

Firm-level trade effects of WTO accession: Evidence from Russia

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Abstract

This paper examines the impact of Russia's World Trade Organization (WTO) accession on international trade patterns at the firm level. A large literature of cross-country studies examines the long-run trade effects of the General Agreement on Tariffs and Trade (GATT)/WTO membership. Our paper contributes to this literature by bringing short-run micro-level evidence from the experience of a large trading country. Using customs data on the monthly import and export transactions of Russian firms over the period 2011–2015, we investigate the short-run responses of firm-level trade along the intensive and extensive margins following Russia's WTO accession in 2012. Our results indicate an increase in the number of foreign countries that Russian firms export to or import from, and a significant increase in the number of exported products. The evidence on the effects of the WTO accession on the intensive margin of firm-level trade is mixed. Additionally, we find suggestive evidence that the Russian retaliatory food embargo imposed in response to the Crimean economic sanctions might have been intended as a protectionist policy to help out a vulnerable domestic industry (i.e. agriculture) directly impacted by the country's WTO accession.

KEYWORDS

GATT, Russian trade, Russian firms, trade barriers, trade policy uncertainty, WTO

JEL CLASSIFICATION

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1 | INTRODUCTION

The World Trade Organization (WTO) and its predecessor, the General Agreement on Tariffs and Trade (GATT), have been the pillars of the global trading system, continuously promoting market integration through the gradual removal of tariffs and other barriers to trade. Today, the WTO is the largest international trade agreement with over 160 member countries worldwide. Membership to the GATT/WTO not only guarantees 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's (2004) seminal paper, who disputes such gains, has stirred a lot of attention and interest in the empirical trade literature. The failure to identify empirically large positive benefits of WTO membership on international trade flows has raised questions about the estimation strategy and data sample. Still, more than fifteen years later, after substantial empirical research on this topic, the public interest about the role of WTO membership in promoting international trade has not subsided in the literature.

This paper aims to contribute to the on-going efforts to expand our understanding of the impacts of the GATT/WTO by bringing micro-level evidence from the experience of Russian importing and exporting firms following the country's 2012 accession to the WTO. Using customs data on monthly level international transactions over the period 2011–2015, we investigate the ways in which trading firms in Russia responded in the short-run to this significant trade policy change. We examine several dimensions of firm-level trade that may be directly impacted by the WTO membership, with a particular focus on capturing any short-run changes along the intensive and extensive margins. Following the work of Handley and Limao (2015, 2017), we hypothesize that Russia's accession to the WTO has the potential to decrease the trade policy uncertainty surrounding Russia's trade partners.¹ 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 value of a firm-level trade transaction. Furthermore, the accession to the WTO might also provide Russian trading firms easier access to new markets along both the product and partner country dimensions as a result of reduced barriers to trade. Finally, the accession to the WTO could increase market competition from foreign firms, which would force the least productive Russian firms to exit foreign trade.² This paper undertakes all of these empirical exercises in order to provide micro-level evidence on the main effects of Russia's WTO accession.

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 margin for both exporting and importing firms, and along the product margin for the exporters. For example, exporters trade on average 5% more products (defined at HS 8-digit level) after Russia's accession to the WTO. Additionally, exporting firms increase on average the number of export destinations by 3%. For the importing firms, we find an increase in the frequency of import shipments of about 3%. We also find that the effects of Russia's accession to the WTO had a stronger impact on the extensive margin of firm-level trade than on the intensive margin. Due to the limitations of our data sample, we are only able to estimate short-run effects of the WTO accession. While it has been shown that it takes a while for countries to experience the full benefits of multilateral trade agreements (Baier & Bergstrand, 2007; Lake et al., 2019), it is informative to illustrate the presence of significant—although small in magnitude—effects of the WTO accession for trading firms. However, given the

short-run nature of our estimates, we are likely under-estimating the full effects of WTO membership over time.

In the last part of the paper we briefly explore the connection between two of Russia's foreign trade policies: the WTO accession and the agricultural retaliatory embargo. Not too long after becoming a WTO member, Russia became the target of economic sanctions following its 2014 intervention in Crimea (Ukraine), to which Russia retaliated by imposing an agricultural trade embargo. While only a small share of Russia's trade is the subject of these trade disputes, the proximity in time of the two trade policy events requires careful consideration.³ Our analysis provides evidence of disproportionate positive impacts of WTO membership on firms that trade in at least one embargoed product (all of which are agricultural products). Such firms witness a significant increase in the frequency of imports, an increase in the average number of products imported, and a significant increase in the size of an average import transaction at firm-product-country level. These findings, which are novel to the literature, could serve as suggestive evidence that the retaliatory embargo imposed by Russia on all the foreign countries that sanctioned it was also intended as a protectionist policy to help a vulnerable domestic industry—agriculture—which was directly impacted by an increase in import competition following Russia's WTO accession. Because protectionist policies are against WTO provisions, the retaliatory embargo may have been a convenient way to kill two birds with one stone—retaliate against the countries imposing economic sanctions on Russia and protect the domestic agricultural production sector.

Our paper makes two important contributions. First, it brings firm-level evidence on the trade effects of WTO membership using the experience of a large economy other than China. Most of our knowledge to date about the impact of WTO accession on firm-level dynamics relies on Chinese data. In part, this is because micro-level datasets have become increasingly available only in recent years and there are only a few countries with prominent presence on global markets whose WTO accession happened in recent years. However, China represents an unusual case study since it is a planned economy with a substantial manufacturing base that is predominantly export-oriented, particularly towards specific foreign markets such as the United States. This calls for the need to examine other countries whose WTO accession experience may be more representative for countries around the world. Russia, by contrast, may serve this purpose well as it is a large economy with a significant presence on foreign markets⁴ and an economic structure that is more oriented towards trade in natural resources.

A second key contribution of our paper comes from our empirical findings, which identify significant but economically small short-run effects of Russia's accession to the WTO. Our analysis suggests three explanations for these outcomes: (a) Russia did not reduce import tariffs very much after its WTO accession; (b) it found an excuse to put in some significant non-tariff measures (such as the food retaliatory embargo); and (c) it was already enjoying the MFN status on its exports in most foreign countries. Other countries around the world may have experienced similar conflicting behaviors following their WTO accession by going through phased liberalization while also manifesting protectionist tendencies. This could provide some explanations as to why the cross-country evidence on the trade effects of WTO membership has not always been unanimous.

