statistical significance. No large changes in trade flows happen for either effect (main treatment or substitution) in the long run, as evidenced by the low statistical significance of the interaction coefficient. However, the negative impacts of both effects persist in the long run, which is shown by the high joint significance of the long-run effects. The same conclusion can be drawn from analyzing Figure 3: the significance of the main and substitution effects dissipate over time, while new trends persist for many periods after the embargo is imposed.

To enhance the analysis of the dynamic effects of the Russian embargo, I analyze whether the "smart" sanctions had any impact on Russian imports. The "smart" sanctions refer to the restrictions imposed on certain Russian individuals and firms who supported the Crimean annexation. The first round of the "smart"

sanctions was imposed immediately after the annexation of Crimea in March of 2014. These sanctions include a ban on all commercial activities with firms in Russia and Ukraine that supported Crimean annexation. I disentangle the impact of the embargo from the impact of the "smart"sanctions and present the results in Table 8.[20]

I find a significant drop in Russian imports of embargoed goods from the sanctioning countries following the imposition of the "smart"sanctions, however this effect is of a much smaller magnitude than the effect of the embargo (-0.158 vs -0.759) and lower significance than the main effect of the embargo. This finding suggests that the sanctions might have a negative impact on Russian imports from the sanctioning countries. This finding is in line with the study by Crozet and Hinz (2019). The sanctions target a small number of firms, so their impact, relative to the size of the embargo, which targets multiple countries and products, is not expected to be large. I do not find a significant impact of sanctions on either the substitution or the spillover coefficients, while the embargo still has a clearly pronounced substitution effect, as expected.

[20]I create a new time indicator for the "smart" sanctions; it takes the value of 1 for periods from March 2014 until August 2014, when the embargo was imposed. I then generate treatment variables by interacting the time dummy with the indicators for the sanctioning or non-sanctioning countries and embargoed or non-embargoed product (same procedure as described in section 4). I re-estimate the benchmark model (3) including the old and new variables of interest; the results are presented in column 2 of Table 8.

TABLE 7.
Dynamics

	Benchmark specification (1)	Dynamics of the effects (2)
Main	-0.713^{***}	-0.665^{***}
	(0.241)	(0.232)
Main × Long run		−0.120
		(0.884)
Substitution	0.352^{***}	0.354^{***}
	(0.091)	(0.090)
Substitution × Long run		−0.162
		(0.724)
Spillover	0.014	0.010
	(0.031)	(0.030)
Spillover× Long run		0.142
		(0.445)
Log of cost	−0.069	0.004
	(0.055)	(0.054)
Period FE	Yes	Yes
Country-product FE	Yes	Yes
Country-year FE	Yes	Yes
Product-year FE	Yes	Yes
Observations	1,565,483	1,565,483
R^2	0.861	0.861
Adjusted R^2	0.856	0.856

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. The short run spans the first five months of the embargo (August 2014 till December 2014), while the long run includes all the other periods following the embargo (January 2015 till December 2016). *Long run* is an indicator variable for the long run. The reference group is short run effects

Falsification exercise

The previous estimates from the heterogeneity and dynamics analysis of the embargo's effects are of a similar significance and magnitude. This provides evidence of the stability and robustness of the results. I conduct an additional robustness checks: a falsification exercise. The aim of the falsification exercise is to provide evidence that the strong negative impact found in the previous estimations

is indeed due to the imposition of embargo and not other unaccounted exogenous shocks and processes happening in the economy before the imposition of the embargo.

The methodology of the falsification exercise is as follows. First, I limit the sample to the period until August 2014, i.e. when the embargo was imposed. Then I conduct permutation tests on this truncated sample. The procedure is as follows. I generate 1000 samples from the truncated data, each sample containing 10000 observations chosen randomly. Next, counterfactual main treatment, substitution and spillover effects variables are generated. Finally, I estimate the benchmark specification (2.3) for each of these samples. The densities of each of the three coefficients of interest are presented in Figure 4. The values for all three coefficients are concentrated around zero, which signifies that no other negative pre-existing trends contribute to the significant drop in Russian aggregate imports after the imposition of the food embargo in August of 2014. To conclude, the falsification exercise confirms that the significant drop in bilateral trade between Russia and the sanctioning partner countries that I estimate is indeed attributed to the imposition of the embargo.

TABLE 8.
Smart Sanctions vs. Embargo

	Benchmark specification	Smart sanctions vs Embargo
	(1)	(2)
Smart sanctions × Main		−0.158**
		(0.077)
Main	−0.713***	−0.759***
	(0.241)	(0.246)
Smart sanctions × Substitution		0.086
		(0.092)
Substitution	0.352***	0.359***
	(0.091)	(0.100)
Smart sanctions × Spillover		0.042
		(0.036)
Spillover	0.014	0.038
	(0.031)	(0.045)
Log of cost	−0.069	−0.138**
	(0.055)	(0.055)
Period FE	Yes	Yes
Country-product FE	Yes	Yes
Country-year FE	Yes	Yes
Product-year FE	Yes	Yes
Observations	1,565,483	1,565,483
R^2	0.861	0.861
Adjusted R^2	0.856	0.856

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. The smart sanctions refer to the restrictions imposed on certain Russian individuals and firms, who supported the Crimean annexation; they were imposed in March of 2014. I generate a separate indicator variable for smart sanctions, which receives the value of 1 for time periods from March till July 2014 and keep the original time dummy variable, which receives value of 1 in time periods following August 2014. I then generate the three coefficients of interest (main, substitution and spillover effects) as described in section 3, using the new time indicator for the smart sanctions. I include these variables along with the original treatment variables in the main specification (3), and re-estimate specification (2.3) .

Spillover Effect: Exports

Major trade shocks like the embargo can have unanticipated impacts on the dimensions of trade not directly impacted by it. Thus, I also explore the possible

impact of the embargo on the trade flows that are not directly impacted by the embargo: imports of non-embargoed goods from the sanctioning countries and Russian exports. I do not find significant spillover effects on the imports side of trade; in this section I analyze the spillover impact of the embargo on Russian exports. The estimation results for the exports sample intensive margin are presented in Table 9, and extensive margin in panel B of Table 3.

Intensive and Extensive Margins

For the intensive margin of exports, i.e., the average export flow of embargoed or non-embargoed goods to the sanctioning or non-sanctioning countries. I follow the same protocol as for the imports and compare the results of the estimating equation (4) across specifications with varying sets of fixed effects and two estimators, PPML and OLS. The benchmark specification is presented in column 7. As expected, the main treatment and substitution effects are insignificant and are of much smaller magnitude than the respective effects for the imports sample. However, interestingly the signs of the coefficients are opposite than expected (main effect is positive and substitution effect is negative). However, the lack of significance is intuitive - only imported goods were embargoed, while none of the Russian exports were embargoed by the Russian government, and the share of the embargoed goods in the sample is only 1%.

Interestingly, I observe a significant negative spillover effect of the embargo on Russian exports. This result is robust with consistent magnitudes and significance

across all specifications, irrespective of the estimator used, OLS or PPML. This result is somewhat surprising, because I would not expect the embargo to hurt Russian exports as its aim was to hurt the exports of the sanctioning countries, not Russian exports. This could be due to (1) the "chilling" effect of the embargo - it acts as an overall suppressant of trade and is driven by the politically motivated decision of the firms in the sanctioning countries to stop importing from Russia to boycott its decision to impose the embargo; (2) the exports' sample consists of predominantly non-embargoed goods, and my results might be picking up the effects of the "smart" sanctions, which are described in the dynamics section of this paper;[21] and (3) the US increased its oil exports, so reliance on Russian imports from the US and other countries declined.

Regarding (3), I account for the oil price as a composite of the cost variable in the regressions and separately perform product heterogeneity analysis. Regarding (1) and (2), I provide analysis of the dynamics of the three effects of interest in order to disentangle the impact of the embargo on Russian exports from the impact of the "smart" sanctions.

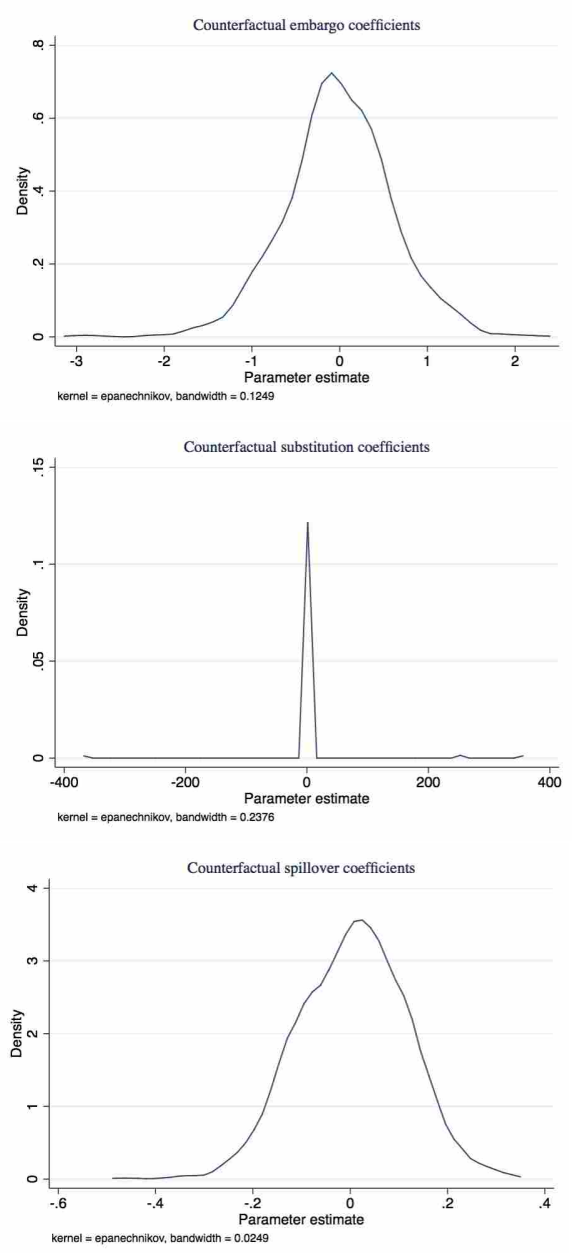
The same significance pattern emerges for the extensive margin coefficients: The spillover effect is negative and highly significant, although its magnitude is several times larger than the spillover effect coefficient of the extensive margin effects for the imports . I estimate that, on average, after the embargo the number of sanctioning countries to which Russia exports non-embargoed goods decreases

[21]The "smart" sanctions are analyzed in detail by Ahn and Ludema (2019).

by 1, which represents a decline of about 20% of the pre-embargo number of sanctioning countries. The average export flow declines by 21%. I estimate the total cumulative loss of the embargo on Russian exports of non-embargoed goods to the sanctioning countries to be 78 billion USD.

This is quite a surprising finding. The chilling effect of the embargo and the sanctions had a much larger impact on the absolute exports levels than for the absolute imports. The embargo was not completely effective in shutting down the import flows from the sanctioning countries, and the optimality of the chosen set of goods is questionable, because substitution was not available for the full set of the goods. Additionally, Russian retaliatory embargo had a chilling effect on Russian exports, impacting export flows of non-embargoed goods to the sanctioning countries. These three points may serve as an evidence of the ineffectiveness of these types of protectionist policies, because not only did the Russian retaliatory embargo fail to coerce the sanctioning countries to lift the sanctions, but it also had an unintentional spillover effect on the Russian exports that were not supposed to be affected by the embargo.

FIGURE 4.
Falsification Exercise: Simulation Results



Notes: This figure provides the results of permutation tests on a truncated sample (January 2010 - July 2014) to ensure that the effects of the embargo do not contaminate the permutation tests. The procedure for the test is as follows. First, 1000 random samples from the data are generated, each sample containing 10000 observations chosen randomly. Next, counterfactual main treatment, substitution and spillover effects are generated. Finally, I estimate the benchmark specification for each of these samples.

Dynamics and Heterogeneity Analysis

To shed light on the driving forces of the embargo's impact on Russian exports, I conduct heterogeneity analysis. First, I analyze the impact of the smart sanctions on Russian exports. The chilling effect of the embargo could be explained by the "smart sanctions" imposed in March of 2014. To analyze whether this concern holds, I create a time indicator for the "smart sanctions", which takes the value of 1 for periods from March 2014 till August 2014, when the embargo was imposed. I then generate variables of interest by interacting these "smart sanctions" time dummy with the indicators for the sanctioning or non-sanctioning countries and embargoed or non-embargoed product (same procedure as described in section 3). I include these interaction terms in the benchmark model (3) and record the results in Table 10. I do not find that the "smart sanctions" had an impact on any types of export flows, and I still find a significant spillover effect after the imposition of the embargo, which confirms that the embargo had unintended consequences for the Russian exports.

Second, I perform a heterogeneity analysis for the exports sample. The largest concern with the Russian exports is the fact that Russia is a large exporter of gas and oil products. These products do not comply with the monopolistic competition assumption due to market structure for these products (cartels), and thus could be biasing the estimates. After removing all gas and oil products

from the exports sample, I estimate the benchmark specification on the truncated sample. These results are presented in column 2 of Table 11. Exclusion of gas and oil products from the sample has an impact on all three coefficients of interest. The main effect coefficient becomes negative and remains not statistically significantly different from zero. This could speak to the fact that in comparison to the oil and gas products, the exports of the embargoed goods to the sanctioning countries increased, because the exports of oil and gas products decreased, but when excluding these goods, the exports of embargoed goods actually decline to both country types. The spillover effect remains unchanged - the average exports of the non-embargoed goods, which are not oil or gas products, to the sanctioning countries decline by about 21%. This points to the fact that the embargo had a chilling effect not only for the oil and gas goods, but for all other export products as well. This eliminates the concerns that the spillover effect I find is driven by macroeconomic factors.

Lastly, I address the break down of the three effects of interest by the BEC good type, as described previously in the imports analysis section. These results are presented in columns 3 and 4 of Table 11. Several interesting findings emerge. The main effect, i.e. average exports of embargoed goods to the sanctioning countries, is negative and is driven by the intermediate goods (a decline of about 63%). This could serve as evidence of Russia's attempt to substitute imported inputs by domestically produced ones - the domestically produced intermediate

goods, which would be exported prior to the embargo, are redirected towards the domestic production. The spillover effect loses significance, but the magnitude is seemingly driven by the non-durable consumption goods (decline of about 48%).

To conclude, I find unexpected spillover effect of the embargo, i.e. that after the imposition of the embargo average Russian export flow of non-embargoed goods to the sanctioning countries (both non-embargoed goods and sanctioning countries are incredibly important in the structure of Russian exports) decline by about 75 billion USD (cumulative loss of the extensive and intensive margins). I cannot attribute this chilling effect to dropping oil prices, the effect is driven by the goods other than oil and gas. I also find some evidence that Russian exports of intermediate embargoed goods fall, either due to redirection of these goods to domestic production or the political or logistical motivations of the partners in the sanctioning countries. Major trade shocks, like sanctions and embargoes, bring heavy blows to bilateral trade flows, and often bring about unintended consequences. This is a very important takeaway for the policy makers - the embargoes will significantly decline the trade in the affected goods, but also have spillover effects onto goods that are affected by increasing the uncertainty of trade policy, political and logistical misalignment of the partners in the sending and receiving countries.

TABLE 9.
Specification Choice for Exports Sample

Dependent variable:	Log of trade			Level of trade			
	OLS			PPML			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Main effect	-0.026	-0.061	-0.020	0.374***	0.472***	0.233	0.233
	(0.101)	(0.099)	(0.066)	(0.084)	(0.175)	(0.188)	(0.188)
Substitution effect	0.078	0.069	0.093	0.083	0.107*	−0.118	−0.118
	(0.062)	(0.072)	(0.072)	(0.102)	(0.064)	(0.076)	(0.076)
Spillover effect	-0.123***	-0.144***	-0.145***	−0.311***	−0.215**	−0.220**	−0.220**
	(0.019)	(0.019)	(0.019)	(0.050)	(0.089)	(0.088)	(0.088)
Turkey sanctions							0.200
							(0.249)
Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-year FE	No	Yes	Yes	No	Yes	Yes	Yes
Product-year FE	No	No	Yes	No	No	Yes	Yes
Observations	930,837	930,832	930,710	931,617	931,612	931,488	931,488
R^2	0.78	0.784	0.79	0.912	0.923	0.930	0.930
Adjusted R^2	0.77	0.774	0.778	0.908	0.919	0.926	0.926

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. As a part of spillover effects analysis, I estimate the impacts of the embargo on Russian exports. Columns 1-3 present OLS results for comparison, while columns 4-7 present PPML results. Each column contains a different set of fixed effects along with the three treatment dummy variables of interest. The benchmark specification is in column 6. Main effect refers to the exports of embargoed goods from the sanctioning countries; substitution effect is exports of embargoed goods from the non-sanctioning countries; spillover effect refers to the exports of non-embargoed goods from the sanctioning countries.

Conclusion

In this study I provide an extensive analysis of different dimensions of the Russian retaliatory embargo and its impacts on Russian trade. I utilize the triple difference estimation of the gravity equation to distinguish between the embargo's impacts on the imports of the embargoed goods from the sanctioning countries (the main effect), the imports of embargoed goods from the non-sanctioning countries (the substitution effect), and the imports of non-embargoed goods from the sanctioning countries (the spillover effect). Even though Russian embargo indeed significantly reduced the import flows from the sanctioning countries, it was not fully effective as it did not eliminate imports of embargoed goods from the sanctioning countries completely. I estimate the lost imports of embargoed goods in the 12 months following the imposition fo the embargo at about 13 billion USD (30% of all imports of embargoed goods in 2013) and lost exports of about 75 billion USD (about 17% of Russian total exports in 2013). Additionally I find that the set of embargoed goods was chosen sub optimally, as the substitution was not available for the entire amount of lost imports: only about 55% of the lost imports were redirected to the non-sanctioning source countries. Although the sanctioning countries indeed took a toll after the Russian embargo was imposed, it did not lead to the desired outcome for Russia - the sanctions are in place till present day. My study emphasizes the importance of understanding the magnitude of the disturbances caused by embargoes, as even the embargoes that target a relatively

small set of products causes spillovers, significantly increasing the costs of political games played by the involved governments.

TABLE 10.
Exports Sample: Smart Sanctions vs Embargo

	Benchmark specification	Smart sanctions vs Embargo
	(1)	(2)
Smart sanctions × Main effect		0.248
		(0.208)
Main effect	0.233	0.301
	(0.188)	(0.251)
Smart sanctions × Substitution effect		0.014
		(0.111)
Substitution effect	−0.118	−0.047
	(0.076)	(0.123)
Smart sanctions × Spillover effect		−0.061
		(0.061)
Spillover effect	−0.220**	−0.262**
	(0.088)	(0.124)
Log of cost	0.006	0.007
	(0.107)	(0.107)
Period FE	Yes	Yes
Country-product FE	Yes	Yes
Country-year FE	Yes	Yes
Product-year FE	Yes	Yes
Observations	931,488	931,488
R^2	0.930	0.930
Adjusted R^2	0.926	0.926

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. The worry that the embargo had a chilling effect on Russian trade, which means that not only the targeted trade was impacted, but there is a sizable spillover onto other trade flows. However, Russian exports could also have been affected by the "smart" sanctions given that certain firms, who are likely to be exporters were targeted. I disentangle the effects of the "smart" sanctions from the effect of the embargo for the exports sample.

TABLE 11.
Exports Sample: Product Heterogeneity

	Benchmark	No oil/gas goods	Intermediate, Consumption and Capital goods	Consumption goods: Durable vs Non-durable
	(1)	(2)	(3)	(4)
Main	0.233	−0.044	0.327**	−0.053
	(0.188)	(0.072)	(0.155)	(0.090)
Main × Intermediate			−1.344***	
			(0.238)	
Main × Capital			-	
Main × Non-durable				-
Substitution	−0.118	−0.118*	−0.100	−0.261***
	(0.076)	(0.068)	(0.078)	(0.100)
Substitution× Intermediate			−0.376	
			(0.272)	
Substitution × Capital			−0.067	
			(0.404)	
Substitution× Non-durable				−0.160
				(0.255)
Spillover	−0.220**	−0.188***	−0.202	−0.315***
	(0.088)	(0.035)	(0.168)	(0.096)
Spillover× Intermediate			0.016	
			(0.152)	
Spillover × Capital			0.071	
			(0.282)	
Spillover× Non-durable				−0.414*
				(0.220)
Log of cost	0.006	0.006	0.008	0.005
	(0.107)	(0.063)	(0.126)	(0.193)
Period FE	Yes	Yes	Yes	Yes
Country-product FE	Yes	Yes	Yes	Yes
Country-year FE	Yes	Yes	Yes	Yes
Product-year FE	Yes	Yes	Yes	Yes
Observations	931,488	921,130	1,704,598	425,224
R^2	0.930	0.902	0.816	0.312
Adjusted R^2	0.926	0.897	0.811	0.289

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. The largest concern with the Russian exports is the fact that Russia is a large exporter of gas and oil products. These products do not comply with the monopolistic competition assumption due to market structure for these products (cartels), and thus could be biasing the estimates. After removing all gas and oil products from the exports sample, I estimate the benchmark specification on the truncated sample (column 2). Columns 3 and 4 are constructed in a similar fashion to columns 2 and 3 in Table 4. Omitted group in column 3 consists of consumption goods. In column 4 the sample is reduced to consumption goods only. The omitted category in column 4 consists of durable goods.

CHAPTER III

QUANTIFYING THE TRADE REDUCING EFFECT OF EMBARGOES: FIRM LEVEL EVIDENCE FROM RUSSIA

Introduction

Sanctions are an important tool of foreign policy, used in response to events and behaviors that are deemed problematic. Sanctions take many forms, including economic and trade restrictions, restrictions on bank activities and financial operations, travel bans, and arms embargoes. These measures are frequently used in practice: for example, currently the UN maintains 14 sanctioning regimes (United Nations Security Council (2017)). In spite of that, the empirical evidence on their economic impact or ultimate success is mixed. This may be explained in part by the fact that historically sanctions have been imposed on smaller economies (for example, Iran, Cuba, Venezuela, North Korea, Syria). It wasn't until recently that a large economy such as Russia was targeted by economic sanctions. This large country case brings new dimensions to the problem of economic sanctions, as the targeted economy has the ability and market power to retaliate in order to inflict economic costs on the sanctioning countries.

The goal of this paper is to take advantage of this unique case study and to investigate the consequences of Russia's counter-sanctions. I am particularly interested to see what effect the retaliatory embargo had on Russia's trade

patterns and how trading firms responded to this negative shock. Understanding the economic impact of the self-imposed retaliatory import embargo is important in the context of the observed protectionist policies and increasing threats to the global trading system made by large countries around the world.

The tensions between Russia and the international community go back several years. After the decision to enter the Crimean Peninsula in 2014, the Russian government has been widely criticized for its actions. This ultimately led to the majority of the OECD countries imposing sanctions on Russia. The goal of the anti-Russian sanctions is to coerce Russia to leave the Crimea. Currently Russia is sanctioned by 37 countries, including the 28 EU countries (counting the United Kingdom), the U.S., Canada, Australia, Norway, Iceland, Lichtenstein, Albania, Montenegro, and Ukraine.[1] The sanctions against Russia were further intensified after the shooting down of the Malaysian flight MH-17 over the territories controlled by the pro-Russian armies in Eastern Ukraine. Russia retaliated against these economic sanctions by imposing a partial embargo on imports of 48 agricultural HS-4 codes from the sanctioning countries only.

Both foreign policies sanctions and the retaliatory embargo, are likely to have significant impacts on Russian economy and trade, because sanctioning countries are important trade partners for Russia: prior to the embargo more than half (i.e., 57 %) of Russia's import value came from the countries sanctioning Russia.

[1]Full list of the countries sanctioning Russia and their affiliations is presented in Table A.1 of Appendix A.

The products targeted by the embargo (targeted products) are also an important component of the Russian imports: prior to the imposition of the embargo, the share of embargoed goods in total imports was 7% (with half of this volume originating in the sanctioning countries). Most of the embargoed products (i.e, 82%) were consumer goods[2] and included such items as dairy products, fresh and frozen fruits and vegetables, fish and meat.[3]. Thus, the imposition of the embargo shut off an important channel of Russian agricultural imports, which was likely to impact consumers and firms that were involved in the importing of these products.

This paper uses firm-level data to examine the behavior of firms in response to the retaliatory embargo. To guide the econometric analysis, I follow Bas and Strauss-Kahn (2014) and propose a partial equilibrium model of intermediate inputs trade that outlines a set of firm-level responses triggered by the imposition of the embargo. In this framework a firm chooses the amount of labor and composite inputs to use in the production process, and where to source these inputs from. Firm could opt for domestic or international sources, and if it goes international, it can choose from countries targeted by the embargo and non-targeted. Inputs sourcing decisions are made to minimize the cost of production, while the price of final goods is set to maximize the firm's profits. Solving the firm's problem, I derive productivity cutoffs for the three types of firms: firms

[2]As per the Broad Economic Categories classification (BEC), all products were classified as consumption, intermediate, or capital goods.

[3]Full list of the HS-4 codes targeted by the retaliatory embargo is presented in Table **??** of Appendix A

sourcing inputs domestically, firms importing inputs from the non-targeted countries, and firms importing inputs from the targeted countries. The imposition of the retaliatory embargo induces a decrease in the number of imported inputs from the targeted countries. This, in turn, affects the productivity cutoffs that determine firms' input sourcing patterns.[4] Given this set-up, I derive three theoretical predictions regarding the firm's response to the imposition of the embargo: (1) after the imposition of the embargo, the exit rates of firms importing inputs from the targeted countries increase for both targeted and non-targeted products (the extensive margin); (2) conditional on a firm staying in the market of a targeted country, the volume of trade falls (the intensive margin); (3) firms exiting the markets of targeted countries begin importing inputs from the non-targeted countries.