Our work contributes to several strands of literature. First of all, it contributes to the substantial work on the trade effects of the 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 & 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 & Wei, 2007). Larch et al. (2019) account for intra-national trade flows and find overall positive and significant trade effects of GATT/WTO membership, which are explained by diversion from domestic sales. Still other studies attempted to reconcile Rose's (2004) results by decomposing the aggregate WTO trade effects along the extensive and intensive margins of trade (Dutt, 2020; Dutt et al., 2013; Liu, 2009). Our findings are in line with the aggregate results in the literature in that, like Dutt et al. (2013) and Dutt (2020), we find a strong effect of WTO membership on the extensive margin of trade but not much of an effect on the intensive margin.⁵ Furthermore, like Liu (2009), we find that these effects are robust to departing from the traditional ordinary least squares (OLS) estimation method and using instead the pseudo-Poisson maximum likelihood (PPML) method.⁶

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 2001 accession to the WTO as a major trade liberalization shock. Brandt et al. (2017) examine the impact of China's WTO accession on firm-level productivity and price mark-ups. Lu and Yu (2015) exploit the same trade liberalization episode to investigate changes in industry-level markup dispersion as a way to shed light on resource misallocations. Baccini et al. (2017) use the experience of Vietnam's accession to the WTO in 2007 to investigate whether state-owned enterprises 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 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 as a policy that significantly reduced the US 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 United States. While not directly related in research scope, our paper connects to all these studies in its use of micro-level data to analyze the economic consequences of the WTO accession of a large country.

Perhaps the paper closest related to ours is Feng et al. (2017), which also studies changes in firm-level trade patterns following China's accession to the WTO. However, the aim of that paper is to understand trade policy uncertainty as a barrier to trade, hence its specific focus on Chinese exports to the United States. By contrast, our paper departs from the experience of China, and instead considers Russia's import and export patterns with respect to *all* its global trade partners, distinguishing between the status of those partners as WTO versus non-WTO members.

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 nature⁷ or employ a computable general equilibrium (CGE) framework.⁸ Several studies investigate the impact of Russia's accession to the WTO using aggregate trade data. For example, Arapova and Isachenko (2019) use an augmented gravity model to analyze the impact of a variety of Russia's foreign policies—including accession to the WTO—on aggregate imports and exports over time. Rasoulinezhad (2018) uses a similar methodology to investigate the impact of the WTO accession on separate samples of Russian trade in agricultural and industrial products. Both studies find significant and positive impacts of the WTO on Russia's exports and imports. Similar to our study, Rasoulinezhad (2018) finds a more pronounced effect of the membership on the agricultural sector.

The remainder of the paper proceeds as follows. In the next section we describe in more detail Russia's process of accession to the WTO and the accession commitments. Section 3 describes the main data sources, the construction of the estimation sample, and provides some descriptive statistics. In Section 4 we provide motivating evidence for our study, including a discussion of aggregate

firm-level trade and of the parallel trends assumption underlying our difference-in-differences strategy. Section 5 presents the estimation strategy and reports the results obtained from estimating the impact of Russia's WTO accession on various margins of firm-level trade. Section 6 describes the robustness checks and sensitivity analyses implemented to further validate our findings. Finally, Section 7 concludes.

2 | POLICY BACKGROUND: RUSSIA'S WTO ACCESSION

2.1 | Accession process

Russia applied to the GATT in 1993, but it only joined the GATT/WTO on August 22, 2012 after 19 years of negotiations. The negotiations, however, were not continuous throughout this period, with the longest break between the meetings of the accession party taking place from 2006 to 2011. After this hiatus, President Putin announced that one of the main goals of his upcoming presidency term was Russia's accession to the WTO.

There are several reasons for these significant delays in Russia's accession process. Among the most important reasons is the fact that when Russia initially applied to the GATT/WTO in early 1990s, its economy had a significantly different structure from the decentralized market economies of the existing GATT/WTO members. After the dissolution of the Soviet Union, Russia went through many socio-economic, legislative, and political reforms, which left its 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 negotiation process has been the strong lobbying interests of certain exporting industries such as auto and airplane production, agricultural sector, and services. The auto and airplane industries typically exploited the infant industry protection argument—that is, the increased need of protection for certain industries that are more prone to be displaced by competition in the short run but are capable of upgrading in the medium to long run. The agricultural industry in Russia, similar to other countries, generally struggled with the WTO's restrictions on state subsidies to the sector and with the fear of foreign competition. The service sector lobbied against intellectual property rights and the issue of foreign ownership in telecommunications, insurance, and banking industries (Åslund, 2010).

Finally, the stalemates that arose during bilateral negotiations with the United States and Georgia significantly contributed to the delays in the accession process. The point of contention in the negotiations with the United States was the Jason–Vanik amendment to the Trade Act of 1974, which limited trade with non-market economies that restricted the freedom of emigration and that were alleged to have violated human rights. The negotiations with the United States concluded on November 19, 2006. The stalemate in the bilateral negotiations with Georgia was due to an armed conflict between Russia and Georgia over the territories of Abkhazia and South Ossetia, the two *de facto* states that declared independence from Georgia in 2008. After the conflict, Russia assumed a status of protector for the two *de-facto* states and is one of their main trade partners till present day. Georgia strongly opposed Russia's accession to the WTO following this direct conflict and following Russia's recognition of the two *de-facto* states' independence. Ultimately, an agreement between Russia and Georgia was reached in October of 2011, which removed this roadblock on Russia's way to the WTO accession.

Russia's protocol of accession was voted on and confirmed by existing WTO members on December 16, 2011. Subsequently, the Russian government had a period of 220 days to ratify the

internal state law regarding the WTO accession. Because of strong anti-WTO sentiments among some Russian political parties, it took several months for the internal law to be passed. On July 21, 2012 Russia announced the ratification to the WTO, and 30 days later it became a full WTO member.

In our analysis, we use the date when the WTO membership went into effect (i.e. August 22, 2012) to mark the change in Russia's trade policy and thus the start of our treatment period. Even though Russia acted as an observer to the WTO during its negotiation process and was notified about the favorable vote on its accession in December 2011, we consider that the uncertainties about the timing and conditions of the WTO membership were fully resolved only at the time when the membership went into effect.⁹

2.2 | Accession commitments

Among the commitments that Russia undertook when joining the WTO is the liberalization of services (including telecommunications, insurance companies, and banks), the elimination of quotas that are unjustified under the WTO provisions, the elimination of industrial subsidy programs, the enforcement of the intellectual property rights, and the augmentation of the tariff schedule, which is one of the main steps of the WTO accession.

According to the WTO provisions, all WTO member countries apply the MFN tariffs to each other. For Russia, 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). Prior to the accession to the WTO, in 2011, Russia's average applied MFN tariff was 9.4% across all products, 14.3% for agricultural products, and 8.7% for manufactured goods.¹⁰ In 2015, the last year available in our sample, the average applied MFN tariff across all products has reached 7.8%, as negotiated in the accession agreement. Similarly, the average applied MFN tariff for agricultural and manufactured products decreased to the targets that were negotiated in the accession agreement, that is, 10.8% and 7.3%, respectively. The products that faced the highest import tariffs were animal products (23.2%) and beverages and tobacco (23.3%). The products with the lowest import tariffs were petroleum (5.0%) and chemicals (5.2%).¹¹ The tariff changes did not apply to the sectors that Russia deemed "most vulnerable," for which a transition period of 7–8 years was negotiated. These industries include several agricultural sub-sectors (e.g. dairy products and cereals), as well as the automotive and civil aircraft industries (Tochitskaya, 2012).

Figure 1 provides a direct illustration of the change in Russia's MFN tariffs at the HS 4-digit product level over the sample period 2011–2015. The scatterplot correlates the tariff changes between 2011 and 2015 to the initial tariff level in 2011, the year prior to Russia's WTO accession. The downward sloping fitted line indicates that the HS 4-digit industries with the highest tariffs prior to the WTO accession were also the industries experiencing the largest drops in tariffs in the first three years post-accession. Even so, for most industries the fall in import tariffs ranges between 0 and 5 percent, which often represents a modest cut compared to the initial tariff levels.

After joining the WTO, Russia has continued to rely on non-tariff measures (NTMs) to guard foreign trade—a behavior that is consistent with the existing trend of an increased reliance on NTMs by countries around the world (Bacchetta & Beverelli, 2012; Evenett, 2012). Figure 2 illustrates the evolution of the average number of NTMs per HS 4-digit product code using information from the TRAINS dataset on non-tariff measures provided by UNCTAD (2017). To construct the total number

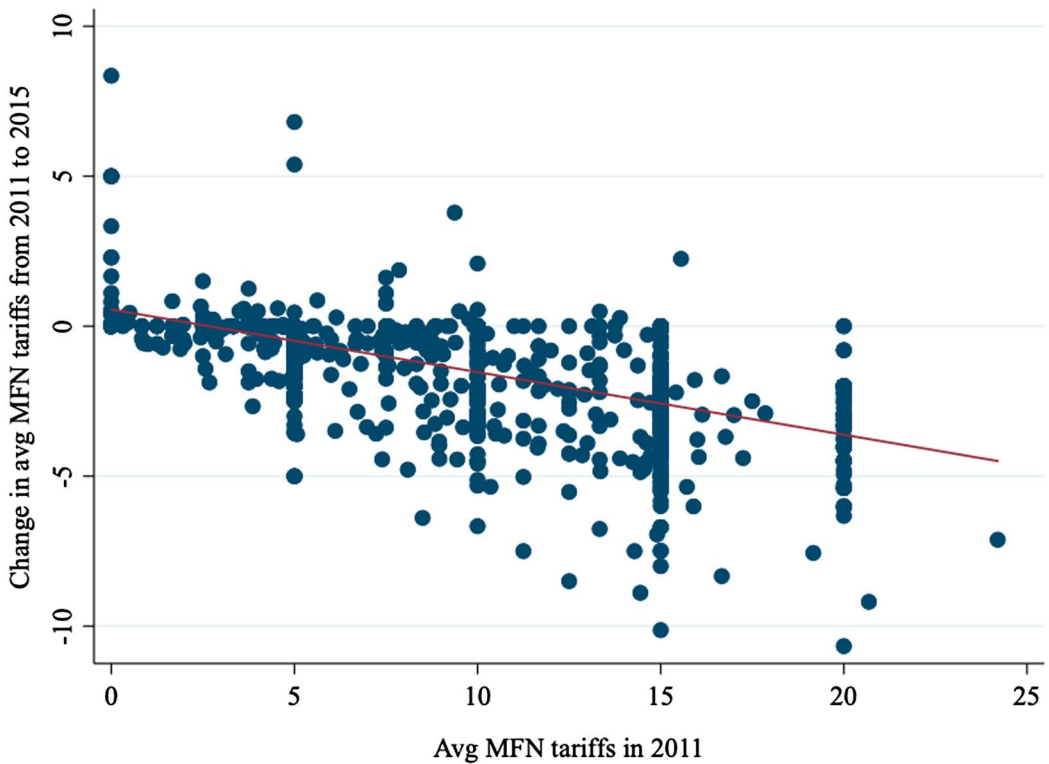


FIGURE 1 Correlation between initial MFN tariffs and the change in MFN tariffs during 2011–2015. This figure illustrates the change in Russia’s average MFN tariffs at the HS 4-digit product level over the period 2011–2015. The scatterplot correlates the tariff changes to the initial tariff level in the year prior to Russia’s WTO accession. The downward sloping fitted line indicates that the HS 4-digit industries with the highest import tariffs prior to Russia’s WTO accession are the same industries experiencing the largest drops in import tariffs in the first three years post-accession [Colour figure can be viewed at wileyonlinelibrary.com]

of NTMs in a given HS 4-digit product code, we aggregate across all categories of NTMs and across all partner countries affected by NTMs specific to that product code. As Figure 2 illustrates, the average number of NTMs per HS 4-digit product code remained fairly constant between 2010 and 2013. However, in 2014 Russia imposed a large number of new NTMs that significantly increased this average. Not only that, but the rate at which previously imposed non-tariff measures were lifted had also been slow.

The majority of NTM measures fall under one of two categories: P6 category, “Export technical measures,” and P31 category, “Export price control measures.” This suggests that the majority of these measures apply to Russian exports rather than imports. When it comes to imports, Russia has relied most frequently on phytosanitary measures. Yet, undoubtedly, the most notorious non-tariff measure utilized by Russia after its accession to the WTO is the retaliatory embargo imposed in the aftermath of the Crimean conflict (August 6, 2014). The retaliatory embargo targets a set of 48 HS 4-digit agricultural products imported from the 38 countries that impose economic sanctions on Russia and is still in place till present day.¹² All this descriptive evidence on the use of NTMs suggests that Russia’s protectionist impulses have heightened following its accession to the WTO.