I test the model predictions using a novel firm-level transaction dataset, from the Federal Customs Service of Russia. The advantage of the data comes from the level of detail it provides on firm level decisions. The data set contains detailed information on all Russian exporting and importing firms' monthly trade flows by partner-country and HS-8 level product code. I use a triple difference estimation strategy to identify the impact of the embargo on the extensive and intensive margins of firm-level imports. The extensive margin of firms in the context of this study refers to the number of firms importing an HS-8 level code product from a given country. The firm's intensive margin refers to the size of a firm's average

[4]Either directly or through the price index channel

product-country import flow. I use information on the products and countries that Russian firms imported from prior to the imposition of the embargo to determine treatment effects. I refer to the changes in the imports of products targeted by the embargo (targeted products) from the countries targeted by the embargo (targeted countries)[5] as *the direct effect* of the embargo. The response of the imports of the targeted products from the non-targeted countries is called *the substitution effect*. Finally, the *spillover effect* refers to the import response of the non-targeted products sourced from the targeted countries.[6] The main empirical contribution of this paper is the analysis of the behavior of Russian firms in response to the unexpected exogenous trade shock represented by the Russian retaliatory embargo. Such micro level dynamics and any potential heterogeneities cannot be uncovered using the aggregate data.

The main results of the paper suggest that firms' exit rates increase in the markets for the targeted products after the embargo is imposed, and these exit rates are driven mostly by small firms. Large firms are able to remain in the markets for the targeted products by switching their sourcing pattern towards non-targeted countries (extensive margin effects). Surprisingly, not all firms discontinue their imports of targeted goods from the targeted countries. For the subset of firms that stay in these markets, the value of imports in targeted goods falls, on average, by 13 percent (intensive margin effects). Although unexpected, this finding is in

[5]Countries that sanction Russia are the countries that Russian retaliatory embargo targets.

[6]Appendix B provides an example for each of the effects.

line with Miromanova (2018), which shows that the Russian retaliatory embargo was not fully effective in shutting down the imports of targeted goods from the targeted countries.[7] Lastly, I find no evidence of unintended consequences of the embargo on the imports of other product categories. Taken together, the findings in this paper suggest that Russian firms have been able to mitigate some but not all of the costs resulting from the Russian retaliatory embargo.

This paper contributes to the economic literature on (*i*) trade sanctions; (*ii*) Russian sanctions; and (*iii*) non-tariff barriers to trade. Regarding (*i*), international sanctions and embargoes generally provide an excellent opportunity to estimate the response of various economic outcomes to large exogenous shocks. These policies have been used to estimate the impacts of shocks on trade flows, GDP level, and stock market. For example, Neuenkirch and Neumeier (2015) utilize a sample of 160 countries, 67 of which experienced economic sanctions over the period 1976-2012 to estimate the effect of the sanctions on the target states' GDP growth. Chavis and Leslie (2009) and Pandya and Venkatesan (2016) use the US consumers' boycott of the French goods to estimate the effects of the boycott on consumer behavior. They find that the sales of brands with French-sounding names and French wine, respectively, declined after the boycott was

[7]This could be either because of the strategic interest of the Russian government in certain targeted goods needed for domestic production or because of the ineffectiveness of the enforcement mechanism. There exists some anecdotal evidence of the fact that the public procurement included purchases of targeted products from the targeted countries even after the embargo was imposed, for example Alexander Soshnikov. "Parmesan forever: officials purchase embargoed products" (*translated from Russian*). BBC, Russian unit, August 5, 2016. Accessed online at `https://www.bbc.com/russian/features-36986348`

declared, but returned to normal levels after the decline in the mentions of the boycott in the media. Afesorgbor and Mahadevan (2016) analyze the Yugoslavian conflict to establish that sanctions and wars decrease not only trade between the countries directly engaged in conflict but also trade with the third countries. Finally, Heilmann (2016) uses a difference-in-differences approach and a synthetic control group method to analyze three episodes of sanctions and boycotts. He finds that boycotts can have strong negative effects on bilateral trade in both goods and services.

Researchers also expressed interest in (*ii*) the Russian sanctions in particular, including their impact on goods prices in Russia (Dreger et al. (2016)), GDP of EU and Russia (Kholodilin and Netsunajev (2016)) and trade flows (Miromanova (2018)). Finally, regarding (*iii*) non-tariff barriers to trade, there are surprisingly few studies of the impact of non-tariff barriers on the behavior of firms. The trade literature has mostly studied how changes in tariffs affect firm behavior. For example, in one of the most influential studies on firms in international trade, Pavcnik (2002) explores the impacts of trade liberalization, i.e., the reduction in tariffs, on firms in Chile. However, to my knowledge, there are few studies that estimate the effects of non-tariff policies, such as sanctions ad embargoes, on firms. Using the case of the Russian retaliatory embargo I analyze the firms' behavior in response to the non-tariff barrier to trade of the embargo.

Two studies are especially relevant to my paper. Crozet and Hinz (2019) estimate the impacts of the Russian sanctions on the extensive and intensive margins of French firms in an attempt to quantify the effect of the embargo on the sending country. My paper complements the work of Crozet and Hinz (2019) as I focus on the other side of the story: I concentrate on estimating the impacts of the Russian embargo on Russian firms. Haidar (2017) utilizes the Iranian customs data set to analyze whether the export sanctions imposed on Iran cause export deflection (defined as the firms in the sanctioned countries seeking new trade partners among non-sanctioning countries). He finds evidence that two-thirds of Iranian exports were deflected to non-sanctioning countries after sanctions were imposed in 2008. I complement this study by analyzing the effect of sanctions on imports rather than exports and whether changes in import patterns as a result of the embargo are similar to the documented changes in exports. I also analyze the effectiveness of sanctions as a trade barrier in the context of a larger country (Russia). The effects could be different to the extents that firms in Russia have different outside options after the embargo was imposed. To gain full understanding of how sanctions and embargoes impact trade, we must analyze the Russian incident from every aspect. My study complements the existing literature on Russian sanctions but expands our understanding of how Russian firms reacted to them.

The paper is organized as follows. Section 3.2 presents theoretical framework of the response of importing firms to the imposition of the retaliatory embargo in a partial equilibrium model. Section 3.3 describes the data used for the empirical analysis and presents some stylized facts about the Russian importing firms. Empirical techniques and corresponding results for the extensive and intensive margin responses are presented in section 3.4. Section 3.5 concludes.

Theoretical Framework

In this section I present a theoretical framework that outlines firms' responses to the imposition of the retaliatory embargo. The embargo is a response to the imposition of sanctions, just as in the Russian case. The countries that impose sanctions are also the countries targeted by the embargo. I propose a model of intermediate input trade that follows the framework in Bas and Strauss-Kahn (2014). The retaliatory embargo is modeled as a negative demand shocks that reduces a firm's ability to source inputs from countries targeted by the embargo.

Set-up

There is a continuum of potential domestic firms who supply horizontally differentiated final goods under monopolistic competition.To produce a variety of a final good k, a firm combines labor (L) and a set of composite inputs (M_i) produced by each industry i. These inputs can be purchased domestically (D) or internationally. Following Bas and Strauss-Kahn (2014), I make the simplifying

assumption that a firm chooses to source all inputs either domestically or internationally. If a firm chooses international inputs, it can source them from two types of countries j: targeted by embargo (T) or non-targeted (NT). A firm can choose to import products only from targeted countries or from non-targeted countries. This choice is endogenous for firms and depends on the firm's exogenously drawn productivity.

The production technology a firm faces is given by a Cobb-Douglas function of the following form:[8]

$$q = \phi L^{\alpha} \prod_{i=1}^{I} M_{ij}^{\theta_i} \tag{3.1}$$

where q represents the production output for firms that are producers and $j \in \{D, T, NT\}$.[9] ϕ represents the exogenous productivity of the firm, drawn from $g(\phi)$ distribution with cumulative distribution function $G(\phi)$. Additionally, α and θ_i are cost shares that satisfy the condition $\alpha + \sum_{i=1}^{I} \theta_i = 1$

The composite inputs are represented by a CES aggregator over different varieties v of inputs from industry i, coming from country j, I_{ij} is a set of all possible varieties v_{ij}, and $\sigma_i > 1$ is the elasticity of substitution across varieties within industry i:

[8]I do not include the firm subscript to simplify the notation.

[9]Alternatively, q can be interpreted as a quantity of sold items for firms that import goods and re-sell them on the domestic market.

$$M_{ij} = \left(\sum_{v \in I_{ij}} m_{iv}^{\frac{\sigma_i - 1}{\sigma_i}} \right)^{\frac{\sigma_i}{\sigma_i - 1}} \tag{3.2}$$

Following Bas and Strauss-Kahn (2014), I assume that the input varieties are symmetrically purchased at a level $\overline{m}$ (i.e. $m_{ij} = \overline{m}$ for all i and j). From (3.1), it follows that the composite input depends on the number of varieties from industry i purchased from a set j (N_{ij}) and the average purchase per input variety ($\overline{m}$):

$$M_{ij} = \overline{m} N_{ij}^{\frac{\sigma_i}{\sigma_i - 1}} \tag{3.3}$$

I model the imposition of the retaliatory embargo as a decline in the number of available varieties from the targeted countries and targeted industries, N_{ij}. The number of varieties drops due to several reasons: (i) unavailability, because it becomes more difficult to import these goods after the sanctions and embargo are imposed (for example, customs paperwork becomes more complicated), (ii) boycotting element, because firms might heed consumers, who choose to boycott goods from the targeted countries. This set-up allows me to account for the *effectiveness* of the embargo, i.e., whether the embargo is strictly enforced or there exist ways to circumvent the embargo. When the embargo is strictly enforced, the number of available varieties in the embargoed industries from the sanctioning

countries becomes an empty set. If the embargo is not strictly enforced, the number of available varieties from the targeted industries from the targeted countries declines, but does not go to zero.[10]

The way I model the retaliatory embargo is through a fall in N_{ij} for $j = \{T\}$. This fall in the number of imported varieties is substantial in embargoed goods (i.e. $\Delta N_{ij} = \delta < 0$ for $i = \{T\}$) but it may affect other product categories as well through a *chilling effect* (i.e. $\Delta N_{ij} = g \leq 0$ for $i = \{NT\}$ with $g > \delta$). Imports of targeted products from the targeted countries will experience a decline due to the *direct effect* of the retaliatory embargo. If firms choose to increase their imports of targeted products from the non-targeted countries to compensate for the losses induced by the retaliatory embargo, they will experience a *substitution effect*. The *chilling* or the *spillover effect* refers to the impact of the embargo on imports of non-targeted products from the targeted countries.

I assume that prior to the imposition of the sanctions and the embargo, $N_{iT} > N_{iNT}$ for all i, i.e., the number of available varieties for all industries in the targeted countries prior to the embargo is higher than the number of available varieties from the non-targeted countries. This assumption reflects a number of stylized facts about the importance of the targeted countries for

[10]Additionally, this set-up allows for the exceptions to the list of targeted products made at the more disaggregate levels, than the level of the imposition of the embargo. For example, current retaliatory embargo is defined at HS-4 product level, and if any exceptions are made at the HS-8 industry level, the imports of HS-4 product will not drop to zero due to the presence of exceptions at the more disaggregated level. Defining the industry i at a different level of aggregation has impact on the set of available varieties and the implications of the embargo for this set.

Russian international trade: (i) more than a half of Russian imports (i.e., 58%) originate from the countries sanctioning Russia (targeted countries); (ii) Targeted countries are developed countries, which means they are likely to have higher levels of production, and thus trade in more products; (iii) most of the targeted countries (i.e., 28 out of 31) are in the EU, and due to their geographical proximity to Russia, involve lower transport costs, which allows for an expanded set of available varieties. I assume that the imposition of the retaliatory embargo reduces the number of available input varieties from the targeted countries (i.e., N_{ij} for $j = \{T\}$). The change in N_{ij} for all i after the retaliatory embargo is large enough to reverse the inequality such that $N_{iNT} > N_{iT}$.

Each firm must pay a constant sunk cost to enter production, F_{sunk} paid in units of labor. This cost represents licensing and set-up costs, and it must be paid before firms observe how productive they are.This allows for the familiar set-up of a productivity cutoff, below which firms do not produce and exit, and above which firms begin to produce and sell their products.

On top of the sunk cost to enter production, each period firms must pay a fixed cost to source the inputs (also paid in units of labor): F_D if a firm uses domestic inputs, F_T if a firm sources inputs from the targeted countries, F_{NT} for firms sourcing their inputs from the non-targeted countries. I assume that $F_T > F_{NT} > F_D$, which captures the stylized fact that importing has additional costs associated with it, such as customs clearing and other bureaucratic procedures,

language barriers and other factors that are typically considered barriers to trade. The assumption that $F_T > F_{NT}$ is necessary for the model. Otherwise, in equilibrium, no firm would import goods from the non-targeted countries due to the lower number of available inputs from these countries.[11] Additionally, I introduce a fixed cost of *lobbying*, $F_{lobby\ j}$, which must be paid by the firms that want to continue importing targeted products from the targeted countries after the embargo. This allows me to further emphasize that large firms who have the necessary resources, can lobby the government and may obtain permission to circumvent the embargo and continue their trade in targeted products with the targeted countries.

Firm's Problem

Given the outlined set-up, there are two types of firms: firms that use domestic inputs, and firms that use imported inputs. The latter firms are further divided into two types based on the source country: firms that import inputs exclusively from targeted countries or from non-targeted countries. Using 3.3, all firms solve the following cost-minimization problem:

[11]I observe that about 30% of all firms in the sample import goods from the non-targeted countries prior to the embargo. Thus, it means that the lower appeal parameter of the inputs must be offset by a lower cost to import. Furthermore, the targeted countries are developed countries with higher standards of living, which implies higher labor and regulatory costs and could translate to a higher entrance cost for the firms.

$$\min_{L,\ \overline{m}} wL + \sum_{i=1}^{I} p_{ij} M_{ij} \tag{3.4}$$

subject to

$$\phi L^{\alpha} \prod_{i=1}^{I} M_{ij}^{\theta_i} \leq q \tag{3.5}$$

Solving this problem leads to an expression for the marginal cost that the firms face:

$$MC_j = \frac{w^{\alpha} \prod_{i=1}^{I} p_{ij}^{\theta_i}}{\phi \prod_{i=1}^{I} N_{ij}^{\frac{\theta_i}{\sigma_i - 1}}} \quad \frac{1}{\alpha^{\alpha} \prod_{i=1}^{I} \theta_i^{\theta_i}} \tag{3.6}$$

in which $j \in \{D; T; NT\}$.[12]

Assuming that consumers in all countries have CES preferences, which take the form of

[12]The term $\frac{1}{\alpha^{\alpha} \prod_{i=1}^{I} \theta_i^{\theta_i}}$ in expression(6) is a constant, so without loss of generality, it can be omitted from the expression.

$U(\Omega_k) = \left(\sum_{k \in \Omega} x(k) \frac{\gamma - 1}{\gamma} \right)^{\frac{\gamma}{\gamma - 1}}$, where $\gamma > 1$ and Ω_k is the set of available varieties, the demand for product k that each firm faces is $x_k = \frac{X}{P} \left(\frac{P}{p_k} \right)^{\gamma}$, where P is the Dixit-Stiglitz price index and X is total expenditure in the economy.

Combining the total cost function and the demand that firms face, it follows that by maximizing profits, firms set their prices as a constant mark-up over the marginal cost: $p_j = \frac{\gamma}{\gamma - 1} MC_j$, where j is the index for source country, which can also serve to indicate the firm type (i.e., firm that uses domestic inputs, inputs from the targeted countries, or inputs from the non-targeted countries). Next, combining the expressions for the demand and prices for good k, we can derive the expressions for the revenue of a firm of type j selling product k:

$$r_k = q_k p_{kj} = X \left[\frac{p_{kj}}{P} \right]^{1-\gamma} = \frac{X}{P^{1-\gamma}} \left[\frac{\gamma}{\gamma - 1} MC_j \right]^{1-\gamma} \tag{3.7}$$

Letting $B = \frac{X}{P^{1-\gamma}} \left(\frac{\gamma}{\gamma - 1} \right)^{1-\gamma}$ and normalizing wages to 1 (i.e., $w = 1$), profits for firms of different types can be defined as follows:

$$\pi_j = B\left[\frac{\phi\prod_{i=1}^{I} N_{ij}^{\frac{\theta_i}{\sigma_i-1}}}{\prod_{i=1}^{I} p_{ij}^{\theta_i}}\right]^{\gamma-1} - F_{sunk} - F_j - F_{lobby\ j} \tag{3.8}$$

in which $j \in \{D;T;NT\}$. $F_{lobby\ j} = 0$ if $j = \{NT\}$ and $F_{lobby\ j} > 0$ if $j = \{T\}$, .i.e., the lobbying cost will apply only to the firms that trade with the targeted countries prior to the embargo and want to continue doing so after the embargo is imposed. It represents the fact that not all firms need to cut their imports of the targeted goods from the targeted countries and some may find it optimal to circumvent the embargo.

Given this set-up, firms will make their sourcing decision based on the exogenously drawn productivity ϕ. Using (8), I solve for the productivity cutoffs for each type of firm. There exists a marginal firm that is indifferent between not producing after paying a sunk cost F_{sunk} (i.e., receiving zero profit) and producing using the domestic inputs: $\pi_D(\overline{\phi}_D) = 0$. Defining $\Gamma_j \equiv \prod_{i=1}^{I} N_{ij}^{\frac{\theta_i}{\sigma_i-1}}$ and $K_j \equiv \prod_{i=1}^{I} p_{ij}^{\theta_i}$, where $j \in \{D;T;NT\}$, the productivity cutoff for firms that choose to produce using domestic inputs is as follows:

$$\overline{\phi}_D = \left(\frac{F_{sunk} + F_D}{B}\right)^{\frac{1}{\gamma - 1}} \cdot \frac{K_D}{\Gamma_D} \tag{3.9}$$

Similarly, the cutoffs for the firms that choose to use inputs from the non-targeted and the targeted countries can be determined. There exists a marginal firm that is indifferent between producing using the domestic inputs or inputs sourced from the non-targeted countries: $\pi_D(\overline{\phi}_{NT}) = \pi_{NT}(\overline{\phi}_{NT})$. Solving this equality for $\overline{\phi}_{NT}$ produces the productivity cutoff above which firms choose to import inputs from the non-sanctioning countries. Finally, there exists a marginal firm that is indifferent between producing using inputs sourced from non-targeted countries or inputs sourced from targeted countries: $\pi_{NT}(\overline{\phi}_T) = \pi_T(\overline{\phi}_T)$. Solving this equality for $\overline{\phi}_T$ produces the productivity cutoff above which firms choose to import inputs from the targeted countries. Definitions of productivity cutoffs $\overline{\phi}_{NT}$ and $\overline{\phi}_T$ are provided in the Appendix C.

Because of the ranking of fixed costs (F_j) and the number of available varieties (N_{ij}), it can be shown that $\overline{\phi}_D < \overline{\phi}_{NT} < \overline{\phi}_T$. The most productive firms with productivities $\phi > \overline{\phi}_T$ source inputs from the targeted countries. Firms with productivities $\overline{\phi}_{NT} \leq \phi < \overline{\phi}_T$ source inputs from the non-targeted countries and firms with productivities $\overline{\phi}_D \leq \phi < \overline{\phi}_{NT}$ source inputs domestically. Figure 5 presents the determination of cutoffs for different types of firms and the profit schedule prior to the embargo.

To summarize, in this model for each product a firm produces, it chooses the average import per variety imported $\overline{m}$, amount of labor to use in production, L, and how to source the composite inputs: domestically or internationally. Inputs are sourced in such a way as to minimize the cost, while the price is set to maximize firm's profits. As shown previously, firm's decisions depend on its exogenously drawn productivity, ϕ, compared to a productivity cutoff $\overline{\phi}_j$, $j \in \{D; T; NT\}$, which is a function of the number of varieties firms import (N_{ij}) and the fixed costs the firm faces. The higher the productivity, the higher the fixed cost a firm can meet. Thus, the more productive firms choose to import their inputs, while firms with lower productivity opt into sourcing the inputs domestically. The advantage of foreign inputs over the domestic ones comes from the larger number of available varieties from the targeted countries, N_{ij} for $j = \{T\}$.

Theoretical Predictions

Recall that when the embargo is imposed, the available number inputs from the targeted countries falls, such that $\frac{N_{iT}}{N_{iNT}} < 1$. The same is true for the embargoed industries, $\frac{N_{Tj}}{N_{NTj}} < 1$, where (T; NT) denote industries targeted by the embargo and non-targeted industries from country j. Thus, the change in the number of available inputs will vary based on the type of source country (targeted versus non-targeted) and industry (targeted versus non-targeted) of the input. The imposition of the retaliatory embargo impacts firms that source inputs from

abroad, and especially from the targeted countries and/or inputs from the targeted industries. The responses of these firms are likely to vary along several margins, conditional on the behavior of the firm prior to the conflict.

Theoretical prediction 1.

After the imposition of the embargo, exit rates of firms from the sanctioning countries increases for both embargoed and non-embargoed products (the extensive margin).

Proof:

When embargo is imposed, number of inputs from the targeted countries decreases, which forces firms to exit the targeted countries markets:

$$\frac{\partial \overline{\phi}_T}{\partial N_{iT}} = \underset{-}{\frac{\partial \overline{\phi}_T}{\partial \Gamma_T}} \underset{+}{\frac{\partial \Gamma_T}{\partial N_{iT}}} < 0 \tag{3.10}$$

Thus, when the available number of inputs from the targeted countries falls, the productivity cutoff for the firms that use inputs from the targeted countries must increase because the profits are negatively affected, and to offset this change, productivity must be higher to be able to cover the fixed cost of importing from the targeted countries. Recall that the number of available inputs N_{iT} has two dimensions conditional on the type of product: embargoed ($N_{T,T}$) vs non-embargoed ($N_{NT,T}$). The exit of firms from the targeted countries markets due to the decline in the available number of the targeted inputs is referred to as the

direct effect of the embargo, while the exit of firms from the targeted countries markets due to the decline in the number of the non-targeted inputs is referred to as the *spillover effect* of the embargo.

Additionally, the productivity cutoff would be further increased by the fixed cost of lobbying $F_{lobby\ j}$ that firms must pay if they want to continue importing targeted products from the targeted countries. This suggests that the direct effect of the productivity cutoff change is larger in magnitude than the spillover effect: $\frac{\partial \overline{\phi}_T}{\partial F_{lobby\ T}} < 0$.

Theoretical prediction 2.

Conditional on a firm staying in the targeted countries market, the volume of trade falls (the intensive margin).

Proof:

For the incumbent firms who imported inputs from the targeted countries prior to the embargo and were able to stay in the market after the imposition of the embargo (i.e., their productivity is above the new productivity cutoff, $\phi > \overline{\phi}'_S$, which allows them to offset the increase in the marginal cost and the fixed cost of lobbying), the total imports of composite inputs decline due to the decrease in N_{ij} for $j = \{T\}$: $\frac{\partial M_{ij}}{\partial N_{ij}} > 0$. This holds for both product types and manifests as the *direct effect* of the embargo (i.e., decline in imports of targeted inputs from the targeted countries) as well as the *spillover effect* (i.e., decline in imports of non-targeted inputs from the targeted countries).

Theoretical prediction 3.

Firms exiting the targeted countries markets will begin importing inputs from the non-targeted countries. Moreover, some firms trading with non-targeted countries are forced out of that market. The net effect on the distribution of firms importing from the non-targeted countries is ambiguous.

Proof:

See Appendix C, C2, C4 - C6

Because the relative number of available inputs from non-targeted countries becomes higher after the imposition of the embargo, i.e. $\frac{N_{iNT}}{N_{iT}} > 1$, firms that are forced to exit the targeted countries markets, switch to importing inputs from the non-targeted countries. This is because these firms with productivities $\phi < \overline{\phi}'_T$ better off importing inputs from the non-targeted countries. The entrance of higher productivity firms into the non-targeted country markets leads to a redistribution of profits among firms.

These firms with productivities $\overline{\phi}_{NT} < \phi < \overline{\phi}'_T$ have lower marginal costs than firms with productivities $\phi < \overline{\phi}_{NT}$ because $\frac{\partial MC_j}{\partial \phi} < 0$, and as a result will be able to offer lower prices for the final products, forcing the less productive firms with higher marginal costs, who cannot compete with lower prices, to exit the non-targeted country markets. Thus, this influx of higher productivity firms into the non-targeted country markets will lower the price index, which in turn will lead

to a change in the productivity cutoffs for the firms that import inputs from the non-targeted countries. This is shown below:

$$\frac{\partial \overline{\phi}_{NT}}{\partial N_{iT}} = \frac{\partial \overline{\phi}_{NT}}{\partial B}_{-} \frac{\partial B}{\partial P}_{+} \frac{\partial P}{\partial N_{iT}}_{+} < 0 \tag{3.11}$$

Due to both, firms with productivities $\overline{\phi}_T < \phi < \overline{\phi}'_T$ switching their import sources to the non-targeted countries and the productivity cutoff $\overline{\phi}_{NT}$ increasing, the net effect of whether the interval $[\overline{\phi}'_{NT}, \overline{\phi}'_T]$ is greater than the interval $[\overline{\phi}_{NT}, \overline{\phi}_T]$ is ambiguous.