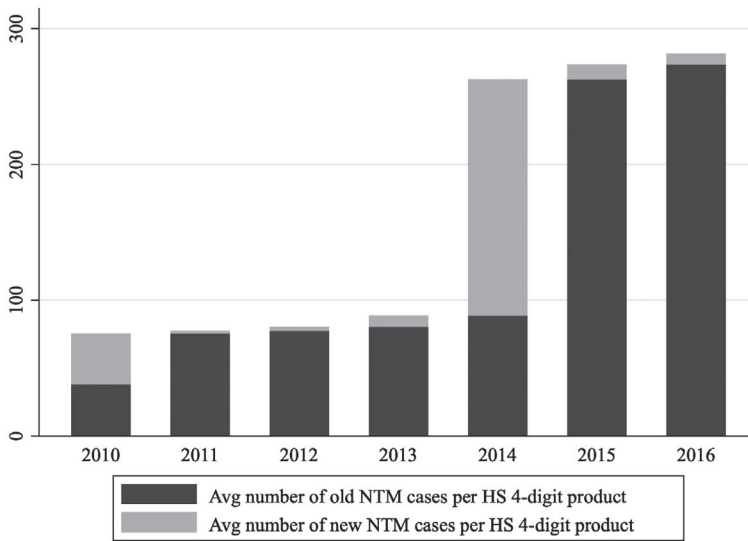


FIGURE 2 Imposition of new NTMs during the 2011–2015 period. This figure illustrates the evolution of the average number of NTMs per HS 4-digit product codes using information from the TRAINS dataset on non-tariff measures provided by UNCTAD (2017). To construct the total number of NTMs in a given HS 4-digit product code, we aggregate across all categories of NTMs and across all partner countries affected by NTMs specific to that product code

3 | DATA

3.1 | Data sources

To estimate the impact of Russia's WTO accession on a variety of firm-level trade margins we use several data sources, including a novel trade transactions dataset provided by the Russian Customs Agency,¹³ as well as standard trade datasets such as the U.N. COMTRADE database, the CEPII Gravity database, and the World Bank Global Economic Monitor database.

The Russian firm-level customs dataset covers the universe of all Russian firms that engage in foreign trade. It provides detailed information on all monthly foreign trade transactions made by Russian exporting and importing firms from 2011 to 2015.¹⁴ Each firm is identified by a unique taxpayer number. The dataset does not provide clear information on the production status of firms. About 80% of the firms report their main activity using the Russian Classification of Economic Activities (OKVED), while 20% of the firms do not. The OKVED code might not realistically reflect the firms' primary activity as the firms are not penalized for not reporting or for misreporting these codes. Of the firms that reported their main activity type in the main sample, 40% of them were engaged in "Transportation, storage, and logistics," 19% of firms reported "Wholesale" as their primary activity and 18% of firms reported "Manufacturing" as their main activity.

Our firm-level dataset is split into import and export transactions. Each observation includes information on the value of the trade transaction in US dollars, the foreign destination of the export flow, respectively the foreign source of the import flow, and the HS 8-digit code of the product being traded. All transactions are reported based on the 2012 revision of the HS product classification system.¹⁵

The U.N. COMTRADE database provides information at monthly frequency on countries' bilateral import and export flows. We utilize the COMTRADE data to construct country—month—year fixed effects to include in our estimations as proxies for multilateral resistance terms.

The CEPII (Centre d'Etudes Prospectives et d'Informations Internationales) Gravity database provides information on country specific variables such as the (population-weighted) geographic distance from Russia to a given foreign country, the GATT/WTO membership of a country, and other bilateral control variables typically used as regressors in gravity equation estimations. In our analysis we use the *de jure* definition of WTO membership rather than the *de facto* definition proposed by Tomz et al. (2007), leaving the observer countries to the WTO as part of the control group of non-WTO member countries.¹⁶ Appendix Table A1 provides the list of WTO, respectively non-WTO member countries in our sample.

Time-varying macroeconomic controls such as the price of oil reported at monthly level or the monthly exchange rate between the Russian ruble and countries' foreign currencies are sourced from St. Louis FRED and Investing.com, respectively.¹⁷ Finally, the GDP data for Russia and for the foreign countries in our sample are taken from the World Bank Global Economic Monitor database, and are recorded at quarterly level. For countries with no quarterly GDP data, we replace the missing values with yearly GDP values divided by 4 (i.e. average quarterly GDP values).

After combining all these data sources, we obtain a panel dataset of Russian firms' export and import transactions by country, HS 8-digit product code, month, and year of transaction.

3.2 | Summary statistics

For our analysis, we limit our sample to include only firms that trade exclusively in products that were not targeted by the Russian retaliatory embargo (which began in August 2014). This is done to streamline the estimation strategy and ensure that our estimates accurately capture the short-term effects of the WTO accession with no contamination from the negative implications of the retaliatory embargo. We nevertheless discuss the effects of Russia's WTO accession on firms that trade in at least one embargoed product in the robustness and sensitivity analyses section.

There is a total of 47,774 exporting firms and 129,458 importing firms in our sample.¹⁸ Prior to Russia's accession to the WTO in 2012, there were 20,225 exporting firms and 62,616 importing firms. One year after Russia joins the WTO, in 2013, the number of exporters increased to 21,005 and the number of importers increased to 69,314. Figure 3 demonstrates the seasonally adjusted dynamic in the number of Russian firms engaged in foreign trade by the WTO membership status of the partner country. The aggregate number of firms is calculated as the number of unique firms (identified by each firm's taxpayer number) that export to or import from the set of WTO-member countries, respectively the set of non-WTO member countries within a month-year time period (January 2011 to December 2015). There are significantly more firms that trade with the WTO member countries compared to firms that trade with the non-WTO member countries, which can be expected given the large number of countries with WTO membership. The raw data exhibits clear parallel trends in the number of exporting, respectively importing firms trading with WTO member countries (i.e. treatment group) and with non-WTO member countries (i.e. control group). The number of exporters trading with the WTO countries increases slightly over time, while the number of firms exporting to the non-WTO member countries stays relatively consistent. As for the importing firms, we observe a clear parallel trend in the number of firms importing from the WTO and from the non-WTO member countries prior to Russia's accession. After that, the number of firms importing from the non-WTO member countries declines, suggesting some evidence of trade diversion. The number of importing firms in both groups declines after Russia imposes the retaliatory food embargo in August 2014.