Similarly, it can be shown that the productivity cutoff for the firms that use domestic inputs increases as well, due to the decrease in the price index P following the drop in the number of available inputs N_{iT}:

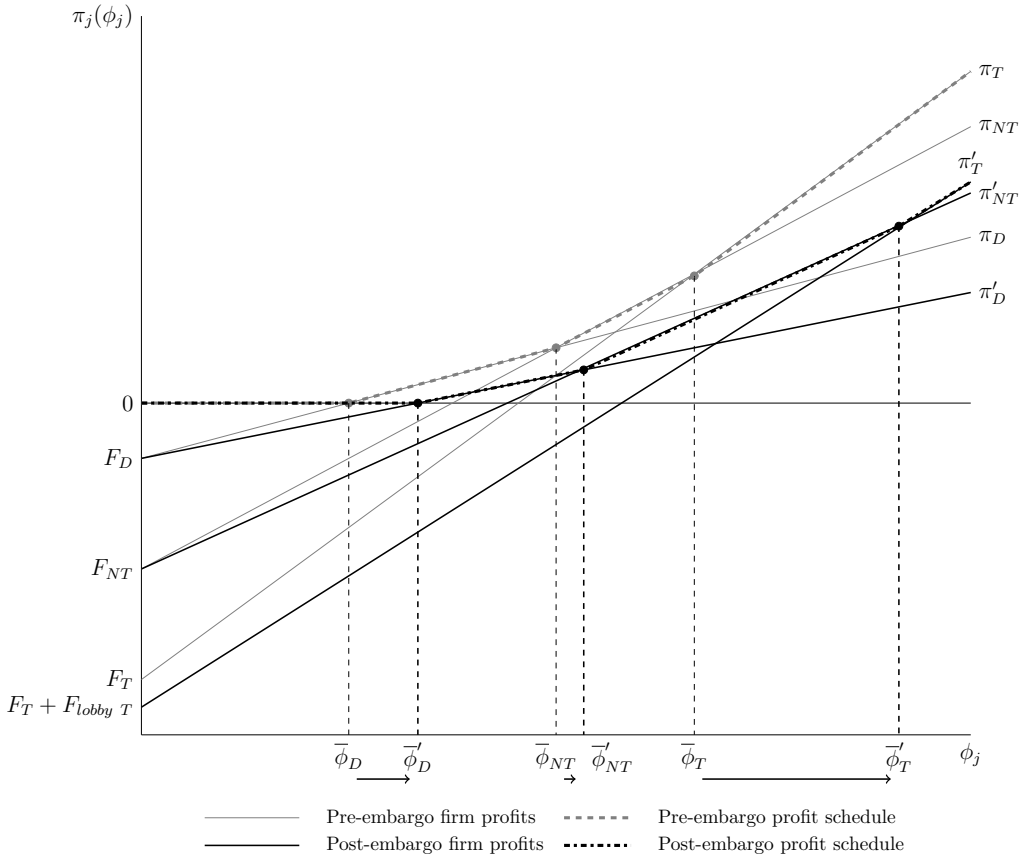
$$\frac{\partial \overline{\phi}_D}{\partial N_{iT}} = \frac{\partial \overline{\phi}_D}{\partial B}_{-} \frac{\partial B}{\partial P}_{+} \frac{\partial P}{\partial N_{iT}}_{+} < 0 \tag{3.12}$$

This forces firms with productivities $\phi < \overline{\phi}'_D$ to exit production completely.

Figure 5 illustrates the three predictions. The decrease in N_{iT} for all i is represented as a decrease in the slope component of the π_T line. Additionally, it leads to the decrease in the price index, which enters through the slope of the π_D and π_{NT} schedules. The fixed costs increases for firms who wish to import

inputs from the targeted countries, because these firms have to pay the lobbying cost, $F_{lobby\ S}$. They are unchanged for the firms that continue to use inputs from non-targeted countries and forms that use domestic inputs. Thus the entire profit schedule shifts to the right due to the increase in the cutoffs for all firm types.

FIGURE 5.
Determination of the Equilibrium Cutoffs Pre- and Post-Embargo



Data and Stylized Facts

I use a novel data set on Russian firms' monthly trade flows. To my knowledge, these data have not been previously used, and I have a unique chance of bridging the gap in the literature on the impacts of the embargo on Russian firms. The data set provides detailed information on all Russian exporter and importer firms' monthly trade flows by partner-country and HS-8 level product code. Because Russian retaliatory embargo directly targets imports, my analysis focuses on the response of the importing firms. The full sample of importing firms contains 21 million observations.The data span the time period from January 2011 to December 2015. The source of the data is Russian Customs; the data set is acquired through the Russian analytical agency VedStat.[13]

The data sample includes a total of 139,873 importer firms, the majority of which (i.e., 84%) begin importing (appear in the sample) before the embargo. Figure 6 demonstrates the seasonally adjusted number of active importers in the sample over time. The imposition of the sanctions in March of 2014 and the retaliatory embargo in August of 2014 are represented by the vertical red lines. The decline in the number of firms after the imposition of the embargo is clear.[14]

[13] `http://www.ved-stat.ru`

[14] Based on Figure 6, one might be concerned that the number of firms seems to decline prior to the imposition of the embargo. The economic and financial sanctions were imposed on Russia in March of 2014, immediately after the Crimean Annexation, which could potentially affect some importers. I do not find a statistically significant impact of the first wave of sanctions on the number of importers in the market.

A small portion of firms (i.e., 6%) engage in trade in embargoed products. The share of firms that trade with at least one country targeted by the embargo is 50%, covering 81% of the observations in the sample. This once again highlights the importance of trade with the targeted countries for Russian importers, which can be explained by the fact that the targeted countries are large (mostly OECD countries) and have large trade shares in world imports and exports.

32% of all importers (or 38% of importers present in the market before the embargo) trade exclusively with targeted countries prior to embargo; the same proportion of importers trade exclusively with non-targeted countries prior to the embargo (33% of all importers or 40% of importers present in the market before the embargo). A smaller share of importers trade with both country types before the embargo (19% of all importers or 22% of importers present in the market before the embargo).

To classify firms as small, medium or large, I create 3 equal sized bins based on their market share in the first sample year. Each size category consists of 46,625 firms. There are 41,266 single-product firms (i.e., about 30%) in the sample. 16% of the firms are both importers and exporters.

Selected summary statistics characterizing the state of the imports market before the embargo are presented in Table 12. Before the embargo, the smallest average trade flow is for the firms that trade with targeted countries in non-targeted goods and the largest is for the firms that import targeted goods from

TABLE 12.
Summary Statistics For the Pre-embargo Sample

Country-product group	Number of observations	Mean imports	Share in total imports	Unit value
T countries - T goods	265,381	119,177.3 (426649.6)	0.03	5.97 (60.19)
NT countries - T goods	212,071	185,872.9 (618100.3)	0.04	4.73 (24.35)
T countries - NT goods	9,520,950	57,484.0 (998289.6)	0.55	2649.35 (1427356)
NT countries - NT goods	5,473,935	67,252.7 (1011360.9)	0.37	991.71 (282213.9)

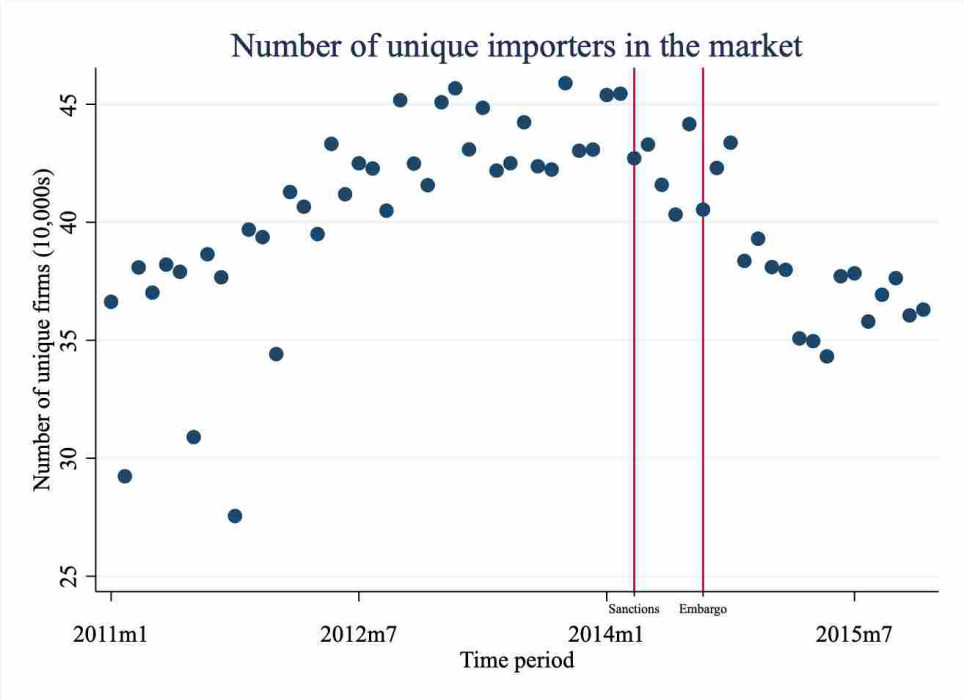
Notes: Standard deviations in parentheses. *T countries* refers to the countries sanctioning Russia and as a result targeted by the Russian retaliatory embargo; NT refers to non-targeted countries. *T goods* denotes products targeted by the embargo, NT refers to the non-targeted goods.

the non-targeted countries. On average, the unit values of non-targeted goods are much higher than for the targeted goods. Intuitively, it makes sense given that the majority of the targeted goods are agricultural products, while the non-targeted category includes durable goods as well.

Estimation Techniques and Results

In this section I describe the empirical estimation techniques and provide the results for the analysis of firms' responses to the embargo along the several margins, in particular, I focus on firms' decision to stay, exit, or enter the market for the targeted goods after the implementation of the policy, as well as on firms' decision to switch source countries for the targeted products. I also quantify the

FIGURE 6.
Number of Importers Over Time



Notes: This figure depicts the evolution over time of the number of unique importing firms in the sample, adjusted for seasonality. The first red vertical line represents the imposition of the sanctions on Russia after the annexation of the Crimea in March of 2014. The second vertical line represents the imposition of the retaliatory embargo in August of 2014.

loss of trade from the embargo at the firm's extensive and intensive margins. I define the extensive margin as a number of firms importing a product from a particular country, and the intensive as a size of a firm's average import flow of an HS-8 level product from a country.

The Russian retaliatory food embargo was imposed in response to the economic sanctions, imposed on Russia by foreign countries following the annexation of the Crimea. However, the exact timing of the embargo itself was triggered by a different exogenous event - the shooting down of the Malaysian flight MH-17 over the territories controlled by the pro-Russian armies in Donbass.[15] The sanctions were intensified after this incident, and Russia responded to the intensification of the sanctions by imposing the embargo on 48 HS-4 codes imported from the sanctioning countries. In my analysis, I treat the timing of the embargo as exogenous. I also make the assumption that the set of embargoed products was chosen exogenously by the Russian government. The aim of the embargo was to completely shut down the imports of the targeted products from the targeted countries and to inflict economic damage to these countries.

The exogenous shock of the embargo provides a convenient triple difference set-up for analyzing of the firm behavior to unexpected trade shocks. As with any trade shock, firms are likely to have a variety of responses to the embargo, conditional on their characteristics. The estimation strategy is built on the

[15]The region of Eastern Ukraine that includes Donetzk and Luhansk oblasts. It is controlled by the pro-Russian military groups.

assumption that the impacts of the embargo will vary conditional on whether the firm trades in targeted goods and with the targeted countries. To capture this heterogeneity, I analyze three effects of interest, described in the theoretical framework section, including the direct, substitution and spillover effects. I utilize these three effects to disentangle the impact of the embargo on the extensive and intensive margins of Russian firms.

Market Decisions and Switching Patterns

I begin the empirical analysis of the importers' behavior by studying their decision to exit a market for a particular product, and the importers' decision to switch source countries for the targeted goods. For these exercises, I concentrate on the importers that are present in the sample before the imposition of the embargo (the majority of the firms in the sample), as they are the firms that face the exogenous shock of the embargo, and are forced to make a decision in response to the policy. This also matches the theoretical framework as firms are in the market prior to the embargo.

I first concentrate on the firm's decision regarding its behavior in the markets for the affected products. According to the theoretical framework, outlined in section 3.2, the firms should be abandoning the markets for the targeted products, as the number of available targeted products decreases after the embargo is imposed. We should also see that the larger firms (i.e. firms with higher productivity, as I use firm's size as a proxi for its productivity) are more likely to

continue importing the targeted products, as they have the resources to circumvent the embargo.

To conduct this analysis, I construct a binary variable $exit$, which gets the value of 1 if the firm is observed importing an HS-8 level product before the embargo but leaves the market for that product after the embargo. To analyze how an importer's decision to exit a market is impacted by the embargo, I regress the binary decision to exit variable on the dummy variable for a targeted good. This is illustrated by the regression model below: $\gamma_h,\ \gamma_f$ stand for HS-2 level fixed effects and importing firm fixed effects, respectively; and $exit_{fk}$ is the firm f decision to exit the market for HS-8 level product k.

$$exit_{fk} = \beta_0 + \beta_1 D_{targeted\ good_k} + \gamma_h + \gamma_f + \varepsilon_{fk} \tag{3.13}$$

The coefficient of interest is β_1. It is identified by comparing the firms exiting markets for HS-8 level products to firms that stay in the market after the imposition of the embargo, as well as to firms that do not import a particular HS-8 product prior to the embargo. Here and other specifications in the probability analysis section, standard errors are clustered at the HS-2 product level to allow for clustering within a product but not across.

To analyze whether these decisions differ based on the firm size, as theory predicts, I also estimate a model specification where I interact the dummy variable

for the targeted good with the dummy variable for each firm size. The results of the exit decision and its potential heterogeneity by size are presented in Tables 13 and 14, respectively. The exit is defined as a firm stopping importing altogether. If a firm exits targeted country but trades with a non-targeted country, this is not counted as exit.

The results from estimating equation 3.13 are presented in column 3, while columns 1 and 2 provide additional specifications with varying sets of fixed effects. Across all specifications, I observe an increase in probability that a firm exists the markets for targeted products in comparison to non-targeted products. The results however are not significant. When I separate effects by size, as seen in Table 14, small firms are more likely to exit imports of targeted products: their probability of exiting the markets for targeted good increases by 4.4 percentage points after the imposition of the embargo. This effect is significant at 10%. Large firms experience a lower probability of exiting, which is in line with theoretical prediction 1 - large firms have more resources to circumvent the embargo and are more likely to stay in the market.

Because the exit decision analysis does not include the country dimension and whether the foreign country is sanctioning Russia or not (which impacts the availability of the import flow for the firms), I further investigate whether the survival of firms is driven by switching patterns. If firms decide to continue importing the targeted products after the embargo, it must be either because

firms can circumvent the embargo, or because they are able to find non-targeted suppliers for these goods, as per theoretical prediction 3. Thus, I analyze the change in probability of switching to suppliers in the non-targeted countries for the firms that decide to stay in the market for the targeted products after the embargo is enforced.

TABLE 13.
Probability of an Importer Exiting an HS-8 Product Market

	(1)	(2)	(3)
Targeted good	0.024**	0.033	0.035
	(0.009)	(0.024)	(0.022)
HS-2 product FE	No	Yes	Yes
Firm FE	No	No	Yes
Observations	7,470,752	7,470,752	7,470,752
R-squared	0.000	0.007	0.470

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-2 code level. This Table reports results from estimating equation (3.13) in the text. The dependent variable is a dummy for firm's decision to exit the imports of a particular HS-8 level product, which takes the value of 1 if a firm is observed importing an HS-8 product before the embargo but drops this product after the imposition of the embargo. *Targeted good* is a dummy variable for the HS-4 product code that is embargoed. The estimation sample includes only firms that are present in the market before the embargo. I utilize OLS to estimate the change in probabilities of the decision to discontinue imports of the targeted goods in comparison to their non-targeted counterparts.

TABLE 14.
Decision to Exit: Heterogeneity by Size

	Benchmark (1)	By size (2)
Targeted good	0.035	0.044*
	(0.022)	(0.023)
Targeted good × Medium firm		0.006
		(0.013)
Targeted good × Large firm		-0.013
		(0.015)
HS-2 product FE	Yes	Yes
Firm FE	Yes	Yes
Observations	7,470,752	7,470,752
R-squared	0.470	0.470

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-2 code level. In this Tablethe firm's decision to discontinue the HS-8 level product import by importer size is analyzed. The decision to exit the imports is constructed in the same way as in Table 13. I utilize OLS to estimate the change in probabilities of each decision for the targeted goods in comparison to their non-targeted counterparts for each importer size bracket. The omitted group consists of small importers.

In the theoretical framework section I show that the switching decisions are likely to differ based on the type of country the importer trades with prior to the imposition of the embargo. Per my theoretical results, we should see the decline in the probability of continuing to import targeted products from the targeted countries for most firms (the direct effect), and an increase in the probability of switching towards the non-targeted countries some of the firms (the substitution effect).

To empirically test these theoretical predictions, I separate the importers that choose to stay in the market for a product k into firms that trade exclusively with

the targeted countries before the embargo (38% of all firms) and firms that trade exclusively with the non-targeted countries before the embargo (40% of all firms). Next I construct variables that represent firms' switching decision for each product a firm imports prior to the embargo. Firms that import goods exclusively from the targeted countries prior to the embargo can continue to import from these countries, switch completely towards the non-targeted countries, or add a new supplier in a non-targeted country while maintaining their trade with targeted country. The empirical model is presented below:

$$switching_{fk} = \beta_0 + \beta_1 D_{targeted\ good_k} + \gamma_h + \gamma_f + \varepsilon_{fk} \tag{3.14}$$

where the binary dependent variable $switching_{fk}$ equals 1 for each of the following cases $\{T\ to\ T; T\ to\ NT; NT\ to\ T; NT\ to\ NT\}$, where T stands for the targeted country and NT stands for the non-targeted country. It essentially represents the probability that after the embargo a firm continues to import from the same type of country as before the embargo or switches to a supplier in a different country type. For example, $T\ to\ T = 1$ if a firm that imported good k from the targeted country prior to the embargo continues to import it from the targeted country after the embargo as well. $T\ to\ NT = 1$ if a firm that imported good k from the targeted country before the embargo switches (or adds) a partner in a non-targeted country after the embargo. The dependent variable accounts for the timing of the

embargo implicitly. As in (13), $\gamma_h,\ \gamma_f$ stand for HS-2 level product and importer fixed effects, respectively.

To investigate the heterogeneity in switching, I also estimate the model in equation (3.14) using interaction terms between the dummy variable for the targeted product and the dummy variables for firm size. The results of the switching decisions and the heterogeneity analysis are presented in Tables 15 and 16, respectively.

TABLE 15.
Switching Decisions

	Only T pre-embargo		Only NT pre-embargo	
	T to T	T to NT	NT to NT	NT to T
	(1)	(2)	(3)	(4)
Targeted good	-0.069***	0.100***	-0.002	-0.003
	(0.023)	(0.028)	(0.003)	(0.008)
HS2 FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	1,728,372	1,728,372	965,232	965,232
R-squared	0.451	0.409	0.585	0.558

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-2 code level. This Table presents the results from estimating equation (16) in the text. The dependent variable is the binary outcome of whether a firm imports a particular HS-8 code from a targeted or non-targeted country prior to the embargo and after the embargo, i.e., it accounts for the timing of the retaliatory embargo implicitly. The results are separated by the type of country firms import from prior to the embargo. The intuition behind these results is that the firms that import exclusively from the targeted countries prior to the embargo have the largest incentive to switch to importing the targeted goods from the non-targeted countries after the embargo. In the table, T stands for the country targeted by the embargo, while NT stands for the non-targeted country. T to T means the probability of continuing to import an HS-8 level product from the targeted country after the embargo if prior to the embargo a firm imported it from the targeted country. The estimator used is OLS and therefore the results are interpreted as a simple linear probability model.

TABLE 16.
Switching Decisions: Size Heterogeneity

	T to T		T to NT	
	Benchmark	By size	Benchmark	By size
	(1)	(2)	(3)	(4)
Targeted good	-0.069***	-0.012	0.100***	-0.000
	(0.023)	(0.050)	(0.028)	(0.075)
Targeted good × Medium firm		-0.036		-0.019
		(0.077)		(0.103)
Targeted good × Large firm		-0.063		0.121
		(0.051)		(0.079)
HS-2 FE	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	1,728,372	1,728,372	1,728,372	1,728,372
R-squared	0.451	0.451	0.409	0.409

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-2 code level. This Table presents the results of the switching analysis by size. The sample consists of firms who import exclusively from the targeted countries prior to the embargo. The omitted group consists of small importers. In order calculate the effect of the embargo on the medium firms, the coefficient on small importers is added to the coefficient of the interaction term between the dummy for the targeted good and the size dummy for the medium importers. The joint significance is determined using the F-test. The results are separated by the stayers (firms that continue to import only from the sanctioning countries after the imposition of the embargo) and the switchers (firms that add a non-targeted partner or switch completely towards the non-targeted source countries. T stands for the targeted country, while NT stands for the non-targeted country. T to T means the probability of continuing to import an HS-8 level product from the targeted country after the embargo if prior to the embargo a firm imported it from the targeted country.

Theoretical prediction 1 is confirmed: for the firms that import exclusively from the targeted countries prior to the embargo, the probability of continuing to import embargoed products from the targeted countries falls by 6.9 percentage points after the embargo. This provides evidence for the direct negative impact of the embargo on firms. I also find evidence of the substitution effect (theoretical prediction 3): firms that import exclusively from the targeted countries prior to the embargo either switch completely their source countries or add a supplier in a non-targeted country for the targeted products, as evidenced by column 2 of Table 15.

Additionally, I test for whether larger firms are indeed more likely to switch source countries. For that I limit the sample to only firms that import exclusively from the targeted countries prior to the embargo, as they are the ones the most affected by this shock. Surprisingly, I find that large firms are less likely to continue importing embargoed product from the targeted countries after the embargo: their probability to continue to import from the targeted countries falls by 7 percentage points (highly significant effect), while for the small firms the decline in probability is only 1.2 percentage points and not statistically significant. However, the switching towards non-targeted countries is driven by the large importing firms (column 4 of Table 16). The probability that they add a supplier in a non-targeted country or switch their sources completely increases by 12 percentage points after the imposition of the embargo. The probability of small

firms switching source countries is zero. This finding is intuitive: large firms have more resources for switching, i.e., it might be less difficult for them to establish new connections, solve logistical or marketing issues than for the smaller firms.

To conclude the analysis on the decision to exit or switch import source countries, I find evidence of an increased exit in the markets for the targeted products. Additionally I find that large importers that choose to stay in the market for the targeted products after the embargo are more likely to switch source partners to the non-targeted countries.

Number of Firms

Next I proceed to quantify the effects of the embargo on the number of importers present in the market for a good k from country j. In the theoretical framework, the change in the number of firms is described by a change in the productivity cutoffs and profits in response to the decrease in the number of imported inputs N_{ij} for $j = \{T\}$.

To estimate the impact of the embargo on the number of firms, I collapse the sample across firms to the product - country - period dimension. In doing so, I count the number of unique importers that import a particular HS-8 level product from a particular country in a particular month. If product k is not imported into Russia from a country j in a given month, the number of importers is recorded as zero. On average, there are 35 firms per HS-8 level product prior to the embargo; after the embargo this number drops to 33.

I estimate the following empirical model of the firm's extensive margin, using the PPML estimator:[16]

$$number\ of\ importers_{kjt} = exp[\beta_1 \times Direct_{jkt} + \beta_2 \times Substitution_{jkt} + \beta_3 \times Spillover_{jkt} + \gamma t + \gamma_{jk} + \gamma_{jy} + \gamma_{ky}] + \varepsilon_{jkt} \quad (3.15)$$

The subscripts k, j, and t denote product, partner country, and time period respectively. Equation (3.15) presents the estimation strategy for identifying each of the three embargo effects (direct, substitution, and spillover effects) on the number of importers per product-country pair. The period fixed effects (γ_t) account for the macroeconomic conditions and seasonal variation in the number of importers. Country-year and product-year (γ_{jy}, γ_{ky}) account for the multilateral resistance terms and the yearly product trends. Finally, country-product fixed effects (γ_{jk}) accounts for the time-invariant country-product trends.

$Direct_{jkt}$ captures the direct effect of the embargo on the number of importers that import targeted products from the targeted countries. This variable reflects whether Russia embargoes a particular product k from a country j at time t. It is constructed as follows:

$$Direct_{jkt} = D_{T\ country} \times D_{T\ product} \times D_{time}$$

[16]Because it is better suited to deal with the zero observations.

where $D_{T\ country}$ is 1 if country j is sanctioning Russia and as a result is targeted by the retaliatory embargo; $D_{T\ product}$ is a dummy that takes the value 1 if the product is targeted by the embargo, and 0 otherwise; D_{time} is a dummy that takes the value of 1 in all the months following August 2014 period when the embargo was imposed.

$Substitution_{jkt}$ is the substitution effect of the embargo. This dummy variable measures how the number of importers that import targeted goods k from the non-targeted countries j at time t was affected by the embargo. It is constructed as follows:

$$Substitution_{jkt} = D_{NT\ country} \times D_{T\ product} \times D_{time}$$

where $D_{NT\ country}$ is 1 if country j is not targeted by the Russian retaliatory embargo; $D_{T\ product}$ and D_{time} are as described above.