In 2011, one year prior to the accession, Russian firms exported to 176 countries, 131 of which were WTO member countries and 45 were not. One year after the accession, the number of export

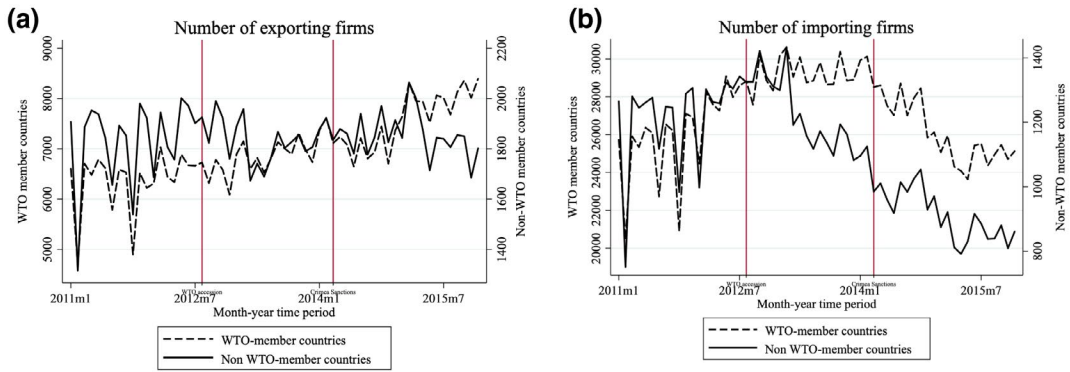


FIGURE 3 Aggregate number of firms over time. This figure presents the evolution of the total number of Russian firms engaged in foreign trade over time. The aggregate number of firms is calculated as the total number of unique firms (identified by each firm's unique taxpayer number) that export to or import from all WTO-member countries, respectively all non-WTO member countries, within a month–year time period (January 2011 to December 2015). The seasonal component is removed from the data by regressing the aggregate number of firms on monthly dummies, separately for the sample of WTO member countries and non-WTO member countries. We then predict the regression residuals and scale them up by the mean of the original series [Colour figure can be viewed at wileyonlinelibrary.com]

destinations that were WTO member countries rose to 144 and the number of destinations that were not WTO member countries rose to 47. On the import side, in 2011 Russian firms imported products from 179 countries, 135 of which were WTO member countries and 44 were not. In 2013, the number of non-WTO trade partners decreased to 37 countries, while the number of WTO member countries that Russian importers traded with remained constant. These changes could signify some degree of trade diversion for the importing firms. In terms of trade value, Russia's top six foreign trade partners with WTO membership are the United States, China, Switzerland, the United Kingdom, Germany, and Cyprus. The top six non-WTO foreign trade partners are Uzbekistan, Serbia, Azerbaijan, Tajikistan, Kazakhstan, and Belarus.

Lastly, we provide some information on within-firm dynamics. We calculate summary statistics by the WTO membership status of the partner country for various characteristics of foreign trade one year prior to Russia's accession to the WTO (i.e. year 2011) and one year after the event (i.e. year 2013). These results are presented in Table 1. On average, firms export to more destinations in 2013 in comparison to 2011. Similar patterns emerge for the importing firms: the average number of import partners increases from 1.08 in 2011 to 1.09 in 2013. Simultaneously, there is some evidence of trade diversion at the country margin for the exporting firms: the number of export destinations that are not WTO members falls from 1.15 in 2011 to 1.10 in 2013. Finally, we report the average value of a firm-level export transaction, respectively import transaction, by product and country, averaging across all months for year 2011 and 2013, respectively.

After Russia joined the WTO, we observe a decline in the average number of exported products, while the value of the average export transaction increased. These changes are consistent with an increase in firms' specialization following trade liberalization. The opposite trend holds for imports: the average number of imported products increases and the average value of an import transaction falls as new markets become available to Russian importing firms. Across both exporting and importing firms we find further signs of trade diversion away from non-WTO member countries: both the average number of traded products and trading partners fall. A firm's average import transaction is significantly lower than the average export transaction.

This could be explained by a significantly larger number of firms that participate in import activities compared to exporting.

4 | MOTIVATING EVIDENCE

Our goal is to analyze whether Russia's accession to the WTO in August 2012 had a significant effect on firm-level trade by employing a difference-in-differences estimation methodology. A key identifying assumption for such an exercise is that Russian firm-level trade with WTO member countries and with non-WTO member countries follows a similar trend prior to the country's WTO accession, after which trade with WTO member countries may be seen growing at a faster rate. To provide motivating evidence for our study and to test the parallel trends assumption, we include a brief discussion of Russia's aggregate country-level trade as well as of total firm-level trade before and after the accession.

We begin by representing graphically Russia's aggregate de-seasoned export and import flows with WTO member countries, respectively non-WTO member countries over time. These trends are presented in Figure 4. To construct this figure, we aggregate the firm-level trade transactions in our dataset within a given month and year across all firms, products, and countries, distinguishing between the WTO status of the partner country. Although the volume of trade with WTO member countries is significantly larger than the volume of trade with non-WTO member countries, the figure illustrates similar trends prior to Russia's WTO accession for both aggregate exports and imports. After the accession in August 2012, there was a clear decline in the volume of aggregate exports and imports with the non-WTO member countries while trade with the WTO member countries either remained at the pre-accession level (imports) or exhibited a very slight increase (exports).

Next we analyze total trade at the firm-level to establish whether the WTO accession had any impact on the trade behavior of firms before we proceed with a more in-depth analysis of the extensive

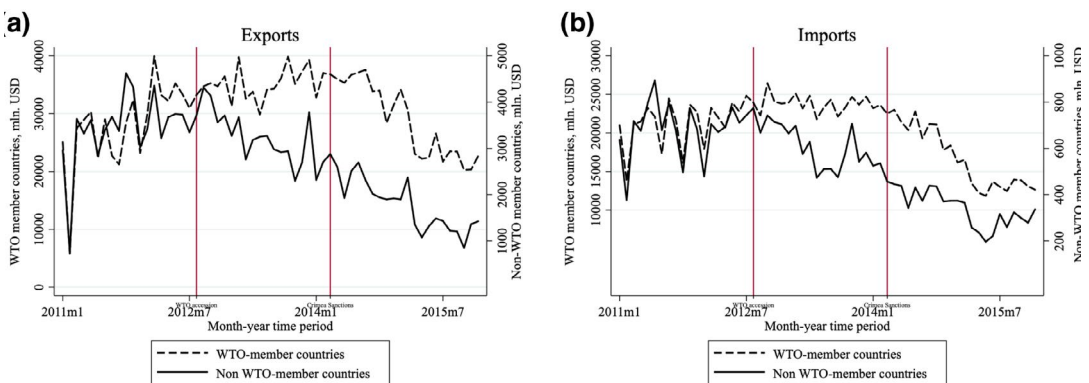


FIGURE 4 Aggregate trade flows over time. This figure presents the evolution of Russia's aggregate trade over time. The left panel plots the total value of exports to all WTO-member countries, respectively non-WTO member countries (y-axis), by month–year time period (January 2011 to December 2015). The right panel plots the total value of imports from all WTO-member countries, respectively non-WTO member countries (y-axis), by month–year time period. Total exports (imports) are calculated by aggregating all firm-level export (import) transactions involving WTO-member countries, respectively non-WTO member countries within a month–year time period. The seasonal component is removed from the data by regressing aggregate trade values on monthly dummies, separately for the sample of WTO member countries and non-WTO member countries. We then predict the regression residuals and scale them up by the mean of the original series [Colour figure can be viewed at wileyonlinelibrary.com]