Finally, $Spillover_{jkt}$ is a dummy variable that captures the change in the number of importers that source non-targeted products k from the targeted countries j. The justification to include this variable is the possibility that the targeted countries voluntarily reduce trade with Russia in non-targeted product categories. This variable is constructed as follows:

$$Spillover_{jkt} = D_{T\ country} \times D_{NT\ product} \times D_{time}$$

where $D_{T\ country}$ and D_{time} are defined above and $D_{NT\ product} = 1$ if a product is not targeted by the embargo, and 0 otherwise.

The three coefficients of interest are β_1, β_2, and β_3. They capture the direct, substitution, and spillover effects of the embargo on the number of Russian importers. As shown in the theoretical framework, it is expected that firms will stop importing targeted products from the targeted countries after the embargo is imposed (in the theoretical framework modeled as a fall in N_{ij} due to the fall in both country- and product-specific components of the number of available inputs), because the availability of these products from the targeted countries decline (the direct effect), and thus the number of importers in this group should decline. Large firms, who have resources to pay the switching cost, will switch to sourcing targeted products from the non-targeted countries (the substitution effect due to the changes in the cutoffs in the theoretical framework). I also expect that some firms will have to leave the markets for the non-targeted goods imported from the targeted countries either due to the uncertainty of trade policy, logistical complications, or economies of scale in shipping. The results from estimating equation (3.15) are presented in Table 17.

TABLE 17.
Number of Firms: Specification Choice

Dependent variable:	Number of firms	Log number of firms	Number of firms
	OLS	OLS	PPML
	(1)	(2)	(3)
Direct effect	-0.717^{***}	-0.226^{***}	-0.504^{***}
	(0.192)	(0.043)	(0.044)
Substitution effect	0.111	0.048	0.109^{***}
	(0.250)	(0.033)	(0.020)
Spillover effect	0.009	0.015	0.003
	(0.094)	(0.014)	(0.003)
Period FE	Yes	Yes	Yes
Country-product FE	Yes	Yes	Yes
Country-year FE	Yes	Yes	Yes
Product-year FE	Yes	Yes	Yes
Observations	5,852,178	5,851,089	5,137,599
R^2	0.425	0.483	

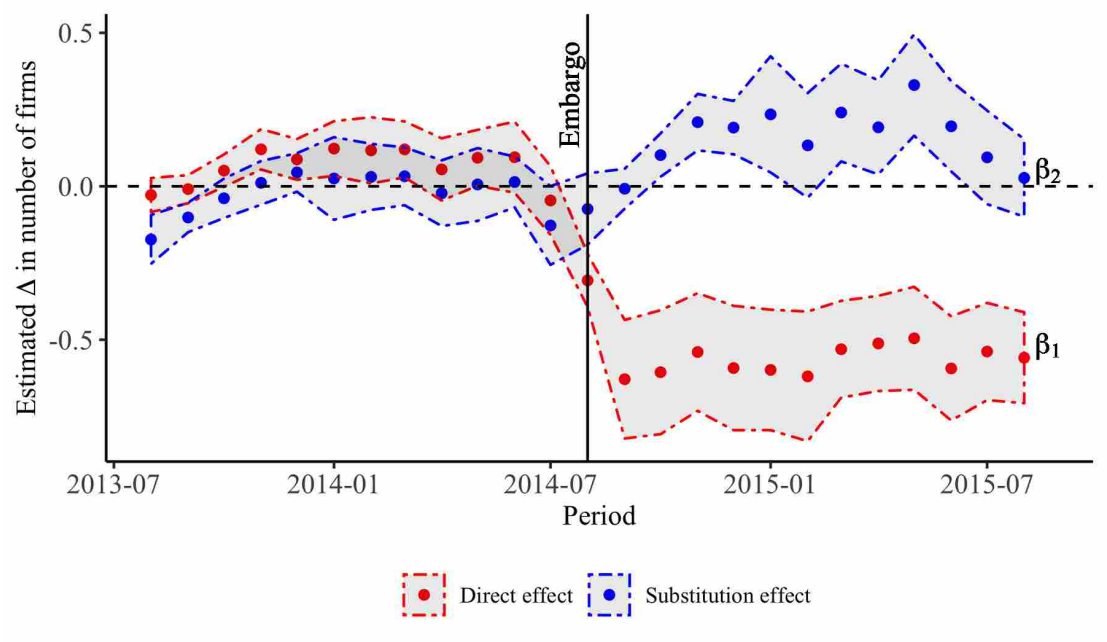
Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at firm level. Extensive margin refers to the number of importers per product k (HS-8 code) from a country j. In columns 1 and 2 I utilize OLS with the dependent variable in levels and logs, and in column 3 I utilize PPML. PPML is the benchmark specification because number of products is a count data, and therefore, Poisson count model is more appropriate. The direct effect refers to the number of importers importing targeted HS-8 product k from a country j targeted by the embargo. The substitution effect refers to the number of importers importing a targeted product k from a non-targeted country j. Finally, the spillover effect refers to the number of importers per non-targeted product k from a targeted country j.

Columns 1 and 2 of Table 17 utilize OLS estimator, with two different types of dependent variables: number of importers per product-country in logs and in levels. Given that the dependent variable is count data (number of firms within a product, which can never be negative and might have a large number of zero observations), the benchmark specification is PPML (column 3) with OLS results

provided for comparison. The direct effect of the embargo can be interpreted as a 45 percent decline in the number of importers that import targeted products from the targeted countries ($e^{-0.679} - 1 = -0.40$). The substitution effect of the embargo translates to an increase of only 11.5 percent in the number of importers that switch to importing the targeted products from the non-targeted countries. I find no evidence of a spillover effect, i.e., the embargo has no impact on the number of firms that import non-targeted products from the targeted countries.

Figure 7 demonstrates the evolution of the direct and spillover effects over time. The Figure is produced by regressing the number of importers per product k from country j on 12 leads and lags of each effect and the same set of fixed effects from equation (15). The Figure clearly demonstrates that the magnitude of the direct effect of the embargo is strong and is not offset by the substitution effect. The direct effect persists over time, while the substitution effect dissipates by the end of the twelfth month after the imposition of the embargo.

FIGURE 7.
Evolution of the Number of Importers per HS-8 Level Product Over Time



Notes: The extensive margin refers to the number of importers per HS-8 code. The direct effect refers to the number of importers importing targeted products from the targeted country, while the substitution effect is the number of importers importing targeted products from the non-targeted countries. The figure is produced by regressing the number of importers per product k from country j on 12 leads and lags of each effect and a set of fixed effects. The Figure demonstrates that the direct effect of the embargo is strong and is not offset by the substitution effect.

The results of the size heterogeneity analysis are presented in Table 18. The omitted group in column 2 consists of small importers. I find that the small importers are the most affected by the embargo: the number of small firms importing targeted and non-targeted goods from the targeted countries drops by 66 and 71 percent, respectively (the direct and spillover effects).[17] In addition,

[17]To compute the direct effect of the embargo on large firms, the following expression is calculated: $e^(- 0.037 - 1.084) - 1 = -0.662$. According to Shang et al. (2018), interpretation of the interaction terms in the PPML regression may not be that straightforward. They compute the true effect of the interaction term as $e^{(\beta_2+\beta_4)} - e^{\beta_2}$, where $y = \beta_2 \times Direct + \beta_3 \times Large + \beta_4 \times Direct \times Large$. Utilizing this method, the estimates in my specification would produce unexpected results and given additional evidence of the robustness of my estimates, I resume

small firms are also not able to substitute towards the non-targeted countries, because the number of these firms importing targeted products from the non-targeted countries falls by 59 percent.

Large firms have more resources and therefore are in a better position to overcome the effects of the embargo. The direct effect of the embargo on the number of large firms translates to a 13 percent decline, while the number of large firms that import targeted products from the non-targeted countries (the substitution effect) increases by 66 percent. These findings are in agreement with the theoretical framework: large firms are more likely to switch to source inputs from the non-targeted countries due to higher productivity and a greater number of available resources. Quite surprisingly, and counter to the theoretical predictions, the number of large firms importing non-targeted goods from the targeted countries increases. One interpretation of this result is that one could explain the spillover effect as a different way of substitution for firms in order to compensate for the losses from the embargo: large firms who already import from the targeted countries have already established partner connections with these countries, and instead of choosing to find new markets from which to source the targeted products (the substitution effect), they might choose to import more non-targeted products from the targeted countries.

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analysis utilizing the traditional approach of interpretation of the interaction terms in the PPML regressions.

TABLE 18.
Number of Firms: Heterogeneity Analysis

	Benchmark	By size
	(1)	(2)
Direct effect	-0.504^{***}	-1.084^{***}
	(0.044)	(0.111)
Direct × Medium		-0.037
		(0.077)
Direct × Large		0.941^{***}
		(0.135)
Substitution effect	0.109^{***}	-0.898^{***}
	(0.020)	(0.032)
Substitution × Medium		0.209^{***}
		(0.036)
Substitution × Large		1.402^{***}
		(0.046)
Spillover effect	0.003	-1.221^{***}
	(0.014)	(0.024)
Spillover × Medium		0.314^{***}
		(0.018)
Spillover × Large		1.699^{***}
		(0.035)
Period FE	Yes	Yes
Country-product FE	Yes	Yes
Country-year FE	Yes	Yes
Product-year FE	Yes	Yes
Observations	5,137,599	5,137,599
R^2	0.962	0.518
Adjusted R^2	0.961	0.507
Note:	*p<0.1; **p<0.05; ***p<0.01	

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-8 product level. In this TableI present results of the heterogeneity analysis of the extensive margin by importer size. The dependent variable is the number of importers of size s importing product k (HS-8 code) from a country j. The direct, substitution, and spillover effects are defined as in Table(7). The omitted group consists of small importers. The estimator used is PPML.

To conclude, the number of firms importing targeted goods from the targeted countries decreases by 66 percent. This decline is driven by small firms discontinuing these imports, and by the number of large firms switching to the countries not targeted by the embargo. Additionally, the number of importers that import targeted products from the non-targeted countries increases by 12 percent. These effects are driven by the large importers, confirming theoretical predictions.

Intensive Margin

As shown in the extensive margin analysis, the exogenous shock of the retaliatory embargo forces smaller importers to discontinue imports of the targeted products imported from the targeted countries. However, large firms have resources to continue importing and the average import flow of these importers is likely to be impacted by the embargo. Recall from theoretical prediction 2 that $\frac{\partial M_{ij}}{\partial N_{ij}} > 0$ for $j = \{T\}$, i.e., the import flow of products from the targeted countries decline as the number of varieties falls after the embargo is imposed. Thus, I expect to see the average import flow of both targeted and non-targeted goods from the targeted countries to decline (the direct and spillover effect, respectively). Additionally, the average import of non-targeted products from the sanctioning countries is expected to increase (the substitution effect).

To capture the true intensive margin effect of the embargo, I restrict the sample to incumbent importers only (firms that are present in the market prior and after the embargo), and use the multiplicative form of the gravity equation to

separate the impacts of the embargo into the direct, substitution, and spillover effects, which were described in the extensive margin section. The estimating equation becomes:

$$Trade_{fjkt} = exp[\beta_1 \times Direct_{jkt} + \beta_2 \times Substitution_{jkt} + \beta_3 \times Spillover_{jkt} + \gamma_{fjk} + \gamma_t] + \varepsilon_{fjkt} \quad (3.16)$$

The subscripts f, k, j and t denotes firm, product (HS-8 level), partner country, and time period, respectively. The reference group consists of the non-sanctioning countries trading in non-embargoed goods. Equation 3.16 presents the estimation strategy for identifying each of the three embargo effects (direct treatment, substitution, and spillover effects) on the level of import flow of firm f importing product k from country j in period t. The firm-country-product fixed effects (γ_{fjk}) account for the time-invariant determinants of bilateral trade in good k such as bilateral distance, common borders, common language, product trends for a particular firm. The period fixed effects (γ_t) account for macroeconomic factors that might affect trade (e.g. inflation, currency movements, etc) and seasonality. The detailed description for the construction of the treatment variables is presented in the previous subsection on the extensive margin analysis. Standard errors are clustered at the firm-product-country level.

Following the literature, I utilize the PPML estimation technique to account for the presence of zeros in the data set. I expect the embargo to have a negative impact on the firms' import flows of the targeted goods from the targeted countries ($\beta_1 < 0$), modeled as a decline in imports due to the decline in the number of the available parameters N_{ij}. Theoretically, β_2 is positive because after the embargo is imposed, firms may decide to source their imports of targeted goods from the non-targeted countries to mitigate the losses from embargo. In the theoretical framework this is due to the increase in the productivity cutoffs for the firms that import products from the sanctioning countries, forcing an influx of a higher productivity firms to source inputs from the non-targeted countries. β_3 is likely to be negative, as I would expect firms to decrease their ties to the targeted countries in order to minimize the losses and uncertainty. This is modeled as a decline in the number of varieties from the targeted countries, N_{iT}.

To motivate the choice of PPML estimation technique over OLS and the set of fixed effects, I estimate equation (16) using OLS (using log-linearized version of the equation) and PPML, and with two sets of fixed effects: 1) firm-product-country, month and year fixed effects versus 2) firm-product-country and period fixed effects. The results of these estimations are presented in Table 19. The coefficients of interest are as hypothesized across all specifications, however there is a significant amount of variation in the magnitudes and significance levels. Using both sets of fixed effects, OLS overestimates the absolute values of coefficients

for the main treatment effect. Reverse pattern holds for the coefficients of the substitution effect. Inclusion of period fixed effects removes the significance of the spillover effect, but the significance and signs of the main treatment and substitution effects is preserved. The benchmark model is presented in column 4 of Table 19; I use PPML estimation technique and the second set of fixed effects to account for oil price and exchange rate fluctuations during that time.

TABLE 19.
Intensive Margin: Specification Choice

Dependent variable:	Log of trade		Level of trade	
	OLS		PPML	
	(1)	(2)	(3)	(4)
Direct effect	-0.328***	-0.274***	-0.219***	-0.143***
	(0.051)	(0.051)	(0.046)	(0.048)
Substitution effect	0.100***	0.148***	0.220***	0.292***
	(0.020)	(0.020)	(0.025)	(0.029)
Spillover effect	-0.066***	-0.014***	-0.082***	-0.014
	(0.003)	(0.004)	(0.019)	(0.025)
Firm-product-country FE	Yes	Yes	Yes	Yes
Month FE	Yes	No	Yes	No
Year FE	Yes	No	Yes	No
Period FE	No	Yes	No	Yes
Observations	18,868,557	18,868,557	18,868,702	18,868,702
R-squared	0.819	0.819		
Number of firm-product-country gr.			2,495,869	2,495,869

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at firm-product-country level. In this TableI analyze the impact of the embargo on firm's average trade flow by product and country types. The main effect refers to the imports of targeted goods from the targeted countries. The substitution effect refers to imports of targeted goods from the non-targeted countries. The last effect of interest is denoted the spillover effect and refers to the effect of the embargo on average import flow of non-targeted goods from the targeted countries.

As expected, I find a highly significant negative direct treatment effect for an average Russian firm of about 13 percent ($e^{-0.143} - 1 = -13\%$). This impact is not as large as expected, which suggests that there might be a large degree of variation in the impact of the embargo conditional on the type of firm. In dollar terms, this corresponds to roughly a loss of about 15,493 USD in imports of targeted goods from targeted countries (for the average firm). A significant positive substitution effect of 34 percent increase in trade flows of targeted goods with non-targeted countries, which on average seems to offset the direct effect of the embargo.[18] Consistent with Miromanova (2018), I do not find a significant average spillover effect at the intensive margin.

It is reasonable to expect a large amount of variation in these estimates conditional on the importer's attributes. Thus, I proceed by conducting heterogeneity analysis of the embargo's impacts on the intensive margin of firms. These results are presented in Table 20. The benchmark model estimates are presented in column 1.

The heterogeneity in the effects of the embargo by firm size is quite large. The reference group for this specification consists of small firms. As theory predicts, I find that the small firms experience the largest direct treatment effect, meaning that a small firm's average trade flow of targeted goods from the targeted countries experiences the largest decrease: 56 percent drop versus 9 percent decline for the

[18]The increase in average firm's import flow of targeted goods from non-targeted countries if roughly 63,197 USD.

large firms, [19] significant at 5%. These findings are in agreement with the effects of the embargo on the extensive margin of bilateral trade described previously - small firms bear the largest impact of the embargo by having the highest exit rates and largest decline in the average import flow. If a large firm is able to continue importing targeted products from targeted countries, its average import flow does not decline by much because it is able to circumvent the embargo. One of the most likely ways to do so is by claiming the need for imported inputs from the targeted countries for a strategic domestic production. Additionally, large firms have more resources for substitution, as they are able to increase their imports of targeted products from the non-targeted countries by 34 percent (significant at 1%), while for the small firms this increase is only 21 percent.

Surprisingly, only medium firms experience a large positive spillover effect: an increase of about 16% in the average trade flow. Medium firms also increase their imports of the targeted goods from the non-targeted countries more than large firms do, and experience a positive spillover effect. Thus, the non-targeted product imports from the targeted countries for the medium sized importers actually benefit from the embargo. It could be that these firms were able to benefit from the smaller firms discontinuing imports of these products by increasing their presence in these markets.

[19]Using the Shang et al. (2018) method, 43 versus 12 percent decline

TABLE 20.
Intensive Margin: Heterogeneity Analysis

	Benchmark (1)	By firm size (2)
Direct effect	-0.143***	-0.822***
	(0.048)	(0.202)
Direct × Medium		0.670***
		(0.234)
Direct × Large		0.723***
		(0.207)
Substitution effect	0.292***	0.206***
	(0.029)	(0.059)
Substitution × Medium		0.230**
		(0.107)
Substitution × Large		0.087
		(0.061)
Spillover effect	-0.014	-0.116
	(0.025)	(0.121)
Spillover × Medium		0.270**
		(0.121)
Spillover × Large		0.094
		(0.120)
Period FE	Yes	Yes
Firm-country-product FE	Yes	Yes
Observations	18,868,702	18,868,702
Number of firm-product-country groups	2,253,754	2,253,754

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at firm-product-country level. This Table presents the results of heterogeneity analysis at the intensive margin by importer size. Importer's size is determined by importer's share in total imports in the first year the importer is present in the sample. I separate the importers into small, medium and large. The omitted group consists of small firms.

I find that all three effects of the embargo are highly significant and have expected signs. Among the incumbent importers the average import flow of the targeted products from the targeted countries declines by 13% (the direct effect),

the average imports of the targeted products from the non-targeted countries increases by 34% (the substitution effect), and the imports of the non-targeted products from the targeted countries declines insignificantly by 1% (the spillover effect). There is a large degree of heterogeneity in the consequences of the embargo among importing firms. Small firms have fewer resources available to mitigate shocks and as a result experience larger direct treatment effects and are not able to offset this negative impact by finding new partners among the non-targeted countries. One surprising finding is that medium size firms seem to have the ability to respond to the embargo by focusing on increasing their trade flows of the non-targeted goods rather than switching to new partners in the non-targeted countries. It could also be the case that medium firms are increasing their trade flows by absorbing the import flows of smaller firms that exit due to the lack of resources, or alternatively the shares of large firms that exit due to inability to switch quickly because of economies of scale.

Robustness checks

To ensure that no other exogenous shocks are causing the observed changes in bilateral trade, I conduct several robustness checks. First, I explicitly test for the concern that the first wave of sanctions might impact the extensive or intensive margin results. Second, for the intensive margin I conduct the placebo test by assigning placebo treatment to random subsamples of the data and re-estimating specification 3.16 to ensure that no other policies are driving my estimates.

TABLE 21.
Number of Firms: Pre-trends Analysis

	Benchmark (1)	Pre-trends (2)
Pre-Direct effect		0.013
		(0.036)
First wave Direct		0.006
		(0.070)
Direct effect	-0.504^{***}	-0.568^{***}
	(0.044)	(0.112)
Pre-Substitution		-0.066^{*}
		(0.036)
First wave Substitution		-0.107
		(0.084)
Substitution effect	0.109^{***}	0.026
	(0.020)	(0.070)
Pre-Spillover		0.079^{***}
		(0.006)
First wave Spillover		0.148^{***}
		(0.010)
Spillover effect	0.003	0.136^{***}
	(0.014)	(0.010)
Period FE	Yes	Yes
Country-product FE	Yes	Yes
Country-year FE	Yes	Yes
Product-year FE	Yes	Yes
Observations	3,946,873	3,946,873
R^2	0.962	0.963
Adjusted R^2	0.961	0.961

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at firm level. In this TableI conduct the robustness check by including the pre-trends (all periods up to March of 2014) for each of the three effects and dummies for first wave of sanctions (March through August of 2014) for each of the three effects of interest to ensure that the embargo is the only policy that had impact on the number of firms.

The results of the first robustness check are presented in Tables 21 and 22 for the extensive and intensive margins, respectively. To ensure that there are no significant pre-existing trends and that the first wave of sanctions does not impact the results, I include interaction terms between the dummy variable for the pre-trends, i.e., 12 months before the imposition of the first wave of sanctions (1 if the time period is between February 2013 and March 2014, and 0 otherwise) and all three effects of interest, as well as interaction terms between the indicator variable for the first wave of sanctions (which is equal to 1 from March to July of 2014 and 0 otherwise) and the three effects of interest. For both, intensive and extensive margin benchmark, I do not find a significant impact of pre-trends or the first wave of sanctions for the direct effect. Controlling for the pre-trends removes the significance of the substitution effect for the extensive margin results. Additionally, interesting dynamics are observed for the spillover effect at the extensive margin (column 2 of Table 21): there exits a pre-existing positive trend for the number of importers who import non-targeted products from the targeted countries. The pre-existing trend persists when I include a tighter set of fixed effects, which suggests that some uncontrolled variation is affecting the coefficients. However, even with varying sets of fixed effects I still find that the magnitude and significance of the main effect remain fairly constant.

TABLE 22.
Intensive Margin: Pre-trends Analysis

Dependent variable:	Level of trade		Log of trade	
	PPML		OLS	
	Benchmark	Pre-trends	Benchmark	Pre-trends
	(1)	(2)	(3)	(4)
Pre-Direct		-0.136		-0.033
		(0.106)		(0.075)
First wave Direct		0.006		0.11
		(0.104)		(0.074)
Direct effect	-0.143***	-0.248**	-0.274***	-0.262***
	[0.048]	(0.113)	[0.051]	(0.076)
Pre-Substitution		-0.217		-0.194**
		(0.169)		(0.092)
First wave Substitution		-0.087		-0.098
		(0.169)		(0.093)
Substitution effect	0.292***	0.106	0.148***	-0.011
	[0.029]	(0.166)	[0.020]	(0.092)
Pre-Spillover		-0.135		0.045
		(0.089)		(0.031)
First wave Spillover		-0.092		0.070**
		(0.088)		(0.031)
Spillover effect	-0.014	-0.139	-0.014***	0.038
	[0.025]	(0.091)	[0.004]	(0.031)
Period FE	Yes	Yes	Yes	Yes
Firm-country-product FE	Yes	Yes	Yes	Yes
Observations	18,868,702	18,868,702	18,868,557	18,868,557
R-squared			0.819	0.819
Number of firm-product-country gr.	2,495,869	2,495,869	2,495,869	2,495,870

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at firm-product-country level. In this TableI conduct the robustness check by including the pre-trends (all periods up to March of 2014) for each of the three effects and dummies for first wave of sanctions (March through August of 2014) for each of the three effects of interest to ensure that the embargo is the only policy that had impact on the intensive margin, and I am identifying the true effect of the embargo in my estimations.

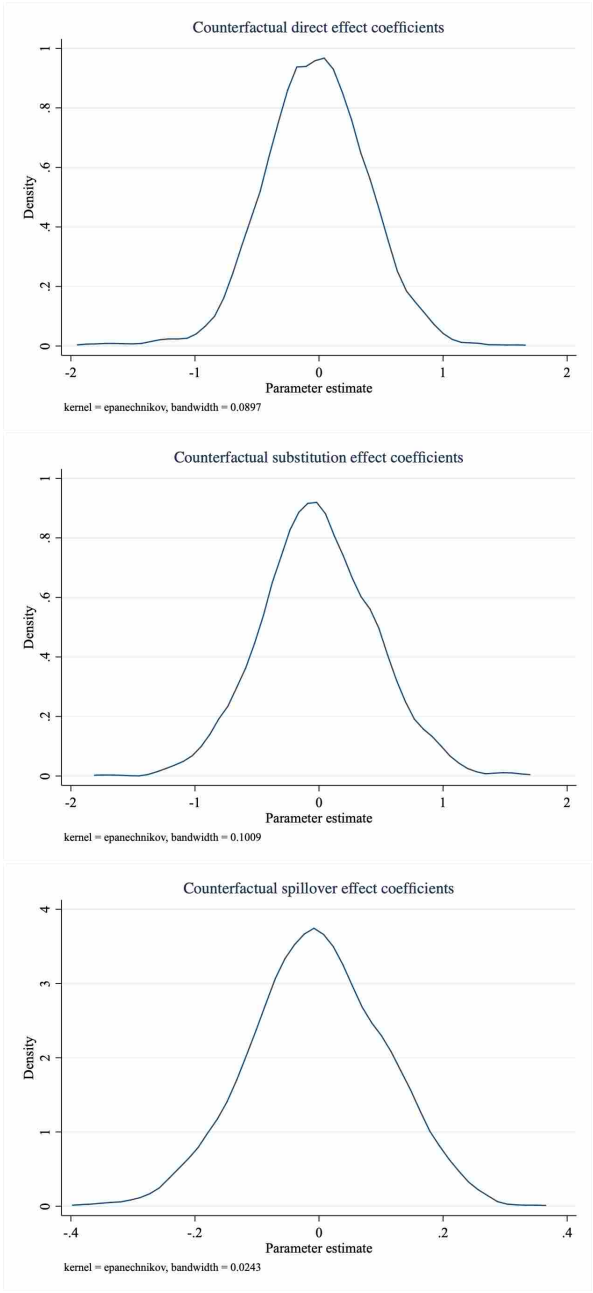
The second robustness check confirms these results. I truncate the sample in July 2014 and create 1000 random samples of 100,000 observations from

this truncated sample. I then estimate specification (3.16) for each of these 1000 samples. Finally, I plot the densities for each of the three coefficients of interest. These plots are presented in Figure 8. It is clear that all three effects are centered around zero with the means of 0.001 for the direct effect, 0.005 for the substitution effect, and 0.001 for the spillover effect, providing further evidence of the fact that the decline in a firm's average import flow of embargoed products from the sanctioning countries is due to the embargo, and not a different policy, implemented prior to the embargo.

Conclusion

In this study I estimate the impacts of the Russian retaliatory embargo, which was imposed in the aftermath of the Crimean conflict in 2014, on the Russian importers. The exogenous timing of the embargo presents an excellent opportunity to study the direct and indirect impacts of these non-tariff policies on firms in the targeted countries. I build a theoretical framework, which outlines firms' responses to the imposition of the retaliatory embargo. Using the framework I then derive three theoretical predictions about possible responses of the importers to the embargo, based on the type of products they import and the source countries of their imports prior to the embargo. Next, I utilize a novel micro level data set, sourced from the Russian customs, to test these predictions empirically.

FIGURE 8.
Intensive Margin Analysis: Placebo Test



Notes: The figure is created using the following methodology. The sample is truncated at July 2014 (one month prior to the imposition of the embargo). I then generate 1000 random samples of 100,000 observations from this truncated sample. Next, the intensive margin specification (16) is re-estimated for each of these 1000 samples. Finally, the densities of each of the three coefficients of interest are plotted. All three effects are centered around zero, providing evidence of the fact that the decline in a firm's average import flow of targeted products from the targeted countries is due to the embargo, and not a different policy, implemented prior to the embargo.

I find that the extensive margin, which is defined as a number of firms importing product k from a country j, experiences a significant negative impact after the embargo is imposed. The number of firms importing targeted goods from the targeted country decreases by 66 percent. This translates to about 23 firms discontinuing their imports of targeted products from the targeted countries after the embargo is imposed. This decline is driven by small firms discontinuing these imports, while the number of large firms experiences a smaller decline. Additionally, the number of importers that import targeted products from the non-targeted countries increases by 12 percent, i.e., about 4 additional firms begin to import targeted products from the non-targeted countries. These effects are driven by the large importers, confirming theoretical predictions that large firms are more productive and therefore, are less likely to discontinue the affected markets.

Conditional on a firm continuing to import targeted products from the targeted countries, the average import flow of targeted goods from the targeted countries decreases, while the average import flow of the targeted products from the non-targeted countries increases. By my estimation, an average firm loses 15,493 USD in its imports of targeted product from the targeted countries in a month. There is a large degree of heterogeneity in the consequences of the embargo for the firms of different sizes. Smaller firms experience larger losses due to the embargo and are not able to mitigate them by redirecting imports towards non-targeted countries, most likely because of insufficient resources to do that. All

of the theoretical predictions are confirmed by the empirical analysis, but some puzzles regarding the behavior of the medium sized importers at the intensive margin remain.

The main contribution of this study is the in-depth analysis of one type of non-tariff barriers on firms, which to my knowledge, is rare in the literature. I use the novel micro-level data set that allows me to uncover the firm level effects of such policies. These impacts could not be estimated with aggregate data. My results also lead to new avenues of research. Some of them include analysis of non-tariff trade barriers on a unique intersection of firms that both import and export, to determine how the embargo impacted the trade openness of these firms, and their ability to remain part of global supply chains. Additionally, geographic heterogeneity of the embargo's impact on firms can be explored.

CHAPTER IV

FIRM LEVEL TRADE EFFECTS OF WTO ACCESSION: EVIDENCE FROM RUSSIA

Introduction

The World Trade Organization (WTO) and its predecessor, the General Agreement on Tariffs and Trade (GATT), have been the pillars of our global trading system, continuously promoting market integration through the gradual removal of tariffs and other barriers to trade. Today, the WTO is undoubtedly the largest international trade agreement with over 160 member countries worldwide. Membership to the GATT/WTO guarantees not only market access benefits and a more predictable trade policy environment (e.g., the most favored nation (MFN) tariffs), but it also provides rules and procedures for settlements over disputes, regulations in the sphere of trade in services, or a framework for intellectual property rights protection. These benefits of trade liberalization have motivated most countries around the world to seek accession to the WTO.

Because of this general belief that GATT/WTO provides important trade gains to its member countries, Rose (2004)'s seminal paper that questions such a belief has stirred a lot of attention and interest in the empirical trade literature. The failure to identify empirically any positive benefits of WTO membership on international trade flows has raised questions about the data sample and

estimation strategy. Yet more than fifteen years later, after substantial empirical research on this topic, there still isn't a consensus in the literature about the role of WTO membership in promoting international trade.

This paper aims to contribute to this on-going debate by bringing micro-level evidence from the experience of Russian importers and exporters following the country's 2012 accession to the WTO. Using customs level data on all international transactions over the period 2011-2015, we investigate the ways in which trading firms in Russia responded to this significant trade policy change. We examine several dimensions of firm-level trade that may be directly impacted by the WTO, and are particularly interested in capturing any short-run changes along the intensive and extensive margins. Following the work of Handley and Limao (2017), we hypothesize that Russia's accession to the WTO has the potential to decrease the trade policy uncertainty surrounding Russia's trade partners. This decrease in uncertainty can manifest through an increase in the number of importing and exporting firms, an increase in the frequency of trade shipments, and possibly an increase in the average trade flow per firm and product-country pair. Furthermore, accession to the WTO also provides Russian trading firms easier access to new markets along both the product and partner country dimensions as a result to reduced barriers to trade. This paper undertakes all of these empirical exercises in order to provide micro-level evidence on the main effects of WTO accession.

To the best of our knowledge, we are among the first to bring firm level evidence on the trade effects of WTO membership. We attribute this gap in the literature to the fact that micro-level datasets have become increasingly available only in recent years while many countries around the world joined the GATT/WTO several decades back. There are only a few countries with prominent presence on global markets whose WTO accession happened in recent years. Along with China, Russia is one such country.

Using Russia's accession to the WTO as a case study has its benefits and limitations. A key advantage is the fact that international trade is an important component of Russia's economy, accounting for 24 percent of its GDP in 2017. Worldwide, Russia ranks 14^{th} in exports of merchandise and 22^{nd} in imports of merchandise for year 2018. This is suggestive of the extent to which Russian firms participate in cross-border transactions and are likely to be affected by the country's WTO accession. However, a limitation in working with data for a single country is that the findings of the econometric analysis may be specific to that event. After all, Russia's accession to the WTO was an unusually long process. While it applied to the GATT in 1993, it only joined the GATT/WTO in 2012 after 19 years of (intermittent) negotiations. It is interesting to ask why it took so long for Russia to join the WTO. One explanation could be that, in line with the findings in Rose (2004), countries are not expecting large benefits from the WTO membership. On the other hand, the increase in foreign competition caused by

trade liberalization may potentially inhibit politically-motivated governments from pursuing the WTO membership more actively.[1] Another complication in assessing the trade effects of Russia's WTO accession is that not too long after becoming a WTO member, Russia became the target of economic sanctions to which it retaliated by imposing a food trade embargo. While only a small share of Russia's trade is the subject of these trade disputes, the time proximity of the two trade policy events requires additional attention in correctly specifying the econometric model and in identifying the firm level trade effects of WTO membership.

Using a difference in differences estimation strategy applied to a firm-level regression model of international trade, we find evidence of strong positive trade effects along the partner-country margins for both exporting and importing firms and along the product margin for the importers. For example, the importers import 8.6% on average more HS 8-level products after the accession to the WTO, while for the exporters the increase of 5% in the average number of partner countries is significant. We also find some evidence of an increase in the number of exporting firms in the market after the WTO accession, and an increase in the frequency of import shipments for importers by about 6%. Finally we also explore the connection between the two foreign trade policies, WTO accession and embargo, which push trade in two different directions. We find some evidence of disproportionate positive impacts of WTO on agricultural imports, such as a

[1] Åslund (2010) provides an excellent description of the history of Russia's accession to the WTO, its goals and hopes for the accession. He explains that one of the main reasons behind its slow accession are the strong lobbying interests of certain exporting industries (aluminium).

significant increase in the frequency of imports, increase in the average number of products imported, and a significant increase in the average firm-product-country import flow. These findings could serve as evidence that the embargo was intended as a protectionist policy and targeted a very specific sector whose imports benefitted significantly from the WTO accession (agriculture) in order to help the vulnerable domestic industry. Because protectionist policies are against WTO provisions, the embargo was a convenient way to kill two birds with one stone - retaliate against the economic sanctions and protect domestic agricultural production.

Our findings contribute to several literatures. First of all, they contribute to the substantial work on the trade effects of WTO membership. Most of this literature follows the seminal work of Rose (2004) and consists of cross-country studies investigating the long-term effects of WTO participation. Some subsequent studies confirm Rose (2004)'s findings of no effect of GATT/WTO membership on bilateral trade flows even after refining the estimation strategy following the latest developments in gravity equation estimations (e.g., Eicher and Henn (2011), Esteve-Perez et al. (2019)). Others found positive effects of WTO membership on total bilateral trade flows once the treatment group was redefined to include *de facto* WTO members (Tomz et al., 2007), or once country heterogeneity based on level of development was directly accounted for (Subramanian and Wei, 2007). Other studies attempted to reconcile Rose (2004)'s results by decomposing the

aggregate WTO trade effects along the extensive and intensive margins of trade (Liu (2009), Dutt et al. (2013)). Our findings are in line with the aggregate results in the literature in that, like Dutt et al. (2013), we find a strong effect of WTO membership on the extensive margin but not much of an effect on the intensive margin, and like Liu (2009), we find that these effects are robust to departing from the traditional Ordinary Least Squares (OLS) estimation method and instead using the Pseudo-Poison Maximum Likelihood (PPML) method.

A second strand of literature that closely relates to our study investigates the effect of WTO accession on various firm- or industry-level economic outcomes other than international trade patterns. Most of these studies exploit China's 2002 accession to the WTO as a major trade liberalization shock. Brandt et al. (2017) examine the impact that China's WTO accession had on firm-level productivity and price mark-ups. Baccini et al. (2017) use the experience of Vietnam's accession to the WTO in 2007 to investigate whether state-owned enterprises (SOEs) respond differentially to trade liberalization compared to privately owned firms, focusing on market entry and exit rates, access to capital, as well as changes in productivity and in profitability. Handley and Limao (2017) examine the impact of trade policy uncertainty on industry-level trade by treating China's accession to the WTO not only as a tariff liberalization event but also a policy that significantly reduced the U.S. threat of a trade war with China. Handley and Limao (2017) show that this reduction in trade policy uncertainty explains a

significant fraction of China's export growth to the U.S. While not directly related in scope, our paper relates to all these studies by analyzing the WTO accession of a country that carries sufficient similarities to the experience of China.

Lastly, our work relates to existing research evaluating the effects of the WTO on the Russian economy. While we are not the first to ever examine Russia's accession experience, most of the existing studies are either descriptive in nature or employ a computable general equilibrium (CGE) framework.[2]

The remainder of the paper proceed as follows. In the next section we describe in more detail Russia's process of accession to the WTO and provide some preliminary descriptive statistics. Section 4.3 presents the estimation strategy and discusses model identification. Section 4.4 describes the main data sources and the construction of the estimation sample. The estimation results are discussed in section 4.5 together with the robustness checks implemented to further validate our findings. Finally, section 4.6 concludes.

[2]For example, Chowdhury (2004) concentrates on the analysis of the negotiations, and emphasizes that some of the serious barriers to Russia's membership in WTO is the presence of heavy subsidization in several sectors of the economy, lack of liberalization and intellectual property rights. Connolly and Hanson (2012) and Tochitskaya (2012) describe the commitments Russia undertook when it decided to join WTO, including the tariff schedules, foreign investment, and non-tariff barriers. Lissovolik and Lissovolik (2006) attempt to estimate whether Russia's "WTO outsider" status had an impact on its exports. They show that Russia's export structure was skewed significantly away from WTO members in the pre-accession period 1995-2002. Jensen et al. (2004) and Rutherford et al. (2005) utilize a CGE model to estimate the impact of Russia's accession to the WTO on a host of economic characteristics. The largest gains are predicted to come from the liberalization of barriers against multinational service providers. Babetskaia-Kukharchuk and Maurel (2004) investigate the impact of institutions on trade and estimates the potential for an increase in trade between the Commonwealth of Independent States (CIS) and the European Union (EU). They then use these estimates to back out the potential benefits of joining the WTO.

Policy Background: Russia's WTO Accession

Process and Timeline

Russian Federation applied to the GATT in 1993, however it only managed to joined the GATT/WTO on August 22, 2012 after 19 years of negotiations. The negotiations were not continuous throughout this period though, with the longest break in the negotiation process taking place from 2006 to 2011 when President Putin announced Russia's accession to the WTO as one of the main goals of his upcoming presidency. There are several reasons for significant delays in Russia's accession process. Among the most important reasons is the fact that when Russia initially applied to the WTO, its economy had a different structure from the decentralized market economies of the existing GATT/WTO members. After the USSR fell apart, Russia went through a host of socio-economic, legislative, and political reforms, which left the financial and fiscal systems in disarray for a long time. The absence of rigorous structure and regulation of many aspects of the economy led a number of WTO members to doubt Russia's ability to fulfill its obligations as a WTO member (Chowdhury, 2004).

Another major reason for the delays in Russia's WTO negotiations process has been the strong lobbying interests of certain exporting industries such as auto and airplane production, agricultural production, and services. The auto and airplane industries typically exploited the infant industry protection argument - i.e., the increased need of protection for certain industries that are more prone

to be displaced by competition in the short run but capable of upgrading in the medium-to-long run. The agricultural industry in Russia, similar to the situation of other countries, generally struggled with WTO's restrictions because of state subsidies to the sector and fear of competition. The service sector lobbied against intellectual property rights and the issue of foreign ownership in telecommunications, insurance, and banking industries (Åslund (2010)). Unfortunately, even after joining the WTO, Russia remains reluctant to fully embrace trade liberalization and relies heavily on non-tariff barriers to trade: in 2018 there were 225 non-tariff measures in force. The most notorious measure is the retaliatory embargo which Russia imposed on a set of 48 agricultural products (defined at HS-4 level) in response to the sanctions that 38 countries imposed on Russia after its invasion in Crimea.

Among the commitments Russia undertook when joining the WTO is the augmentation of the tariff schedule, liberalization of services, including telecommunications, insurance companies and banks, elimination of quotas that are unjustified under WTO provisions, elimination of industrial subsidy programs, and enforcements of the intellectual property rights. Tariffs on more than one third of national tariff lines had to be reduced immediately after Russia's accession to the WTO. The rest of the tariff cuts were scheduled to be implemented gradually over a three year period (Tochitskaya (2012)). These changes, however, do not apply to the sectors that Russia deemed "most vulnerable", for which a transition

period of 7 to 8 years was negotiated. These industries include agriculture, automotive and civil aircraft industries (Tochitskaya (2012)).

Summary Statistics

International trade is a very important component of Russia's GDP: in 2017, trade accounted for 24 percent of Russian GDP. Russia accounts for about 2 percent of the world trade. Russia is ranked 16th in exports of merchandise and 20th in imports of merchandise; as for the trade in services, Russia takes 26th place worldwide in exports of services and 16th in imports of services. Among the top Russian imports are fruits, pharmaceuticals, broadcasting equipment, planes and helicopters, and motor transport for personal transportation. As for the exports, Russia was the third largest producer and exporter of oil and natural gas in the world in 2019. Other top exports are wheat and coal. In terms of trade value, Russia's five top export destinations are China, Netherlands, Germany, Belarus, and the United States. Five top import origins are Germany, Belarus, the United States, Italy, and China.

One of the main steps of the WTO accession is the augmentation of the country's tariff schedule. According to the WTO provisions, all WTO member countries apply the Most Favored Nation (MFN) tariff to each other. Prior to the accession to the WTO, Russia's average bound tariff for all products was 10%, for agricultural products 13.2%, and for manufactured goods 9.5%. According to the negotiated agreement, the average bound tariff for all products must decrease

to 7.8% by 2017, and for the manufactured products to 7.3%. Agricultural tariffs must be decreased to 10.8% by 2021. In 2018, the simple average final bound tariff for Russia was 7.6%, 7.1% for the manufactured goods, and 11.2% for agricultural products. Products that receive the highest import tariffs are animal products (23.2 percent on average) and beverages and tobacco (23.3 percent). Products with the lowest tariffs are petroleum (5.0 percent) and chemicals (5.2 percent).[3]

FIGURE 9.
Evolution of Russia's Average MFN Tariffs over 2011-2015

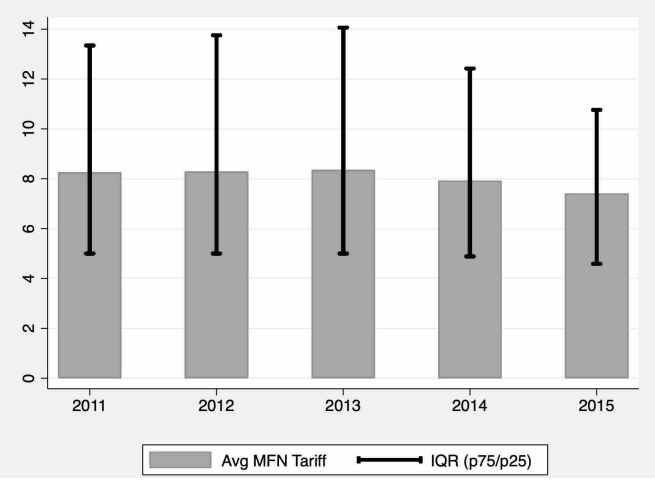


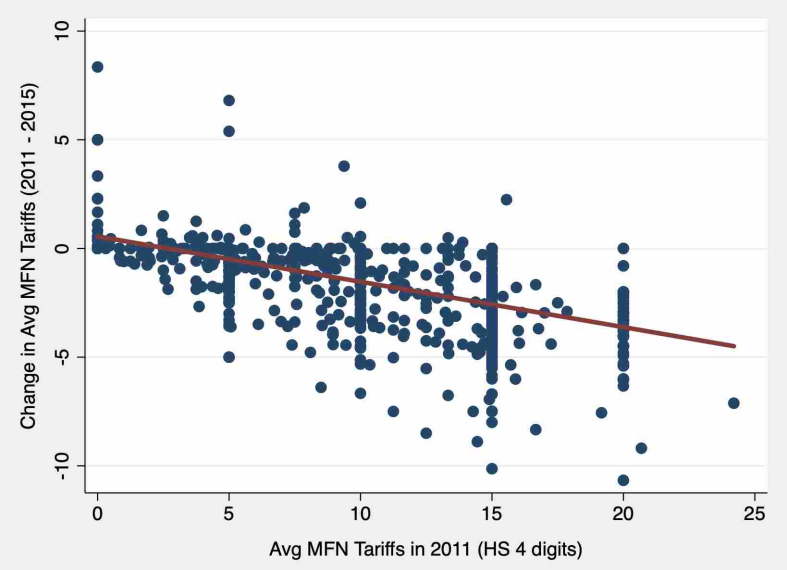
Figure 9 uses information collected by the WTO on Russia's ad-valorem MFN tariffs. The grey bars correspond to the (unweighted) average MFN tariff computed across all HS 4-digit products codes. The overlapping dark lines indicate the inter-quartile range (IQR) of ad-valorem MFN tariffs over all HS 4-digit product codes. The figure confirms our earlier claim about the modest change in

[3]Information from the WTO Russian Federation member profile. The averages do not include zero tariff lines.

average MFN tariffs in the first three years following Russia's WTO accession. It also illustrates that the tariff liberalization efforts were focused particularly on the sectors with the highest import tariffs (as suggested by the fall in the IQR post-accession).

Figure 10 provides a better illustration of the change in Russia's average MNF tariffs at the HS 4-digit product level over the period 2011-2015. The scatterplot correlates the tariff changes to the initial tariff level in the year prior to Russia's WTO accession. The downward sloping fitted line indicates that the industries (i.e., HS 4-digit products) with the highest tariffs prior to WTO accession are the industries experiencing the largest drops in tariffs in the first three years post-accession.

FIGURE 10.
Correlation Between Initial MFN Tariffs and the Change in MFN Tariffs During 2011-2015



Because we are interested in the impact of the WTO membership on the dynamics of Russian firms that engage in international trade, we next provide a brief overview of the firms' international trade performance. To conduct this study, we use a novel data sourced from the Russian Customs Agency[4]. The data set provides detailed information on all Russian exporter and importer firms' monthly trade flows by partner-country and HS-8 level product code. The full sample of importing firms contains 21 million observations, while the exporting firms' sample consists of approximately 2.5 million observations.The data span the time period from January 2011 to December 2015.

Prior to Russia's accession to the WTO in 2012, there are 20,225 exporting firms and 62,616 importing firms. One year after Russia joins WTO, in 2013, the number of exporters increases to 21,005 and the number of importers increases to 69,314. Figure 11 demonstrates the seasonally adjusted dynamic in the number of Russian firms engaged in foreign trade. The number of exporters exhibits a clear upward trend after Russia joined the WTO (first vertical line on the plot). The plot presents some evidence that more exporters were present in the market after Russia joined WTO due to the opening of new markets for the domestic firms and exporters. We observe a steady increase in the number of importers prior to the WTO accession, which continues for some time after August 2012. However, after that the number of importers stabilizes and, finally, it decreases

[4]The data set is acquired through the Russian analytical agency VedStat, `http://www.ved-stat.ru`.

after the retaliatory embargo is imposed in August of 2014. The stabilization and the decline in the number of importers prior to the embargo could be due to the macroeconomic shocks that hit Russian economy after the significant drop in oil prices in the end of 2013 - beginning of 2014.

To complement Figure 11, we also plot the firm entry into foreign trade. We separate firms into purely exporters, purely importers, and firms that both import and export. We then plot the number of firms in each category that begin their operations before Russia joins WTO and after Russia's accession. This information is presented in Figure 12. The number of firms is weighted by firm size, and the time period ends in February 2014, one month prior to the imposition of economic sanctions on Russia after its invasion of Crimea. The entry rate for the importing firms after Russia joins the WTO is higher than for the exporters. Typically, importing involves lower costs, which could explain partly why there are initially more importers than exporters. However, the number of exporters that begin to export after Russia joins WTO is a little higher than the number of exporters that begin to export prior to the accession. This could be explained by the fact that accession to the WTO opens new markets abroad for domestic producers stimulating export entry, while importers suffer from increased foreign competition, which leads to a decline in the number of firms that import.