and intensive margins of firm-level trade. To accomplish this, we construct a treatment variable as an interaction term between an indicator variable equal to 1 for the month–year periods post August 2012 and the WTO membership status of a foreign country j at that time, that is, $Post_t \times WTOmember_{jt}$. This will become our treatment variable of interest. The estimated coefficient from this difference-in-differences estimation exercise will capture the extent to which Russian firms change their trade patterns in relation to WTO member countries (i.e. treatment group) in the post-accession time periods relative to the pre-accession time periods. This change in trade patterns with WTO members is compared to any potential changes observed in the trade relations with non-WTO member countries (i.e. control group) over the same pre- versus post-WTO accession periods.¹⁹ A significant contrast between changes in trade flows involving WTO versus non-WTO member countries is indicative of the economic impact of Russia's WTO accession.

The regression model that we estimate to examine total firm-level trade effects takes the following form:

$$\begin{aligned} \text{Total trade}_{fjt} = & \alpha_{fj} + \alpha_t + \beta Post_t \times WTOmember_{jt} + \\ & + \delta WTOmember_{jt} + X'_{jt} \gamma + \epsilon_{fjt} \end{aligned} \quad (1)$$

where f , j , and t index the firm, foreign country, and month–year period, respectively. $Total\ trade_{fjt}$ denotes the total value of trade that firm f conducts with country j at time t . α_{fj} and α_t denote firm–country, respectively month–year fixed effects. Time-invariant gravity variables like distance, common language, or common border are captured by the first set of fixed effects, while macroeconomic conditions in Russia that may affect production and trade with all foreign countries, such as its level of GDP, price inflation, or the drastic changes in oil prices over the sample period, will all be captured by the period fixed effects.

The vector X_{jt} of control variables captures observable time-varying country characteristics that influence trade patterns, such as the quarterly GDP level of the foreign country, the (weighted) bilateral distance to the foreign country interacted with the monthly BRENT oil price (as proxy for transport costs), and the exchange rate between country j 's currency and the Russian rouble.²⁰

Given that many of the WTO member countries happen to be countries that imposed sanctions on Russia after its intervention in Crimea, and, as a result, are subsequently targeted by the Russian retaliatory embargo, it is important to carefully control for any potential negative consequences of such foreign policy decisions. Two variables in the vector X_{jt} serve this purpose: one captures the effects of the first wave of the post-Crimean sanctions imposed by a select group of countries on Russia in March 2014 (i.e. $Post\ sanctions_t \times sanct.\ country_j$), and the other variable captures Russia's counter-sanctions in the form of a retaliatory food embargo imposed in August 2014 (i.e. $Post\ embargo_t \times sanct.\ country_j$).²¹

Our treatment variable $Post_t \times WTOmember_{jt}$ varies at the country–month–year level, so it is not possible to include country–month–year fixed effects in our estimation equation to control for the multilateral resistance terms (Anderson & van Wincoop, 2003). To alleviate this concern, we use monthly COMTRADE data covering all country pairs worldwide to estimate a standard gravity equation and predict exporter–month–year, respectively importer–month–year fixed effects, which we then include in our estimating Equation (1) as a part of the vector of control variables X_{jt} . The importer–month–year fixed effects (in log form) proxy for the multilateral resistance terms of foreign countries that import goods from Russia, hence we include them in all import sample estimations. The exporter–month–year fixed effects (in log form) capture the multilateral resistance terms of foreign countries that export goods to Russia, hence we include them in all export sample estimations.

We estimate Equation (1) using PPML with high dimensional fixed effects (Santos Silva & Tenreyro, 2006), which allows us to account for a large number of zeros typically present in trade datasets. To account for correlations between the transactions of a given firm f trading in country j at time t , we cluster the standard errors at the firm–country level (ff). We carry out the analysis separately for export and for import transactions.

The results from estimating Equation (1) are reported in Table 2. The coefficient of interest is the difference-in-differences estimator β . We find that, on average, total firm-level exports and imports with WTO member countries experience a statistically significant increase of 45%, respectively 12%, following Russia's accession to the WTO.

A key identifying assumption in this type of estimation method is that, conditional on the set of control variables, the evolution of total firm-level trade with WTO member countries would have followed the same trajectory as trade with non-WTO member countries in the absence of Russia's WTO accession (i.e. parallel trends assumption). Another important condition that is necessary in order to ensure an unbiased estimate of β is the exogenous timing of Russia's WTO accession such that no firm would alter its trading behavior in expectation of the accession date. 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 verify the validity of the parallel trends assumption, we perform an event study analysis by including in Equation (1) a set of interaction terms between the dummy variable for the WTO membership of the partner country and individual dummies for the 12 months prior to Russia's WTO accession and for the 24 months following the accession. We then plot the estimated coefficients of these interaction terms with the 95% confidence intervals in Figure 5. Although both the export and import estimates exhibit an upward trend, this trend is more pronounced for the export estimates, which is in agreement with the results reported in Table 2. Importantly, the parallel trends assumption holds for both exports and imports: prior to Russia's accession to the WTO in August 2012, the majority of export and import estimates lack statistical significance, which changes (although less so for exports) after the accession month.

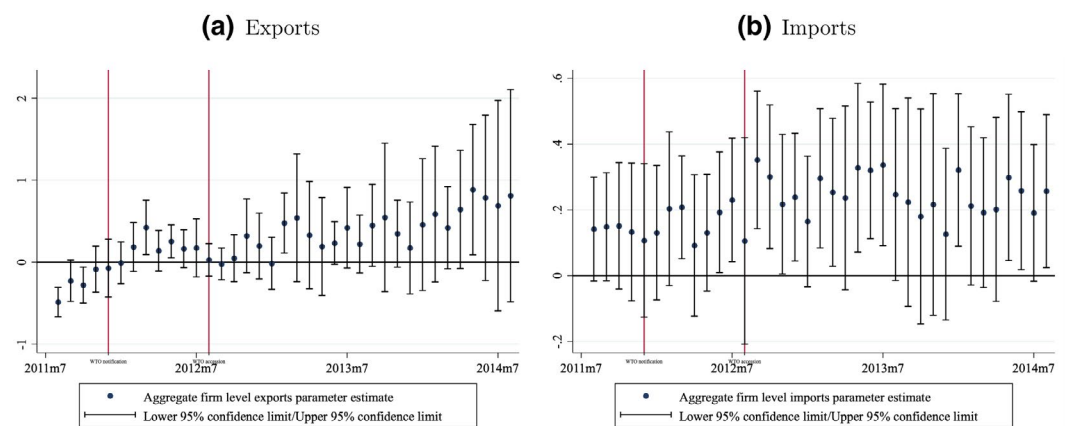


FIGURE 5 Event study of total firm-level trade. This figure presents the results of an event study of total firm-level trade. We plot the estimated coefficients and the 95% confidence intervals of the interaction terms between the dummy variable for the WTO membership of the partner country and individual time dummies for each of the 12 months prior to Russia's WTO accession and each of the 24 months following the WTO accession. All the control variables from Equation (1) are included in the estimation [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 1 Summary statistics