FIGURE 11.
Number of firms engaged in foreign trade over time

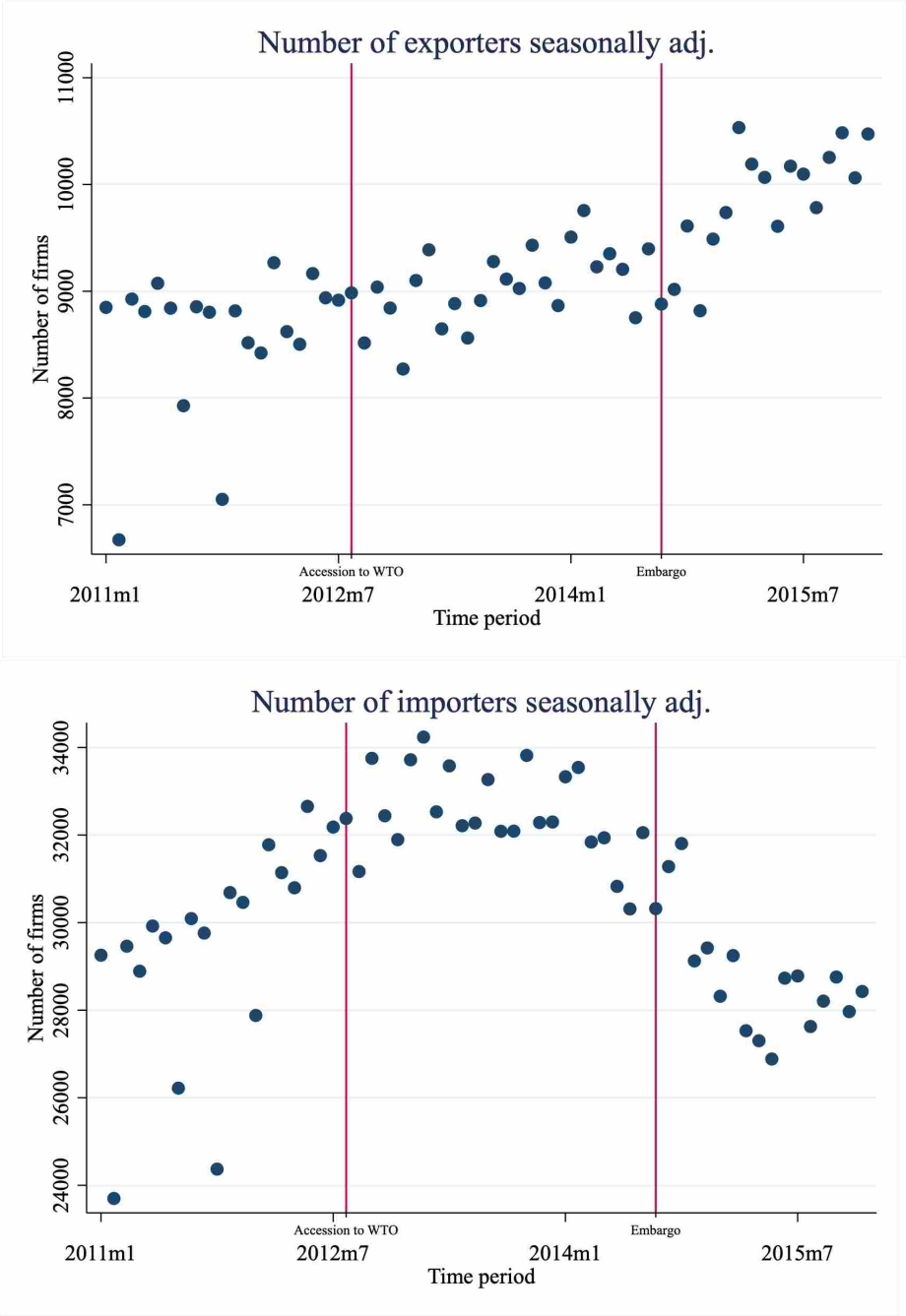
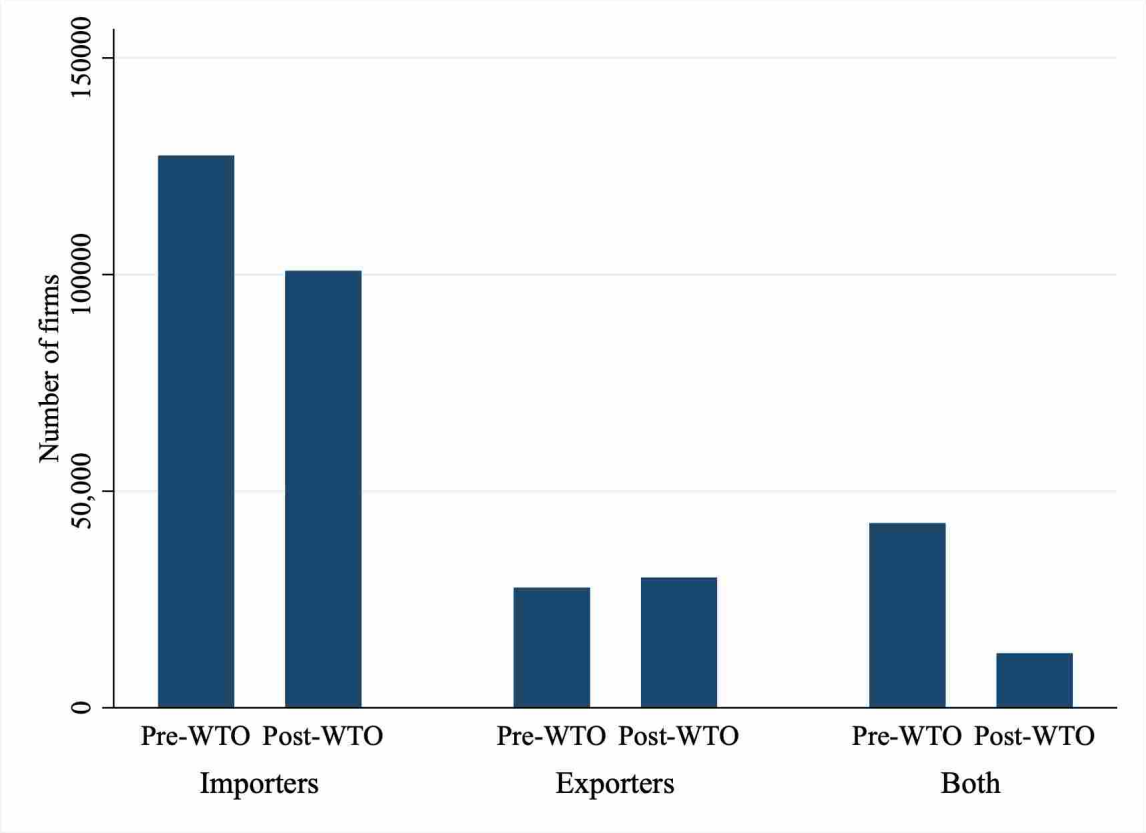


FIGURE 12.
Number of Firms to Begin Foreign Trade



Lastly, we provide some information on within-firm dynamics. We calculate summary statistics on some characteristics of foreign trade and present them in Table 23. We compare the value of each firm characteristic one year before Russia's accession to the WTO (i.e., year 2011) to the value one year after Russia joins WTO (i.e., year 2013). Trade frequency, which we define as the number of periods within 6 months intervals when a firm has at least one positive trade flow, be it exports or imports, increases for both importing and exporting firms. On average, firms import (export) about 2.6 (2.37) times every six months prior to

the accession. After Russia joins WTO, these values increase to 2.77 for imports and 2.54 for exports. Additionally, WTO positively affects the average number of products traded for both importers and exporters and the average number of partner countries to which an average firm exports. An average firm's import flow is significantly lower than an average export flow. This could be explained by a significantly larger number of firms that participate in imports compared to exporting firms. The average value of imports declines after Russia joins WTO, due to a decrease in both the quantity of imports (i.e., the average weight of an import shipment) and in unit values. The average exporting firm, on the other hand, increases the value of its trade flow from 736,159 USD in 2011 to 882,148 USD in 2013. This increase can be attributed to a large, five-fold increase in a firm's average unit value.

TABLE 23.
Summary Statistics

	IMPORTS		EXPORTS	
Variable	2011	2013	2011	2013
Avg value of a trade flow*	68,174.78	62,096.48	736,158.7	882,147.5
	(1218553)	(870131.9)	(1.67e+07)	(1.94e+07)
Avg weight of a trade flow*	25,602.27	23,470.23	1,352,433	1,307,704
	(792872.9)	(784849.6)	(3.41e+07)	(2.67e+07)
Avg unit value of a trade flow*	1,642.98	1,485.48	69,643.55	377,400.3
	(996491.5)	(383572)	(1.87e+07)	(8.19e+07)
Trade frequency	2.60	2.77	2.37	2.54
	(1.75)	(1.86)	(1.67)	(1.81)
Avg number of products traded**	7.76	7.97	3.10	3.13
	(22.60)	(22.60)	(8.28)	(7.29)
Avg number of partner countries	1.09	1.09	1.29	1.31
	(0.39)	(0.41)	(0.99)	(1.10)

Notes: Standard deviations in parentheses.
* Calculated at HS-8 level product-country.
** HS-8 level products traded with one country.

Estimation Strategy

This section describes the estimating equations for the firm-level extensive and intensive margins, as well as for the frequency of trade shipments. Our micro-level dataset includes information on monthly import and export transactions by firm, (HS 8-digit) product and foreign country. This allows us to define the extensive margin in multiple ways, such as, the number of products traded by a firm, or the number of products traded by a firm in a given foreign market, or the number of countries that a firm trades with, or the number of countries that a firm trades a particular product. The intensive margin is defined as the value of a trade transaction for a given product carried out by a firm in a given foreign market. Similarly, the frequency of trade shipments is defined at the firm-product-country

level as the number of months within a six-month period that a firm registers positive trade flows.

Our methodological approach to evaluate the response of Russian firms along all these different margins following the country's WTO accession boils down to a difference-in-differences estimation strategy. In presenting the estimating equations, we will also discuss the preferred estimation method and any model identification issues.

Firm-Level Extensive Margins

Russia joined WTO in August 2012, so any trade transaction after this date takes place under the new trade policy regime. To evaluate whether Russian firms have changed their behavior post-WTO accession, we construct a treatment variable as an interaction term between the month-year periods post August 2012 and the WTO membership status of a foreign country j, i.e., $Post0812_t \times WTOmember_j$. This will become our variable of interest. The estimated coefficient will capture the extent to which Russian firms change their trade patterns in relation to WTO member countries in the post-accession month-year periods relative to the pre-accession periods (i.e., treatment group) compared to any changes in relation to non-WTO member countries over the same periods (i.e., control group).

Starting with the product extensive margin, the difference-in-differences estimation equation that we propose takes the following form:

$$\begin{aligned} Prod_{fjst} = \alpha_{fjs} + \alpha_t + \beta Post0812_t \times WTOmember_{jt} \\ + X_{jt}{}'\gamma + \delta Embargo_s \times Target_{jt} + \epsilon_{fjst} \end{aligned} \tag{4.1}$$

where f, j, s and t index the firm, foreign country, sector group and month-year period, respectively. The sector group s separates the set of HS 4-digit industries that are subject to the retaliatory embargo from the rest of the traded goods. So, $Prod_{fjst}$ denotes the number of HS 8-digit products within group s that are traded by firm f with country j at time t. The vector X_{jt} captures a set of time-varying country characteristics that influence trade patterns, such as the GDP level, the existence of free trade agreements (FTA) in effect with Russia and the exchange rate.[5] $Embargo_s$ equals 1 for the group of HS 4-digit industry codes that are embargoed starting from August 2014, while $Target_{jt}$ equals 1 if foreign country j imposed economic sanctions on Russia in period t. α_t and α_{fjs} denote month-year, respectively firm-country-sector group fixed effects.

We estimate equation (4.1) using Pseudo-Poisson Maximum Likelihood (PPML) with high dimensional fixed effects (Santos Silva and Tenreyro (2006)) and cluster the standard errors at the firm-country (fj) level (in the robustness section we discuss OLS results as well). We carry out the analysis separately for export and import transactions.

The coefficient of interest is the difference-in-difference estimator β. A key identifying assumption in this type of estimation method is that, conditional on the set of control variables, the trend of the product extensive margin would have followed the same trajectory for the average firm in the sample as that of the control group (i.e., the group of countries that are no part of the WTO). Another important condition that is necessary in order to ensure an unbiased estimate of β

[5]Since our treatment variable of interest varies by country, month and year, we cannot control for foreign country characteristics using standard country-time fixed effects. So, we are forced to include in the estimation equation as many observable time-varying country characteristics as possible. For variables that are available only annually (e.g., GDP level), we divide the GDP by 4 to get the average quarterly GDP. For dummy variables that are available annually (e.g., FTA status), we use these variables as is.

is the exogenous timing of Russia's WTO accession such that no firm would alter their trade behavior prior to August 2012. We assume the latter condition is likely to hold given the lengthy and unpredictable behavior of the Russian government in matters of foreign policy. To ensure the first condition, i.e., the parallel trends assumption, we are particularly careful about the interplay between two of Russia's trade policy decisions: the WTO accession and the retaliatory embargo imposed two years later. Since all countries imposing economic sanctions on Russia are WTO members, bilateral trade with these countries may decrease in the post-WTO period for reasons that are not a direct consequence of Russia's accession to the WTO. This decrease is most likely to happen in product categories in which Russia has imposed a retaliatory embargo against the sanctioning countries. For these reasons, it is important that we control in our regression estimations for the subset of sanctioning countries (i.e., $Target$ countries) as well as the interaction between these countries and the set of HS 4-digit embargoed goods.

In our analysis, we experiment with variations of equation (4.1) by aggregating the model across the two sector groups to estimate the changes induced by the WTO accession across all HS-8 product categories traded by firm f with country j. We further aggregate the estimation equation across all countries that are WTO members in period t versus the group of non-WTO countries to estimate the change in the number of products traded by a given firm f across the entire set of WTO members versus non-WTO members. As we will show in the results section, there are no qualitative differences between the different aggregation levels of equation (4.1).

Next we estimate the country extensive margin using the following difference-in-difference specification:

$$Country_{fmkt} = \alpha_{fmk} + \alpha_t + \beta Post0812_t \times WTOmember_{mt} + X_{mt}'\gamma + \delta Embargo_k \times Target_{mt} + \epsilon_{fmkt} \quad (4.2)$$

where f, m, k and t stand for firm, country group, HS 8-digit sector and month-year time period, respectively. The country group m denotes four sets of countries: WTO member countries that later impose sanctions on Russia, WTO member countries that do not impose sanctions on Russia, non-WTO member countries that impose sanctions on Russia as well as non-WTO member countries that do not impose sanctions on Russia. Thus, $Country_{fmkt}$ denotes the number of foreign countries within a given country group m that firm f trades with in product k and time period t. $WTOmember_{mt}$ is equal to 1 if country group m consists of WTO members, and 0 otherwise. $Target_{mt}$ equals 1 if country group m consists of countries that impose economic sanctions on Russia following the invasion of Crimea (a subset of WTO member countries). Finally, the vector X_{mt} controls for a set of time-varying macroeconomic variables that characterize country group m.

As with the product margin case, we experiment with different levels of sample aggregation to estimate versions of equation (4.2). In particular, we aggregate the data across country groups m and keep only the distinction between WTO members versus non-members to ask whether trade transactions in a given product category are more likely with WTO member countries irrespective of whether these countries are sanctioning or non-sanctioning countries. We then further aggregate the sample across all products k traded by a given firm to see whether post WTO-accession the firm is more likely to enter new foreign markets

(where it has no experience trading any product) which are WTO members as opposed to non-WTO members.

Firm-Level Intensive Margin

Firm-level intensive margin refers to an average import and export flow within firm-product-country groups. Additionally, we also estimate the impact of the WTO on the weight and unit value of an average trade flow.

$$Trade_{fjkt} = \alpha_{fjk} + \alpha_t + \beta Post0812_t \times WTOmember_{jt} + X_{jt}'\gamma + \delta Embargo_k \times Target_{jt} + \epsilon_{fjkt} \quad (4.3)$$

where f, j, k and t stand for firm, foreign country, HS 8-digit product and month-year time period, respectively. Thus, $Trade_{fjkt}$ represents average value of a trade flow in HS 8-digit product k firm f exports (imports) to (from) country j during period t. Similarly to equation (4.1), the variable of interest that captures the effect of Russia's accession to the WTO on the intensive margin is represented by the interaction term $Post0812_t \times WTOmember_{jt}$. We also control for the impacts of the retaliatory embargo by including the interaction term between the indicator variable that separates a set of embargoed HS 8-digit product codes from the non-embargoed products ($Embargo_k$) and the control for the countries that sanctioned Russia in period t ($Target_{jt}$): $Embargo_k \times Target_{jt}$. Finally, the vector X_{jt} contains a set of time-varying country characteristics that have been shown to impact trade patterns. The variables we include are distance between countries weighted by population, dummy for the presence of FTA or RTA between Russia

and the foreign country j, dummy for common border, dummy for common language, dummy for common religion, and GDP of the foreign partner.

We complement our analysis of an average value of export and import flows by analyzing the impact of the WTO accession on the average weight and unit value of the export and import flow. The unit value is calculated by dividing the value of the firm - product - country trade flow in a given period of time by the weight of this flow in the same time period.

Firm-Level Frequency of Trade Transactions

We also investigate the frequency at which Russian firms engage in international transactions. Following the work of Handley and Limao (2017) on trade policy uncertainty that can be mitigated by the WTO accession, we hypothesize that one additional channel in which Russian firms may respond to the reduction in trade uncertainty is by trading more often. This would be the case if trade policy uncertainty manifests itself as a fixed cost per shipment in the eyes of trading firms. To test this hypothesis, we estimate a similar regression model as before given by the following equation:

$$\begin{aligned} Freq_{fjkh} = \alpha_{fjk} + \alpha_h + \beta Post0812_h \times WTOmember_{jh} \\ + X_{jh}{}'\gamma + \delta Embargo_k \times Target_{jh} + \epsilon_{fjkh} \end{aligned} \tag{4.4}$$

where f, j, k and h index the firm, foreign country, HS 8-digit sectors code and a half-year time period. The dependent variable $Freq_{fjkh}$ captures the number of months within a six-month period h during which firm f trades with foreign

country j in a given product k.[6] All the other variables and fixed effects are defined as before.

Similarly to our analysis of product and country margins we experiment with variations of equation (4.4) by aggregating the model across all HS 8-level products to estimate the changes induced by the WTO to the frequency of trade of firm f with country j across all products. We further aggregate the estimation equation across all countries to estimate the change in foreign trade frequency of a given firm f across the entire set of WTO members versus non-WTO members in time period t. As we will show in the results section, there are no qualitative differences between the different aggregation levels of equation (4.4).

Data

To estimate the regression models described above, we use several data sources, including the firm level trade data sourced from the Russian Customs Agency, CEPII Gravity, and World Bank Global Economic Monitor databases. The novel dataset provides detailed information on all Russian exporter and importer firms' monthly trade flows by partner-country and HS 8-digit product code. The data span the time period from January 2011 to December 2015.

The CEPII (Centre d'Etudes Prospectives et d'Informations Internationales) Gravity database provides information on the country-time specific macroeconomic controls such as geographic distance between Russia and its trading partners, common language and border, regional and free trade agreements, and other controls typically used as regressors in the gravity equation. Time-specific

[6]We estimate the trade frequency regression over six-month time periods because of the short length of our panel dataset spanning 2011-2015. In unreported results we have also experimented with year-long time periods over which trade frequency is defined and the results are qualitatively similar.

macroeconomic controls such as oil price and USD to ruble exchange rate are sourced from St. Louis FRED and Investing.com[7], respectively. Finally, the GDP data for Russia and for foreign countries are taken from the World Bank Global Economic Monitor database, and are recorded on a yearly basis.

After combining all these data sources, we obtain a panel dataset of Russian firms' import and export transactions by country, by HS 8-digit product, by month and year of transaction. The import sample contains 21 million observations, while the exports sample has about 2.5 million observations. There is a total of 214 exports destinations for the Russian exporting firms, 163 of which are WTO members. Prior to the WTO accession Russian exporters export to 147 WTO member countries, while after the accession this number increases to 162. There are 211 foreign countries that import from Russia, 159 of which are WTO members. Prior to the WTO accession, Russian firms import from 148 WTO member countries, while after the accession this number increases to 153.

When estimating the product margin of exporting and importing firms we collapse the sample across all products by counting the number of unique HS 8-digit product codes within partner country - firm pairs each month-year time period. For the country margin analysis, we collapse the dataset by the foreign country WTO membership and count the number of unique partner countries each firm trades with in a particular HS 8-digit product code each month-year time period. When we analyze the intensive margin of firm - level trade, we look within the firm and utilize the sample in its original form with each observation providing information on the value and weight of the firm - foreign country - HS 8-digit product code trade flow.

[7] `https://www.investing.com/currencies/usd-rub-historical-data`

Estimation Results

Product Margin

We begin our analysis by investigating the impact of Russia's accession to the WTO on the product margin of exporting and importing firms. We define the product margin as the number of unique HS-8 codes a firm exports or imports in a period of time. It is likely that the accession to the WTO opened more markets for the Russian exporters and importers due to the decline tariffs, decline in trade uncertainty, and increase in the variety of products available for imports. This would encourage both importers and exporters to trade more products. We use equation (4.1) to estimate the effect of the WTO on the product margin. The results of these estimations are presented in Table 24. The benchmark specification used for the product margin is Pseudo-Poisson Maximum Likelihood (PPML) due to the count nature of the dependent variable. OLS results are presented in the robustness checks section for comparison.

Each column of Table 24 presents a different variation of equation (4.1). Columns 3 and 6 present the results of estimation of the most disaggregated version of equation (4.1). The dependent variable in columns 3 and 6 is the number of unique HS 8-digit products separated by their embargo status s a firm f trades with each foreign country j. Columns 2 and 5 aggregates the model across the two sector groups to estimate the changes induced by the WTO accession across all HS-8 product categories traded by firm f with a country j. Columns 1 and 4 further aggregate the estimation equation across all countries that are WTO members versus the group of non-WTO countries. The dependent variable is a number of unique HS-8 level products firm f imports (exports) from (to) *all*

WTO member countries and all non-WTO partner countries in a given time period t, i.e., the level of aggregation of the dependent variable is the WTO-membership.

From Table 24 we can see that the exported number of HS 8- level products decreases, although this effect is statistically not different from zero. Controlling for the effects of the embargo does not alter the effect of interest, which leads us to the conclusion that the product margin of the exporting firms is not impacted by the accession to the WTO. This could be the result of an increased competition from foreign firms which typically follows trade liberalization episodes. Standard prediction of a Melitz model is that less efficient firms are forced out of the markets, while the more efficient exporters continue to export, but limit their efforts to a smaller set of products.

The opposite effect is observed for importers: average number of HS-8 level products imported from country j increases by 8.6%. Controlling for the embargo does not change the coefficient of interest. This finding could serve as evidence of increased access to foreign markets, and a decrease in importing tariffs, which would allow firms to begin importing additional products. Finally, consumers prefer variety and importing firms could be attempting to capitalize on this behavior.

TABLE 24.
Product Margin

	EXPORTS			IMPORTS		
	(1)	(2)	(3)	(4)	(5)	(6)
$Post0812_t \times WTOmember_{jt}$	-0.056	-0.010	-0.008	0.100***	0.085**	0.086**
	[0.045]	[0.023]	[0.022]	[0.034]	[0.034]	[0.034]
$Embargo_s \times Target_{jt}$			-0.084***			-0.345***
			[0.025]			[0.040]
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm - WTO membership FE	Yes	No	No	Yes	No	No
Firm-country FE	No	Yes	No	No	Yes	No
Firm-country-product type FE	No	No	Yes	No	No	Yes
Time macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Country-time macro controls	No	Yes	Yes	No	Yes	Yes
Observations	145,718	782,491	800,780	1,331,375	2,590,748	2,648,460
No. firm-WTO membership gr.	11,765			65,820		
No. firm-country gr.		75,378			213,985	
No. firm-country-product type gr.			77,326			220,644
Standard error clustering	Firm	Firm-country	Firm-country	Firm	Firm-country	Firm-country

Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is the Pseudo-Poisson Maximum Likelihood (PPML). In columns 1 and 4 the dependent variable is a number of unique HS-8 level products firm j imports (exports) from (to) all WTO member countries and all non-WTO partner countries in time period t. In columns 2 and 5 the dependent variable is a refinement of columns 1 and 4: number of unique HS-8 level products firm f imports (exports) from (to) each country j. Finally, in columns 3 and 6 the dependent variable in this table is the number of unique embargoed and non-embargoed HS-8 level products firm f trades with each country j. $Embargo_s$ equals 1 for the group of HS 4-digit industry codes that are embargoed starting from August 2014, while $Target_{jt}$ equals 1 if foreign country j imposed economic sanctions on Russia in period t. Variable of interest is $Post0812_t \times WTOmember_{jt}$ is an interaction term between the month-year periods post August 2012 and the WTO membership status of a foreign country j. Country-time macro controls include distance between countries weighted by population, dummy for presence of FTA or RTA between Russia and country j, dummies for common border, common language, common religion, and GDP of partner countries.

Country Margin

Next we explore the impact of Russia's accession to the WTO on the number of partners an average firm exports to or imports from. It is reasonable to check the country margin, because WTO membership grants many benefits, including lower tariffs and lowering of the non-tariff barriers. Additionally, the decline in trade uncertainty caused by Russia's accession to the WTO might increase its appeal as a trade partner for other country, increasing the number of partners an average firm can trade with.

Country margin in the context of this analysis is defined as a number of unique partner-countries a firm f exports to or imports from in a period of time. We separate the countries by their WTO membership status. We use equation (4.2) to estimate the effect of the WTO on the country margin. The results of these estimations are presented in Table 25. Our estimator of choice is Pseudo-Poisson Maximum Likelihood (PPML), because similarly to the product margin, the dependent variable is a count. OLS results are presented in the robustness checks section for comparison.

In columns 3 and 6 we present the results of estimation of equation (4.2), where the dependent variable is a number of unique partner countries that belong to one of the country groups in m firm f imports (exports) an HS 8-digit product k from (to) with in a given time period t. The country group m denotes four sets of countries: WTO member countries that later impose sanctions on Russia, WTO member countries that do not impose sanctions on Russia, non-WTO member countries that impose sanctions on Russia as well as non-WTO member countries that do not impose sanctions on Russia. In columns 2 and 5 we get rid of the sanctioning country dimension and keep only the distinction between

WTO members versus non-members. Dependent variable in these columns is the number of unique partner countries that are WTO members versus non-WTO member countries firm f imports (exports) HS 8-digit product k from (to) with in a given time period t. Finally, in columns 1 and 4 we present the results of the highest level of sample aggregation by getting rid of the product dimension. The dependent variable is a number of unique WTO-member and non-WTO member partner countries firm f trades with in a given time period t.

The effects of joining the WTO on the country margin are present for both Russian exporters and importers. An average exporting firm experiences a 5% increase in the number of export destinations per product (columns 2 and 3), while for the importers this effect is under 1% per product (columns 5 and 6). While the embargo has an expected negative impact on number of trading partners for importers, it has no statistically significant impact on the exporters. These results are indicative of a positive impact accession to the WTO had on some margins of the Russian firms engaged in foreign trade.

TABLE 25.
Country Margin

	EXPORTS			IMPORTS		
	(1)	(2)	(3)	(4)	(5)	(6)
$Post0812_t \times WTOmember_{mt}$	0.045***	0.055***	0.050***	0.046***	0.011***	0.006***
	[0.016]	[0.004]	[0.004]	[0.004]	[0.001]	[0.001]
$Embargo_k \times Target_{mt}$			-0.023			-0.101***
			[0.015]			[0.008]
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-WTO member FE	Yes	No	No	Yes	No	No
Firm-WTO membership-product FE	No	Yes	Yes	No	Yes	Yes
Time-specific macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	145,718	1,789,427	1,911,198	1,331,375	16,350,121	16,442,716
No. of firm-WTO membership groups	11,765			65,820		
No. of firm-WTO-product groups		226,590	245,058		2,070,180	2,110,162
Standard error clustering	Firm	Firm-product	Firm-product	Firm	Firm-product	Firm-product

Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is the Pseudo-Poisson Maximum Likelihood (PPML). In columns 1 and 4 the dependent variable is a number of unique partner countries that are WTO members and unique non-WTO countries firm f trades with in a given time period t. In columns 2 and 5 the dependent variable is a number of unique partner countries that are WTO members and unique non-WTO countries firm f imports (exports) product k from (to) with in a given time period t. Finally, in columns 3 and 6 the dependent variable is a number of unique partner countries from group m firm f imports (exports) product k from (to) with in a given time period t. The country group m denotes four sets of countries: WTO member countries that later impose sanctions on Russia, WTO member countries that do not impose sanctions on Russia, non-WTO member countries that impose sanctions on Russia as well as non-WTO member countries that do not impose sanctions on Russia. $WTOmember_{mt}$ is equal to 1 if country group m consists of WTO members, and 0 otherwise. $Target_{mt}$ equals 1 if country group m consists of countries that impose economic sanctions on Russia following the invasion of Crimea (a subset of WTO member countries). Time macro controls include price of oil, Russia's GDP, and the USD to rouble exchange rate.

Average Export and Import Flow of Firms

We complement the extensive margin analysis with analysis of the intensive margin of trade, which we define as an average import and export flow per product-country. Joining WTO makes foreign trade more accessible and has potential to increase the size of an average trade flow for both exporters and importers due to a decline in tariffs and non-tariff barriers. The effects for the weight and unit value are not straightforward.

We use equation (4.3) to analyze these effects. $P \times Q$ represents the value of an import or export flow; Q denotes the weight (mass) in kilograms of the flow; P is the average unit value. The results of the intensive margin analysis for both exports and imports are presented in Table 26.

Overall, we find mixed effects of the WTO accession on the intensive margin of Russian firms, which is consistent with the aggregate results in the literature in that, like Dutt et al. (2013), we find a strong effect of WTO membership on the extensive margin but not much of an effect on the intensive margin. We find no significant effect on the value or quantity of an average export flow of Russian exporters. However, the average unit value of an export flow increases. This finding is in line with existing trade theory, according to which when countries open to trade, the price of exports tends to increase due to the comparative advantage of the exporting country, which allows firms to produce at a relatively lower cost and sell at a higher price after the trade barriers decline.

One puzzle presented is the increase in the value of an average export flow of embargoed goods to the sanctioning countries after the imposition of the embargo (direct effect variable in column 1). This increase in the value seems to be driven by the increase in price (positive direct effect in column 3), rather than

the increase in quantity, which actually decreases, although none of these effects are significant.

The embargo has significant negative impact across all dependent variables (value, quantity, and unit value) for the importing firms. The only significant impact of Russia's accession to the WTO on imports comes from the quantity of imports: mass of an average import flow from a WTO-member country increases after Russia joins WTO, while the average value and unit value of the import flow do not change significantly after the accession.

TABLE 26.
Intensive Margin of Firm - Level Foreign Trade

	EXPORT			IMPORT		
	(1)	(2)	(3)	(4)	(5)	(6)
	$P \times Q$	Q	P	$P \times Q$	Q	P
$Post0812_t \times WTOmember_{jt}$	0.009	0.110	1.821**	0.050	0.113**	0.361
	[0.113]	[0.104]	[0.706]	[0.047]	[0.050]	[0.324]
$Embargo_k \times Target_{jt}$	0.224***	-0.201	0.176	-0.148***	-0.372***	-0.462**
	[0.079]	[0.128]	[0.381]	[0.046]	[0.083]	[0.222]
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-period-country FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,269,504	2,269,528	1,503,375	18,868,262	18,868,262	18,868,262
No. of firm-product-country gr.	311,171	311,181	219,967	2,495,855	2,495,855	2,495,855

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at firm-period-country in brackets. Dependent variables: value ($P \times Q$), mass (Q) or unit value (P) of exports and imports by firm-country-product. $Embargo_k$ equals 1 if HS 8-digit product is embargoed starting from August 2014, while $Target_{jt}$ equals 1 if foreign country j imposed economic sanctions on Russia in period t. Variable of interest is $Post0812_t \times WTOmember_{jt}$ is an interaction term between the month-year periods post August 2012 and the WTO membership status of a foreign country j. Estimator used is the Pseudo-Poisson Maximum Likelihood (PPML).

Foreign Trade Frequency

Finally we propose a less conventional test to analyze the impacts of Russia's accession to the WTO on the exporting and importing firms by analyzing the response of foreign trade frequency. We define foreign trade frequency as the

number of periods, in which a positive export or import flow is observed for a firm f with a country j. We use estimation equation (4.4) to analyze the impacts of WTO on foreign trade frequency. These results are presented in Table 27. Columns 3 and 6 present the most disaggregated version of the trade frequency model, equation (4.4) itself. Dependent variable in this case is the number of periods firm f imports (exports) product k from (to) country j. In columns 2 and 5 we aggregate the model across all HS 8-level products, to estimate the changes induced by the WTO to the frequency of trade of firm f with country j across all products. Finally, the dependent variable in columns 1 and 4 is a number of periods, in which a firm has at least one positive import or export flow from all WTO countries and all non-WTO member countries.

Interestingly, we find radically different results for the average exporting frequency and average importing frequency. While the frequency of exporting to country j decreases on average by 5%, and this effect is statistically significant, average importing from country j increases by 6%. Exports usually are more specialized, due to the existence of country's comparative advantage prior to the WTO accession. Exporting firms are, on average, larger and more effective (Bernard and Jensen (2004)), so they might be less likely to respond to the WTO accession, because they found their exports niche prior to the WTO. Operating on the importing markets might be easier for firms (easier to find new partner connections and access to new product markets) and thus we might see a positive effect on these firms. Controlling for the embargo produces expected results for the importing firms.

Robustness Checks

We next conduct several robustness checks. One worry about the exports estimates might be that the large share of Russia's exports are comprised of crude oil and natural gas, and the intensive margin results in Table 26 might be driven by these products. To check if this is the case, we exclude crude oil and gas products (HS-4 level products 2709 "Petroleum oils, oils from bituminous minerals, crude", 2710 " Oils petroleum, bituminous, distillates, except crude", and 2711 "Petroleum gases and other gaseous hydrocarbons") from the sample. The results of this exercise are presented in Table 28. We do not find that this changes our estimates in any significant way, so the exports results at the intensive margin are not driven by oil and gas products.

Next, we also check the consistency of our estimations by utilizing OLS estimator as opposed to the Poisson-PseudoMaximum Likelihood (PPML) estimator, which is our preferred method of estimations. We re-estimate equations (4.1), (4.2), (4.3), and (4.4) using OLS. These results are presented in the appendix Tables A.4, A.5, A.6, and A.7. The majority of extensive margin OLS results for the coefficient of interest $Post0812_t \times WTOmember_{jt}$ have similar significance levels and signs as the PPML results. However, the magnitude of the coefficients varies. The OLS results for the intensive margin estimations (Table A3) overestimate the results of the accession to the WTO for the trade value and price. Following the convention in the trade literature we use PPML to estimate the intensive margin effects.

TABLE 27.
Foreign Trade Frequency

	EXPORTS			IMPORTS		
	(1)	(2)	(3)	(4)	(5)	(6)
$Post0812_h \times WTOmember_{jh}$	-0.001	-0.035***	-0.054***	0.022**	0.022**	0.060***
	[0.008]	[0.007]	[0.004]	[0.010]	[0.010]	[0.004]
$Embargo_k \times Target_{jh}$			-0.012			-0.386***
			[0.017]			[0.007]
Biannual FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm - WTO membership FE	Yes	No	No	Yes	No	No
Time-specific macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Country-time specific controls	No	Yes	Yes	No	Yes	Yes
Firm-country FE	No	Yes	No	No	Yes	No
Firm-product-country FE	No	No	Yes	No	No	Yes
Observations	161,020	274,484	933,501	478,910	862,258	7,267,969
No. of firm-WTO membership groups	34,633			94,264		
No. of firm-country groups		63,892			187,878	
No. of firm-country-product groups			252,651			2,011,283
Standard error clustering	Firm	Firm-country	Firm-country	Firm-level	Firm-country	Firm-country

Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is the Pseudo-Poisson Maximum Likelihood (PPML). In columns 1 and 4 the dependent variable is a biannual frequency of trade (each 6 months), which is defined as number of periods, in which a firm has at least one positive import or export flow from all WTO countries and all non-WTO member countries. In columns 2 and 5 the dependent variable is the number of periods firm f imports (exports) any/all products from (to) country j. Finally, in columns 3 and 6 the dependent variable is the number of periods firm f imports (exports) product k from (to) country j. $Embargo_k$ equals 1 for the group of HS 8-digit industry codes that are embargoed starting from August 2014, while $Target_{jh}$ equals 1 if foreign country j imposed economic sanctions on Russia in half-year period h. Variable of interest is $Post0812_h \times WTOmember_{jh}$ is an interaction term between the half-year periods post August 2012 and the WTO membership status of a foreign country j. Country-time macro controls include distance between countries weighted by population, dummy for presence of FTA or RTA between Russia and country j, dummy for common border, dummy for common language, dummy for common religion, and GDP of partner countries.

TABLE 28.
Intensive Margin: Exports Sample Excluding Oil and Gas Products

	(1) $P \times Q$	(2) Q	(3) P
$Post0812_t \times WTOmember_j$	-0.100	0.112	1.821***
	[0.127]	[0.085]	[0.706]
Month-year FE	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes
Observations	2,221,187	2,220,687	2,220,634
Number of firm-product-country groups	306,393	306,389	306,374

Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is PPML. Standard errors clustered at firm-period-country in brackets. Dependent variables: value ($P \times Q$), mass (Q) or unit value (P) of exports and imports by firm-country-product. The sample excludes post-embargo time and all crude oil and gas products (HS 4-digit codes 2709, 2710, and 2711).

The final robustness check we conduct addresses the worry that imports estimates might be biased by the fact that the accession to the WTO disproportionately impacted Russian agricultural producers. Many agricultural enterprises in Russia rely heavily on the state subsidies, which are against the WTO provisions. After Russia joined WTO, many agricultural enterprises including producers of grain, dairy, and produced voiced their concerns about the inability to face the increased competition. To check whether the agricultural enterprises might be biasing our results, we conduct the extensive and intensive margins analysis for two separate samples. One sample includes only enterprises that trade (export, import or both) non-agricultural products, while the other sample covers agricultural enterprises. The way we select agricultural enterprises is by selecting firms which trade in at least one agricultural product over the duration of our sample. We identify the agricultural products as products that are later embargoed by the Russian government. This method also allows us to check whether the way the products were chosen for the embargo was more of a convenient instrument of protectionist policy to benefit the agricultural sector

which is vulnerable in the face of increased competition after the WTO accession rather than a simple retaliation instrument.

We re-estimate equations (4.1), (4.2), (4.3), and (4.4) for the two samples separately. These results are presented in Tables 30, 31, 29, and 30. It is not straightforward whether the agricultural products are disproportionately impacted by the accession to the WTO, because certain dimension of firm's behavior in agricultural sector, like frequency of trade for exports or product margin of the importers are more impacted by the WTO, while others, like exports unit value are driven by the non-agricultural sector.

The frequency of trade for the exporting firms is more negatively impacted by the accession to the WTO and the imposition of embargo than a non-agricultural sample. However, the imports frequency for the agricultural sample increases. At the product margin, agriculture importers benefit the most from the WTO accession: the number of HS 8-digit products increases by 14.5% while for the non-agriculture sector this effect is not statistically significant. Intensive margin results in Table 26 are mostly driven by the non-agricultural sector, while the embargo results are driven, expectedly, by the agricultural sector. We find a positive and significant impact of WTO on the average value of an import flow, while export flow is not affected in a statistically significant manner.

Our findings could justify the fears of increased competition that some Russian agricultural enterprises share. We find evidence of disproportionate positive impacts of WTO on agricultural imports: significant increase in frequency of imports, increase in the average number of products imported, and a significant increase in the average firm-product-country import flow. These findings could serve as the evidence that the embargo was intended as a protectionist policy and targeted a very specific sector whose imports benefitted significantly from the

WTO accession (agriculture) in order to help the vulnerable domestic industries. Because the protectionist policies are against the WTO provisions, the embargo could have been a convenient way to kill two birds with one stone - retaliate against the embargo and protect domestic agriculture.

TABLE 29.
Agricultural Sector: Intensive Margin

	EXPORTS			IMPORTS		
	(1)	(2)	(3)	(4)	(5)	(6)
	P × Q	Q	P	P × Q	Q	P
$Post0812_t \times WTOmember_{jt}$	0.028	-0.150	-0.029	0.119**	0.020	0.407
	[0.085]	[0.130]	[0.177]	[0.052]	[0.087]	[0.549]
$Embargo_s \times Target_{jt}$	0.009	-0.330**	0.160*	-0.128***	-0.110**	-0.485**
	[0.084]	[0.152]	[0.090]	[0.035]	[0.054]	[0.189]
Firm-product-country FE	Yes	Yes	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	485,963	485,966	485,963	3,048,029	3,048,029	3,048,029
No. of firm-product- country gr.	62,431	62,432	62,431	457,287	457,287	457,287

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at firm-period-country in brackets. Dependent variables: value ($P \times Q$), mass (Q) or unit value (P) of exports and imports by firm-country-product.$Embargo_k$ equals 1 if HS 8-digit product is embargoed starting from August 2014, while $Target_{jt}$ equals 1 if foreign country j imposed economic sanctions on Russia in period t. Variable of interest is $Post0812_t \times WTOmember_{jt}$ is an interaction term between the month-year periods post August 2012 and the WTO membership status of a foreign country j.Estimator used is the Pseudo-Poisson Maximum Likelihood (PPML).

TABLE 30.
Agricultural Sector: Extensive Margin

	EXPORTS			IMPORTS		
	(1)	(2)	(3)	(4)	(5)	(6)
	Product margin	Country margin	Frequency	Product margin	Country margin	Frequency
$Post0812_{(t,h)} \times WTOmember_{(j,m)(h,t)}$	-0.040	0.086***	-0.096***	0.145**	-0.001	0.091***
	[0.039]	[0.008]	[0.008]	[0.059]	[0.002]	[0.007]
$Embargo_{(k,s)} \times Target_{(j,m)(t,h)}$	-0.125***	-0.026*	-0.045**	-0.317***	-0.105***	-0.361***
	[0.032]	[0.015]	[0.018]	[0.044]	[0.008]	[0.008]
Biannual FE	No	No	Yes	No	No	Yes
Month - year FE	Yes	Yes	No	Yes	Yes	No
Firm - country - emb. product FE	Yes	No	No	Yes	No	No
Firm - WTO - sanctions - product FE	No	Yes	No	No	Yes	No
Firm - country - product FE	No	No	Yes	No	No	Yes
Observations	114,863	384,168	185,032	483,695	2,614,482	1,139,043
No. of firm - country - emb. product gr.	10,148			40,253		
No. of firm - country - product gr.			47,897			350,748
No. of firm -WTO - sanctions - product gr.		47,827			380,516	
Standard error clustering	Firm - country	Firm - country - WTO	Firm - product - WTO	Firm-country	Firm - country - WTO	Firm-product - WTO

Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is PPML. The sample excludes all firms that trade (export, import or both) in at least one embargoed agricultural product. Product margin in columns 1 and 4 refers to a number of unique HS-8 level products separated by embargo status (s) firm f imports (exports) from (to) country j in a time period t. Country margin in columns 2 and 5 refers to a number of unique countries from group m with which firm f trades in HS 8-level product k. The country group m denotes four sets of countries: WTO member countries that later impose sanctions on Russia, WTO member countries that do not impose sanctions on Russia, non-WTO member countries that impose sanctions on Russia as well as non-WTO member countries that do not impose sanctions on Russia. Finally, frequency in columns 3 and 6 refers to the number of periods in half-year period h firm f imports (exports) HS 8-level product k from (to) country j. $Post0812_{(t,h)} \times WTOmember_{(j,m)(h,t)}$ is an interaction term between the time period (month - year or half - year) periods post August 2012 and the WTO membership status of a foreign country j (or country group m). $Embargo_{(k,s)}$ equals 1 for the group of HS 8-digit industry codes that are embargoed starting from August 2014, while $Target_{(j,m)(h,t)}$ equals 1 if foreign country j or country group m imposed economic sanctions on Russia in month - year t or half-year period h.

TABLE 31.
Non-agricultural Sector: Extensive Margin

	EXPORTS			IMPORTS		
	(1)	(2)	(3)	(4)	(5)	(6)
	Product margin	Country margin	Frequency	Product margin	Country margin	Frequency
$Post0812_{(t,h)}\times$	0.013	0.043***	-0.047***	0.066	0.008***	0.027***
$WTOmember_{(j,m)(h,t)}$	[0.026]	[0.004]	[0.005]	[0.041]	[0.001]	[0.005]
Biannual FE	No	No	Yes	No	No	Yes
Month - year FE	Yes	Yes	No	Yes	Yes	No
Firm - country - emb. product FE	Yes	No	No	Yes	No	No
Firm - WTO - sanctions - product FE	No	Yes	No	No	Yes	No
Firm - country - product FE	No	No	Yes	No	No	Yes
Observations	687,998	1,527,030	754,706	2,165,171	13,828,234	6,134,435
No. of firm - country - emb. gr.	67,452			180,452		
No. of firm - country - product gr.			206,539			1,661,588
No. of firm -WTO - sanctions - product gr.		197,231			1,729,646	
Standard error clustering	Firm - country	Firm - country - WTO	Firm - product - WTO	Firm-country	Firm - country - WTO	Firm-product - WTO

Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is PPML. The sample includes only firms that trade exclusively in non-agricultural products. Product margin in columns 1 and 4 refers to a number of unique HS-8 level products separated by embargo status (s) firm f imports (exports) from (to) country j in a time period t. Country margin in columns 2 and 5 refers to a number of unique countries from group m with which firm f trades in HS 8-level product k. The country group m denotes four sets of countries: WTO member countries that later impose sanctions on Russia, WTO member countries that do not impose sanctions on Russia, non-WTO member countries that impose sanctions on Russia as well as non-WTO member countries that do not impose sanctions on Russia. Finally, frequency in columns 3 and 6 refers to the number of periods in half-year period h firm f imports (exports) HS 8-level product k from (to) country j. $Post0812_{(t,h)} \times WTOmember_{(j,m)(h,t)}$ is an interaction term between the time period (month - year or half - year) periods post August 2012 and the WTO membership status of a foreign country j (or country group m). $Embargo_{(k,s)}$ equals 1 for the group of HS 8-digit industry codes that are embargoed starting from August 2014, while $Target_{(j,m)(h,t)}$ equals 1 if foreign country j or country group m imposed economic sanctions on Russia in month - year t or half-year period h.

TABLE 32.
Non-agricultural Sector: Intensive Margin

	EXPORTS			IMPORTS		
	(1)	(2)	(3)	(4)	(5)	(6)
	P × Q	Q	P	P × Q	Q	P
$Post0812_t \times WTOmember_j$	0.009	0.118	1.811**	0.035	0.142**	0.011
	[0.117]	[0.107]	[0.708]	[0.060]	[0.056]	[0.218]
Firm-product-country FE	Yes	Yes	Yes	Yes	Yes	Yes
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,783,541	1,783,562	1,783,541	15,820,233	15,820,233	15,820,233
No. of firm-product- country gr.	248,740	248,749	248,740	2,038,568	2,038,568	2,038,568

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at firm-period-country in brackets. Dependent variables: value ($P \times Q$), mass (Q) or unit value (P) of exports and imports by firm-country-product.$Embargo_k$ equals 1 if HS 8-digit product is embargoed starting from August 2014, while $Target_{jt}$ equals 1 if foreign country j imposed economic sanctions on Russia in period t. Variable of interest is $Post0812_t \times WTOmember_{jt}$ is an interaction term between the month-year periods post August 2012 and the WTO membership status of a foreign country j.Estimator used is the Pseudo-Poisson Maximum Likelihood (PPML).

Conclusion

In this paper we estimate the impact of Russia's accession to the WTO on a variety of exporting and importing firms' outcomes. We find that, contrary to the predictions of the seminal Rose's paper, Russian exporters and importers experience significant impacts of Russia's accession to the WTO. These effects vary significantly across the trade margins, with extensive margin of trade being more significantly impacted that the intensive margin. We find that imports, especially imports of agricultural products, are more impacted by the WTO. These impacts include an increase in average frequency of import shipments, as well as increased number of imported HS 8-digit product codes. Our findings are in line with the aggregate results in the literature in that, like Dutt et al. (2013), we find a strong effect of WTO membership on the extensive margin but not much of an effect on the intensive margin, and like Liu (2009), we find that these effects are robust to

departing from the traditional Ordinary Least Squares (OLS) estimation method and instead using the Pseudo-Poison Maximum Likelihood (PPML) method.

Our findings also uncover disproportionate positive impacts of WTO on agricultural imports, which could serve as the evidence that the embargo was intended as a protectionist policy and targeted a very specific sector whose imports benefitted significantly from the WTO accession (agriculture) in order to help the vulnerable domestic industry. Because the protectionist policies are against the WTO provisions, the embargo was a convenient way to kill two birds with one stone - retaliate against the embargo and protect domestic agricultural production.

To conclude, our empirical analysis of Russia's accession to the WTO confirms that this trade liberalization episode impacted several dimensions of the Russian exporting and importing firms' behavior.

CHAPTER V

CONCLUSION

In this dissertation I investigate the evolution of the current Russian foreign trade policy from trade liberalization following the accession to the World Trade Organization in 2012 to protectionism in the form of the retaliatory embargo in 2014. I focus on estimating the effects of each individual policy on Russian international trade, as well as the interconnection of these two opposing policies as parts of a broader international policy strategy.

Russia joined the WTO in August of 2012, after 19 years of negotiations. My analysis of firms' dynamics in response to this trade liberalization episode in Chapter IV uncovers disproportionately positive impacts of the WTO accession on several dimensions of the Russian importing firms. However, along with the certain economic gains that inevitably come with trade liberalization, there are also drawbacks. In the case of Russia's accession, agricultural production that typically heavily relies on governmental subsidies, faced increased competition from the foreign producers. When the European Union and the US imposed economic sanctions on Russia after its invasion in Crimea in 2014, the Russian government retaliated by hurting the sanctioning counties through an imposition of a retaliatory embargo, which also could be viewed as a protectionist trade policy in response to the struggles of the agricultural sector after the WTO accession.

As I show in Chapters II and III, the retaliatory embargo led to a significant decline in Russia's trade in embargoed products with the EU countries and the US, while its trade with the non-sanctioning countries increased significantly. Estimated losses for the imports of the embargoed goods are approximately 13 billion USD and the substitution towards the non-sanctioning countries is available

only for 50% of this amount. However, aside from foreign trade losses, the embargo also led to a significant reshuffling of trade and diplomatic connections among the involved participants. The Russian government used this opportunity to push for an increase in domestic production of certain embargoed products, and to focus its diplomatic and cooperation efforts with other countries that share the "anti-Western" mentality, such as Turkey, Egypt, Belarus, former USSR countries.

In its pursuit of retaliation, Russia sacrificed its own economic gains, including the gains from the WTO accession. However, it also reaped certain benefits in the form of newly established or strengthened political and economic connections with the non-sanctioning countries, increased domestic production of grains and other embargoed products, and weakened reliance on the approval of its policies from the EU and the US.