	EXPORTS				IMPORTS			
	WTO		Non-WTO		WTO		Non-WTO	
	(1) 2011	(2) 2013	(3) 2011	(4) 2013	(5) 2011	(6) 2013	(7) 2011	(8) 2013
Panel A: Aggregate trade								
Trade value (mil. USD)	236.3 (1013.4)	317.2 (1272.2)	84.21 (410.7)	83.51 (360.1)	186.8 (446.3)	204.1 (444.2)	21.16 (61.16)	18.71 (46.49)
	<i>n</i> = 1252	<i>n</i> = 1330	<i>n</i> = 407	<i>n</i> = 375	<i>n</i> = 1321	<i>n</i> = 1385	<i>n</i> = 398	<i>n</i> = 388
Panel B: Firm-level trade								
Average firm-level trade transaction ^a	924.33 (19,408.01)	1177.71 (23,322.02)	440.23 (9505.73)	457.71 (7899.57)	67.03 (1321.24)	61.07 (932.76)	62.46 (497.70)	57.39 (464.40)
in thousand USD (i.e. intensive margin)	<i>n</i> = 312,379	<i>n</i> = 350,124	<i>n</i> = 75,586	<i>n</i> = 66,066	<i>n</i> = 3,106,658	<i>n</i> = 3,810,066	<i>n</i> = 91,738	<i>n</i> = 86,863
Average number of traded products per firm ^b (i.e. product margin)	2.930 (8.126)	2.835 (7.016)	2.841 (7.824)	2.749 (5.820)	7.899 (22.01)	7.994 (21.60)	8.380 (25.27)	7.427 (21.01)
Average number of partner countries per firm (i.e. country margin)	1.304 (1.044)	1.317 (1.144)	1.151 (0.457)	1.101 (0.383)	1.079 (0.357)	1.089 (0.389)	1.002 (0.0460)	1.002 (0.0502)
	<i>n</i> = 239,493	<i>n</i> = 265,842	<i>n</i> = 65,685	<i>n</i> = 59,988	<i>n</i> = 2,877,935	<i>n</i> = 3,499,805	<i>n</i> = 91,552	<i>n</i> = 86,662

Notes: The table reports the variable means with standard deviations in parentheses; *n* denotes the number of observations. All averages are calculated across all firms.

^aCalculated at HS 8-digit product by country level.

^bHS 8-digit product codes traded with one country.

TABLE 2 Total firm-level trade

	Exports (1)	Imports (2)
$Post_t \times WTOmember_{jt}$	0.455* [0.249]	0.120* [0.064]
$WTOmember_{jt}$	-0.295* [0.151]	-0.506*** [0.153]
$Post\ embargo_t \times sanct.\ country_j$	-0.153 [0.098]	0.001 [0.036]
$Post\ sanctions_t \times sanct.\ country_j$	-0.002 [0.119]	0.051 [0.043]
Log quarterly GDP _{jt}	1.953*** [0.612]	0.126 [0.207]
Log transport cost _{jt}	0.040 [0.213]	-0.169*** [0.063]
Log exchange rate _{jt}	0.069 [0.168]	0.146 [0.094]
Importer-month-year FE (log)	0.030 [0.055]	
Exporter-month-year FE (log)		0.028 [0.018]
Month year FE	Yes	Yes
Firm-country FE	Yes	Yes
Observations	685,160	2,144,233
Number of firm-country groups	66,914	178,012

Notes: Standard errors clustered at firm-country level. The sample includes all firms that trade exclusively in non-embargoed products. The reported coefficients are obtained by pseudo-Poisson maximum likelihood (PPML). The dependent variable represents the total value that firm f exports to (imports from) country j in a given month-year time period t . The variable of interest is $Post_t \times WTO\ member_{jt}$ and represents an interaction term between a dummy variable equal to 1 in the month-year periods after Russia joins the WTO and the WTO membership status of the partner country j at time t . $Post\ sanctions_t \times sanct.\ country_j$ accounts for the first wave of economic sanctions imposed on Russia, while $Post\ embargo_t \times sanct.\ country_j$ captures the effect of the retaliatory embargo imposed by Russia. The estimation also controls for the quarterly GDP of the partner country, for the bilateral transport costs (measured as the product of bilateral distance and the monthly price of BRENT oil), and for the exchange rate between the Russian rouble and country j 's foreign currency. Finally, to account for country-time specific effects typically controlled for in gravity model estimations, we include country-month-year fixed effects previously generated from bilateral country-level gravity estimations based on monthly UN COMTRADE data.

* $p < .1$; ** $p < .05$; *** $p < .01$.

5 | ESTIMATION MODELS AND RESULTS

This section's purpose is twofold: (1) it describes the estimating equations for the firm-level extensive and intensive margins, as well as for the frequency of trade shipments and (2) it reports and discusses the results obtained from estimating the impact of Russia's WTO accession on firm-level

TABLE 3 Product margin of firm-level trade

	Exports		Imports	
	(1)	(2)	(3)	(4)
	Baseline specification	Government connectedness	Baseline specification	Government connectedness
$Post_t \times WTOmember_{jt}$	0.054** [0.025]	0.050** [0.025]	0.058 [0.045]	0.058 [0.045]
$Post_t \times WTO member_{jt} \times Connected firm_f$		0.107 [0.109]		0.052 [0.094]
$WTO member_{jt}$	-0.005 [0.043]	-0.002 [0.043]	-0.672*** [0.156]	-0.672*** [0.156]
$Post embargo_t \times sanct. country_j$	0.050*** [0.016]	0.050*** [0.016]	-0.008 [0.011]	-0.008 [0.011]
$Post sanctions_t \times sanct. country_j$	0.031* [0.017]	0.030* [0.017]	0.011 [0.012]	0.011 [0.012]
Log quarterly GDP _{jt}	0.140 [0.090]	0.140 [0.091]	0.199*** [0.077]	0.200*** [0.077]
Log transport cost _{jt}	-0.005 [0.022]	-0.004 [0.022]	0.002 [0.016]	0.002 [0.016]
Log exchange rate _{jt}	0.025 [0.024]	0.025 [0.024]	-0.038 [0.024]	-0.038 [0.024]
Importer-month-year FE (log)	0.023* [0.014]	0.024* [0.014]		
Exporter-month-year FE (log)			0.027*** [0.008]	0.027*** [0.008]
Firm-country FE	Yes	Yes	Yes	Yes
Month-year time period FE	Yes	Yes	Yes	Yes
Observations	685,162	685,162	2,144,233	2,144,233
Number of firm-country groups	66,915	66,915	178,012	178,012