APPENDIX

SUPPLEMENTAL FIGURES AND TABLES

A. Supplemental Tables and Figures

TABLE A.1.
List of countries sanctioning Russia and targeted by the Russian retaliatory embargo

Country name	UN COMTRADE code	Affiliation
Albania	8	
Australia	36	OECD
Austria	40	OECD, EU
Belgium	56	OECD, EU
Bulgaria	100	EU
Canada	124	OECD
Croatia	191	EU
Cyprus	196	EU
Czech Republic	203	OECD, EU
Denmark	208	OECD, EU
Estonia	233	OECD, EU
Finland	246	OECD, EU
France	251	OECD, EU
Germany	276	OECD, EU
Greece	300	OECD, EU
Hungary	348	OECD, EU
Iceland	352	OECD
Ireland	372	OECD, EU
Italy	381	OECD, EU
Latvia	428	OECD, EU
Lichtenstein/Switzerland	757	OECD
Lithuania	440	OECD, EU
Luxembourg	442	OECD, EU
Malta	470	EU
Montenegro	499	
Netherlands	528	OECD, EU
Norway	579	OECD
Poland	616	OECD, EU
Portugal	620	OECD, EU
Romania	642	EU
Slovakia	703	OECD, EU
Slovenia	705	OECD, EU
Spain	724	OECD, EU
Sweden	752	OECD, EU
Ukraine	804	
United Kingdom	826	OECD, EU
USA	842	OECD

TABLE A.2.
List of products targeted by the embargo

Sanctioned products	Description
0201*	Meat and edible meat offal
0202*	Meat of bovine animals, frozen.
0203*	Meat of swine, fresh, chilled or frozen.
0207	Meat and edible offal, of the poultry of heading 01.05, fresh, chilled or frozen.
0210	Meat and edible meat offal, salted, in brine, dried or smoked; edible flours and meals of meat or meat offal.
0301	Live fish.
0302	Fish, fresh or chilled, excluding fish fillets and other fish meat of heading 03.04.
0303	Fish, frozen, excluding fish fillets and other fish meat of heading 03.04.
0304	Fish fillets and other fish meat (whether or not minced), fresh, chilled or frozen.
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.
0306	Crustaceans, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked crustaceans, whether in shell or not, whether or not cooked before or during the smoking process; crustaceans, in shell, cooked by steaming or by boiling in water, whether or not chilled, frozen, dried.
0307	Molluscs, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine; smoked molluscs, whether in shell or not, whether or not cooked before or during the smoking process; flours, meals and pellets of molluscs, fit for human consumption.
0308	Aquatic invertebrates other than crustaceans and molluscs, live, fresh, chilled, frozen, dried, salted or in brine; smoked aquatic invertebrates other than crustaceans and molluscs, whether or not cooked before or during the smoking process; flours, meals and pellets of aquatic invertebrates other than crustaceans and molluscs, fit for human consumption.

0401	Milk and cream, not concentrated nor containing added sugar or other sweetening matter.
0402*	Milk and cream, concentrated or containing added sugar or other sweetening matter.
0403	Buttermilk, curdled milk and cream, yogurt, kephir and other fermented or acidified milk and cream, whether or not concentrated or containing added sugar or other sweetening matter or flavoured or containing added fruit, nuts or cocoa.
0404	Whey, whether or not concentrated or containing added sugar or other sweetening matter; products consisting of natural milk constituents, whether or not containing added sugar or other sweetening matter, not elsewhere specified or included.
0405	Butter and other fats and oils derived from milk; dairy spreads.
0406	Cheese and curd.
0701*	Potatoes, fresh or chilled.
0702	Tomatoes, fresh or chilled.
0703	Onions, shallots, garlic, leeks and other alliaceous vegetables, fresh or chilled.
0704	Cabbages, cauliflowers, kohlrabi, kale and similar edible brassicas, fresh or chilled.
0705	Lettuce (Lactuca sativa) and chicory (Cichorium spp.), fresh or chilled.
0706	Carrots, turnips, salad beetroot, salsify, celeriac, radishes and similar edible roots, fresh or chilled.
0707	Cucumbers and gherkins, fresh or chilled.
0708	Leguminous vegetables, shelled or unshelled, fresh or chilled.
0709	Other vegetables, fresh or chilled.
0710	Vegetables (uncooked or cooked by steaming or boiling in water), frozen.
0711	Vegetables provisionally preserved (for example, by sulphur dioxide gas, in brine, in sulphur water or in other preservative solutions), but unsuitable in that state for immediate consumption.
0712	Dried vegetables, whole, cut, sliced, broken or in powder, but not further prepared.

0713	Dried leguminous vegetables, shelled, whether or not skinned or split.
0714	Manioc, arrowroot, salep, Jerusalem artichokes, sweet potatoes and similar roots and tubers with high starch or inulin content, fresh, chilled, frozen or dried, whether or not sliced or in the form of pellets; sago pith.
0801*	Coconuts, Brazil nuts and cashew nuts, fresh or dried, whether or not shelled or peeled.
0802	Other nuts, fresh or dried, whether or not shelled or peeled.
0803	Bananas, including plantains, fresh or dried.
0804	Dates, figs, pineapples, avocados, guavas, mangoes and mangosteens, fresh or dried.
0805	Citrus fruit, fresh or dried.
0806	Grapes, fresh or dried.
0807	Melons (including watermelons) and papaws (papayas), fresh.
0808	Apples, pears and quinces, fresh.
0809	Apricots, cherries, peaches (including nectarines), plums and sloes, fresh.
0810	Other fruit, fresh.
0811	Fruit and nuts, uncooked or cooked by steaming or boiling in water, frozen, whether or not containing added sugar or other sweetening matter.
0813	Fruit, dried, other than that of headings 08.01 to 08.06; mixtures of nuts or dried fruits of this Chapter.
1601	Sausages and similar products, of meat, meat offal or blood; food preparations based on these products.
1901*	Malt extract, flour, dairy preparations, low cocoa
2106	Food preparations, nes
2501	Salt (including table salt and denatured salt) and pure sodium chloride, whether or not in aqueous solution or containing added anti-caking or free-flowing agents; sea water.

Notes: * denotes HS-4 codes that include consumption and intermediate goods as per BEC classification. HS-4 codes not marked with an asterisk include only consumption goods.

TABLE A.3.
Smuggling Analysis

	Azerbaijan		Belarus		Georgia		Kazakhstan	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Imports of E goods from S countries	−0.175		0.218		0.067		0.132	
	(0.125)		(0.160)		(0.108)		(0.090)	
Imports of E goods from NS countries	−0.358**		−0.056		−0.274***		−0.241**	
	(0.156)		(0.116)		(0.091)		(0.101)	
Exports of E goods to Russia		0.610		0.287***		0.732***		−0.180
		(0.600)		(0.088)		(0.124)		(0.213)
Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	388,487	38,130	640,455	291,762	407,702	66,587	579,771	74,786
R^2	0.506	0.943	0.960	0.896	0.747	0.796	0.798	0.900
Adjusted R^2	0.469	0.930	0.958	0.887	0.728	0.756	0.786	0.882

Notes: *p<0.1; **p<0.05; ***p<0.01. Standard errors clustered at HS-4 code level. I choose four countries, through which the smuggling of embargoed goods might happen. The choice of these countries is was based on several factors: for each of these countries there is anecdotal evidence of smuggling (reports or mentions in the media); these countries are members of the Commonwealth of Independent States (CIS), and they share common past and connections with Russia; Belarus and Kazakhstan are both members of a customs union with Russia. To investigate the possibility of smuggling, I analyze the response of these countries' imports of embargoed goods from the sanctioning countries (columns 1, 3, 5 and 7) and the response of their exports of embargoed goods to Russia (columns 2, 4, 6, 8).

TABLE A.4.
Product Margin: OLS Estimator

	EXPORT			IMPORT		
	(1)	(2)	(3)	(4)	(5)	(6)
$Post0812_t \times WTOmember_j$	-0.232	-0.066	-0.021	1.228***	0.649**	0.800***
	[0.147]	[0.083]	[0.071]	[0.253]	[0.271]	[0.225]
$\delta Embargo_s \times Target_{jt}$			0.091*			-0.923***
			[0.054]			[0.121]
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm - WTO membership FE	Yes	No	No	Yes	No	No
Firm-country FE	No	Yes	No	No	Yes	No
Firm-country-product type FE	No	No	Yes	No	No	Yes
Time-specific macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Country-time specific macro controls	No	Yes	Yes	No	Yes	Yes
Observations	151,629	831,040	850,532	1,346,467	2,696,903	2,758,336
R-squared	0.004	0.002		0.010	0.005	
No. of firm-WTO membership groups	17,676			80,912		
No. of firm-country groups		123,927			320,140	
No. of firm-country-product type groups			127,078			330,520
Standard error clustering	Firm	Firm-country	Firm-country	Firm	Firm-country	Firm-country

Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is OLS. In columns 1 and 4 the dependent variable is a number of unique HS-8 level products firm j imports (exports) from (to) all WTO member countries and all non-WTO partner countries in time period t. In columns 2 and 5 the dependent variable is a refinement of columns 1 and 4: number of unique HS-8 level products firm f imports (exports) from (to) each country j. Finally, in columns 3 and 6 the dependent variable in this table is the number of unique embargoed and non-embargoed HS-8 level products firm f trades with each country j. $Embargo_s$ equals 1 for the group of HS 4-digit industry codes that are embargoed starting from August 2014, while $Target_{jt}$ equals 1 if foreign country j imposed economic sanctions on Russia in period t. Variable of interest is $Post0812_t \times WTOmember_{jt}$ is an interaction term between the month-year periods post August 2012 and the WTO membership status of a foreign country j. Time macro controls include price of oil, Russia's GDP, and the USD to rouble exchange rate. Country-time macro controls include distance between countries weighted by population, dummy for presence of FTA or RTA between Russia and country j, dummy for common border, dummy for common language, dummy for common religion, and GDP of partner countries.

TABLE A.5.
Country Margin: OLS Estimator

	EXPORT			IMPORT		
	(1)	(2)	(3)	(4)	(5)	(6)
$Post0812_t \times WTOmember_j$	0.058**	0.077***	0.064***	0.084***	0.013***	0.007***
	[0.023]	[0.005]	[0.004]	[0.005]	[0.001]	[0.001]
$\delta Embargo_s \times Target_{jt}$			-0.031*			-0.121***
			[0.018]			[0.010]
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-WTO member FE	Yes	No	No	Yes	No	No
Firm-WTO membership-product FE	No	Yes	Yes	No	Yes	Yes
Time-specific macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	151,629	2,055,719	2,200,721	1,346,467	18,160,777	18,337,706
R-squared	0.006	0.008	0.007	0.014	0.002	0.002
No. of firm-WTO membership groups	17,676			80,912		
No. of firm-WTO-product groups		492,882	534,581		3,880,836	4,005,152
Standard error clustering	Firm	Firm-product	Firm-product	Firm	Firm-product	Firm-product

Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is OLS. In columns 1 and 4 the dependent variable is a number of unique partner countries that are WTO members and unique non-WTO countries firm f trades with in a given time period t. In columns 2 and 5 the dependent variable is a number of unique partner countries that are WTO members and unique non-WTO countries firm f imports (exports) product k from (to) with in a given time period t. Finally, in columns 3 and 6 the dependent variable is a number of unique partner countries from group m firm f imports (exports) product k from (to) with in a given time period t. The country group m denotes four sets of countries: WTO member countries that later impose sanctions on Russia, WTO member countries that do not impose sanctions on Russia, non-WTO member countries that impose sanctions on Russia as well as non-WTO member countries that do not impose sanctions on Russia. $WTOmember_{mt}$ is equal to 1 if country group m consists of WTO members, and 0 otherwise. $Target_{mt}$ equals 1 if country group m consists of countries that impose economic sanctions on Russia following the invasion of Crimea (a subset of WTO member countries).

TABLE A.6.
Intensive Margin of Firm-level Foreign Trade: OLS Estimator

	EXPORT			IMPORT		
	(1)	(2)	(3)	(4)	(5)	(6)
	P × Q	Q	P	P × Q	Q	P
$WTOmember_j$	0.164***	0.214***	-0.044***	-0.105***	-0.075**	-0.030***
	[0.021]	[0.020]	[0.009]	[0.038]	[0.038]	[0.010]
$Post0812_t \times WTOmember_j$	-0.062***	-0.069***	0.008**	0.094***	0.098***	-0.004
	[0.008]	[0.008]	[0.004]	[0.009]	[0.010]	[0.003]
$\delta Embargo_s \times Target_{jt}$	-0.013	-0.096***	0.084***	-0.244***	-0.276***	0.032***
	[0.034]	[0.033]	[0.012]	[0.023]	[0.023]	[0.006]
Month-year FE	Yes	Yes	Yes			
Firm-product-country FE	Yes	Yes	Yes			
Observations	2,269,397	2,269,397	2,269,397	17,028,490	17,028,490	17,028,490
R-squared	0.899	0.951	0.963	0.815	0.878	0.938

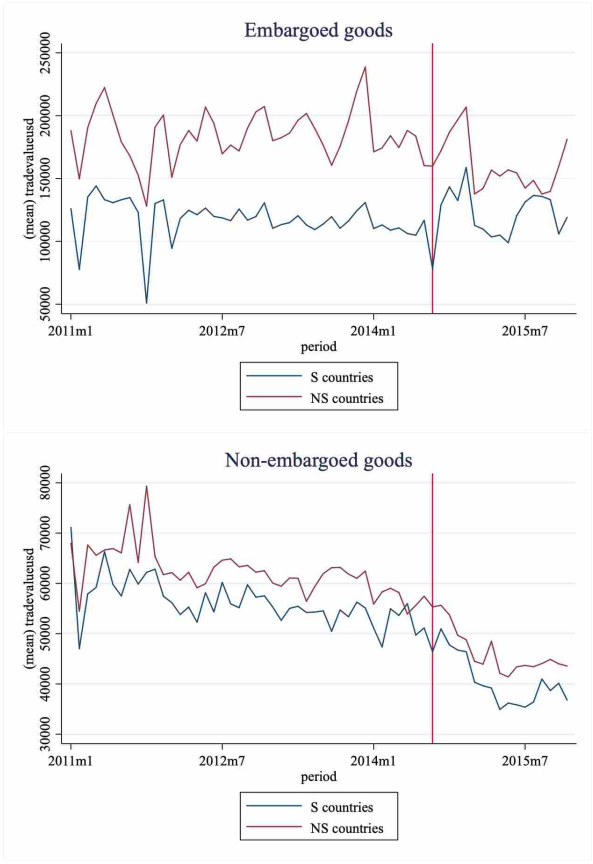
Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is OLS. Standard errors clustered at firm-period-country in brackets. Dependent variables: value ($P \times Q$), mass (Q) or unit value (P) of exports and imports by firm-country-product. $Embargo_k$ equals 1 if HS 8-digit product is embargoed starting from August 2014, while $Target_{jt}$ equals 1 if foreign country j imposed economic sanctions on Russia in period t. Variable of interest is $Post0812_t \times WTOmember_{jt}$ is an interaction term between the month-year periods post August 2012 and the WTO membership status of a foreign country j.

TABLE A.7.
Frequency of Foreign Trade: OLS Estimator

	EXPORT			IMPORT		
	(1)	(2)	(3)	(4)	(5)	(6)
$WTOmember_j$		0.066	0.189***		-0.344***	-0.104***
		[0.045]	[0.025]		[0.112]	[0.039]
$Post0812_t \times WTOmember_j$	0.004	-0.085***	-0.141***	0.022**	0.091***	0.148***
	[0.023]	[0.020]	[0.010]	[0.010]	[0.030]	[0.010]
$\delta Embargo_s \times Target_{jt}$			-0.033			-1.069***
			[0.046]			[0.019]
Biannual FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm - WTO membership FE	Yes	No	No	Yes	No	No
Time-specific macro controls	Yes	Yes	Yes	Yes	Yes	Yes
Country-time specific controls	No	Yes	Yes	No	Yes	Yes
Firm-country FE	No	Yes	No	No	Yes	No
Firm-product-country FE	No	No	Yes	No	No	Yes
Observations	187,129	334,012	1,369,553	530,464	994,164	10,117,186
R-squared	0.003	0.044	0.040	0.010	0.053	0.049
No. of firm-WTO membership groups	60,742			145,818		
No. of firm-country groups		123,927			320,140	
No. of firm-country-product groups			688,703			4,860,500
Standard error clustering	Firm	Firm-country	Firm-country	Firm-level	Firm-country	Firm-country

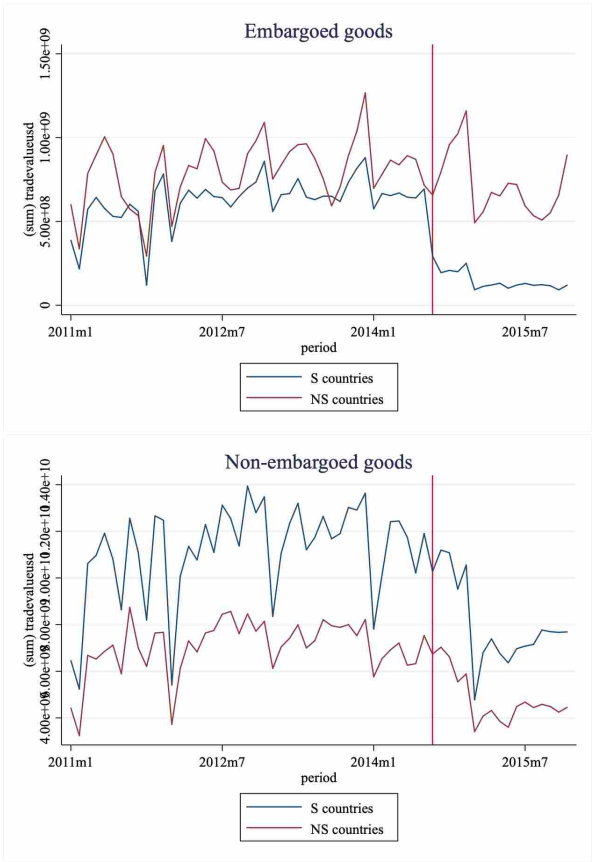
Notes: *p<0.1; **p<0.05; ***p<0.01. Estimator used is OLS. In columns 1 and 4 the dependent variable is a biannual frequency of trade (each 6 months), which is defined as number of periods, in which a firm has at least one positive import or export flow from all WTO countries and all non-WTO member countries. In columns 2 and 5 the dependent variable is the number of periods firm f imports (exports) any/all products from (to) country j. Finally, in columns 3 and 6 the dependent variable is the number of periods firm f imports (exports) product k from (to) country j. $Embargo_k$ equals 1 for the group of HS 8-digit industry codes that are embargoed starting from August 2014, while $Target_{jh}$ equals 1 if foreign country j imposed economic sanctions on Russia in half-year period h. Variable of interest is $Post0812_h \times WTOmember_{jh}$ is an interaction term between the half-year periods post August 2012 and the WTO membership status of a foreign country j. Time macro controls include price of oil, Russia's GDP, and the USD to rouble exchange rate. Country-time macro controls include distance between countries weighted by population, dummy for presence of FTA or RTA between Russia and country j, dummy for common border, dummy for common language, dummy for common religion, and GDP of partner countries. of partner countries.

FIGURE A.2.
Average trade flows by firm-product-country combination



Notes: This figure depicts the evolution over time of a raw average import flow for embargoed products (left panel) and non-embargoed products (right panel), disaggregated by the sanctioning and non-sanctioning countries over time. The vertical red line depicts the imposition of the retaliatory food embargo in August of 2014.

FIGURE A.1.
Aggregate trade flows by good and country types



Notes: This figure depicts raw total Russian imports for embargoed products (left panel) and non-embargoed products (right panel), disaggregated by the sanctioning and non-sanctioning countries over time. The vertical red line depicts the imposition of the retaliatory food embargo in August of 2014.

B. Visualization of the Three Effects of the Embargo

	Targeted country	Non-targeted country
Targeted good	Direct effect	Substitution effect
Non-targeted good	Spillover effect	Control group

For example, prior to the embargo firms import apples under the HS-4 code of 0808 from Poland. After the embargo is imposed, apples become an embargoed good if they are imported from Poland, which is a country that is sanctioning Russia. These firms' imports from Poland become restricted and firms can no longer import apples from Poland. This change in the import flow is the *direct effect* of the embargo.

Some firms, which imported goods targeted by the embargo from the targeted countries prior to the embargo, may choose to find new suppliers of the same goods in a non-targeted country. For example, they may decide to begin importing apples from Belarus. This is an example of a *substitution effect*. It is true that Polish firms may choose to export their goods to Belarus instead, and their partners in Belarus then re-direct these apples to Russia. Unfortunately, currently I am not able to disentangle the true substitution effect from these smuggling activities due to the illegal nature of such actions.

Some firms may choose to switch to a new set of products but keep ties with suppliers in the targeted countries. For example, they may choose to start importing apple juice under the non-embargoed HS-4 code of 2009 instead of apples from Poland. This is a manifestation of a *spillover effect*. In this case we will observe a positive spillover effect, because a new trade link will appear.

Another way for spillover effect to take place is if some firms, who imported targeted goods from the targeted countries prior to the embargo, have to cut ties with their suppliers in the targeted countries completely. This could happen

if, for example, there are economies of scale and without targeted goods it is no longer profitable for firms to import non-targeted goods from their suppliers in the targeted countries. Another possibility is if Russian importers and their foreign suppliers are risk averse and are worried that the rest of product categories might become embargoed later on. Another explanation for the spillover effects would come from logistical or political reasons. Irrespective of the mechanisms at play, a negative spillover effect will be observed.

C. Theoretical Framework Appendix

1. In order to derive the productivity cutoff for the firms that use domestic inputs for production, recall that profits of this type of firms is given by

$$\pi_D = B\left[\frac{\phi_D \prod_{i=1}^{I} N_{iD}^{\frac{\theta_i}{\sigma_i - 1}}}{\prod_{i=1}^{I} p_{iD}^{\theta_i}}\right]^{\gamma-1} - F_{sunk} - F_D \tag{C1}$$

Defining $B \equiv \frac{X}{P^{1-\gamma}}\left(\frac{\gamma}{\gamma-1}\right)^{1-\gamma}$, $\Gamma_j \equiv \prod_{i=1}^{I} N_{ij}^{\frac{\theta_i}{\sigma_i - 1}}$ and $K_j \equiv \prod_{i=1}^{I} p_{ij}^{\theta_i}$, where $j \in \{D; T; NT\}$, the productivity cutoff for the firms that use domestic inputs for production can be found by solving the following equation:

$$\pi_D(\overline{\phi}_D) = B\left[\frac{\overline{\phi}_D \Gamma_D}{K_D}\right]^{\gamma-1} - F_{sunk} - F_D = 0$$

$$\overline{\phi}_D = \left(\frac{F_{sunk} + F_D}{B}\right)^{\frac{1}{\gamma_i - 1}} \cdot \frac{K_D}{\Gamma_D} \tag{C2}$$

2. Similarly, productivity cutoff for firms using inputs from non-targeted countries is determined by solving the inequality $\pi_{NT}(\overline{\phi}_{NT}) = \pi_D(\overline{\phi}_{NT})$ for $\overline{\phi}_{NT}$:

$$\overline{\phi}_{NT} = \left(\frac{F_{NT} - F_D}{B}\right)^{\frac{1}{\gamma - 1}} \left[\left(\frac{\Gamma_{NT}}{K_{NT}}\right)^{\gamma-1} - \left(\frac{\Gamma_D}{K_D}\right)^{\gamma-1}\right]^{\frac{1}{\gamma - 1}} \tag{C3}$$

3. Productivity cutoff for firms using inputs from targeted countries is determined by solving the inequality $\pi_T(\overline{\phi}_T) = \pi_{NT}(\overline{\phi}_T)$ for $\overline{\phi}_T$:

$$\overline{\phi}_T = \left(\frac{F_T - F_{NT} - F_{lobby\ T}}{B}\right)^{\frac{1}{\gamma - 1}} \left[\left(\frac{\Gamma_T}{K_T}\right)^{\gamma-1} - \left(\frac{\Gamma_{NT}}{K_{NT}}\right)^{\gamma-1}\right]^{\frac{1}{1 - \gamma}} \tag{C4}$$

4. Recall that price index is given by $P = \left[\sum_{k\in\Omega_k} \frac{\gamma}{\gamma-1} MC_j\right]^{\frac{1}{1-\gamma}}$. Substituting in the expression for the marginal cost, price index is then given by

$$P = \left[\sum_{k\in\Omega_k} \frac{\gamma}{\gamma-1} \frac{\prod_{i=1}^{I} p_{ij}^{\theta_i}(k)}{\phi \prod_{i=1}^{I} N_{ij}^{\frac{\theta_i}{\sigma_i-1}}}\right]^{\frac{1}{1-\gamma}} \tag{C5}$$

Differentiating price index with respect to the number of varieties N_{ij} gives

$$\frac{\partial P}{\partial N_{iT}} = \frac{1}{1-\gamma}\left[\sum_{k\in\Omega} \frac{\gamma}{\gamma-1} \cdot \frac{\prod_{i=1}^{I} p_{ij}^{\theta_i}(k)}{\phi \prod_{i=1}^{I} N_{ij}^{\frac{\theta_i}{\sigma_i-1}}}\right]^{\frac{\gamma}{1-\gamma}} \times \left(\frac{\gamma}{(\gamma-1)\phi} \sum_{k\in\Omega} \frac{\prod_{i=1}^{I} p_{ij}^{\theta_i}(k)}{\prod_{i=1}^{I} N_{ij}^{\frac{\theta_i}{\sigma_i-1}}} \frac{\theta_i}{1-\sigma_i} N_{iT}^{\frac{\theta_i-1+\sigma_i}{1-\sigma_i}}\right) > 0 \tag{C6}$$

5. Price index is a component of an expression B, which in turn enter the expressions for $\overline{\phi}_j$. Thus, I find the expression for $\frac{\partial B}{\partial P}$ to be able to find the impact of the change in price index on the productivity cutoff:

$$\frac{\partial B}{\partial P} = (\gamma - 1)\frac{X}{P^{\gamma}}\left(\frac{\gamma}{\gamma - 1}\right)^{1-\gamma} > 0 \tag{C7}$$

6. Finally,

$$\frac{\partial \overline{\phi}_D}{\partial B} = \frac{1}{1-\gamma} B(F_{sunk} + F_D)^{\overline{\gamma - 1}} \frac{\pi_D}{\Gamma_D} < 0 \tag{C8}$$

$$\frac{\partial \overline{\phi}_{NT}}{\partial B} = \frac{1}{1-\gamma} B(F_{sunk} + F_{NT})^{\overline{\gamma - 1}} \frac{\pi_{NT}}{\Gamma_{NT}} < 0 \tag{C9}$$

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