Notes: Standard errors clustered at firm-country level. The sample includes all firms that trade exclusively in non-embargoed products. The reported coefficients are obtained by pseudo-Poisson maximum likelihood (PPML). The dependent variable represents the number of unique HS 8-digit product codes that firm f exports to (imports from) country j in a given month-year time period t . The variable of interest is $Post_t \times WTO member_{jt}$ and represents an interaction term between a dummy variable equal to 1 in the month-year periods after Russia joins the WTO and the WTO membership status of the partner country j at time t . $Connected firm_f$ is a dummy variable equal to 1 if a firm has connections to the Russian government and 0 otherwise. $Post sanctions_t \times sanct. country_j$ accounts for the first wave of economic sanctions imposed on Russia, while $Post embargo_t \times sanct. country_j$ captures the effect of the retaliatory embargo imposed by Russia. The estimation also controls for the quarterly GDP of the partner country, for the bilateral transport costs (measured as the product of bilateral distance and the monthly price of BRENT oil), and for the exchange rate between the Russian rouble and country j 's foreign currency. Finally, to account for country-time specific effects typically controlled for in gravity model estimations, we include country-month-year fixed effects previously generated from bilateral country level gravity estimations based on monthly UN COMTRADE data.

* $p < .1$; ** $p < .05$; *** $p < .01$.

trade patterns. Our micro-level dataset includes information on monthly import and export transactions by firm, by (HS 8-digit) product and by foreign country. The richness of the data gives us the opportunity to study various margins of firm-level trade.

The underlying hypothesis for all our estimation exercises is that the WTO membership comes with reduced barriers to trade, increased access to foreign markets, and reduced trade policy uncertainty, all of which should contribute to an increase in Russia's imports and exports. In our context, trade policy uncertainty stems from at least two sources. First, the timing and specific conditions surrounding Russia's accession to the WTO were uncertain and quite difficult to anticipate by trading firms. Second, although Russian exporters benefited from MFN tariffs even before the country's accession to the WTO, the threat of tariff reversals to non-preferential levels acted as a significant deterrent to trade (Handley & Limao, 2015, 2017). In fact, one of the key benefits of joining the WTO is the increased stability and predictability of member countries' trade policy (Limao & Maggi, 2015).²²

5.1 | Product margin

We begin our analysis of firm-level margins of trade by investigating the impact of Russia's WTO membership on the product margin of exporting and importing firms. We define the product margin as the number of unique HS 8-digit product codes traded by a firm with a given foreign country in each month during the 2011–2015 sample period. Our methodological approach to evaluate the response of Russian firms to the country's WTO accession is the same as for the analysis of the total firm-level trade. Thus, the difference-in-differences estimation equation that we propose for the product extensive margin takes the following form:

$$\begin{aligned} Prod_{fjt} = & \beta Post_t \times WTOmember_{jt} + \delta WTOmember_{jt} + \\ & + X'_{jt} \gamma + \alpha_{ff} + \alpha_t + \epsilon_{fjt} \end{aligned} \quad (2)$$

where f , j , and t index the firm, the foreign country, and the month–year period, respectively. $Prod_{fjt}$ denotes the number of HS 8-digit product codes that are traded by firm f with country j at time t . The vector X_{jt} is the same as previously defined (i.e. it includes the quarterly GDP of the foreign partner, the bilateral distance interacted with the monthly oil price, the real exchange rate, time trends for the first wave of economic sanctions and for the retaliatory embargo, as well as proxies for the multilateral resistance terms). α_{ff} denotes the firm–country fixed effects and α_t denotes the month–year time fixed effects. We estimate Equation (2) using PPML.²³

The results from estimating Equation (2) are presented in columns 1 and 3 of Table 3. We find that the number of HS 8-digit product codes exported by a Russian firm to a WTO member country experiences, on average, a statistically significant increase of 5% after Russia's accession to the WTO. We do not find, however, any statistically significant impact on the number of imported products. The insignificant import effect could be a consequence of our short-run analysis and of the modest reduction in import tariffs following Russia's WTO accession. It also sheds light on the heterogeneous impact that WTO membership may have on trading firms. While the main sample consists of firms that trade exclusively in products that were not embargoed by Russia in response to the economic sanctions, in the robustness and sensitivity analyses section we show that the import product margin increased significantly post-WTO accession for firms that trade in at least one embargoed product. All embargoed products are agricultural products, and agricultural goods have generally faced significantly higher tariffs than manufacturing goods. Our finding that the product margin responded stronger for firms that trade in embargoed goods is consistent with this fact.

Following Baccini et al. (2017), we check whether a firm's connection to the Russian government exposes it in a different way to the market changes brought by the country's WTO accession. One possibility

is that the firms connected to the state are more likely to benefit from government protection following the WTO accession compared to firms that have no connection to the government. To test this hypothesis, we add to our regression Equation (2) an interaction term between our treatment variable and a firm-specific indicator, *Connected firm_f*, that takes the value of 1 if a firm has any connections to the Russian government and 0 otherwise. A firm is classified as connected to the state if one of the two scenarios is true: (1) a firm is owned by the government and is funded from the federal budget (e.g. state universities and hospitals, state producers) or (2) a firm is publicly traded and the Russian government owns shares in this firm (e.g. Sberbank, VTB bank, KamAZ, AutoVAZ, etc.). The information on firms' ownership is either inferred from the firm's name (all state owned enterprises in Russia have some indication of governmental ownership in their name such as "state," "federal," "government"), or it is collected from a list of state owned firms that is maintained by the Russian government.²⁴

The results of this estimation are presented separately for exporting and importing firms in columns 2, respectively 4 of Table 3. *Post_t × WTO member_{jt}* captures the effect of Russia's accession to the WTO on privately owned firms. To understand whether the firms connected to the state respond differently, we need to calculate the marginal effect by combining the main treatment coefficient with the one from the triple interaction term (involving the *Connected firm_f* dummy). We test the significance of this marginal effect using an F-test. We do not find any evidence of a statistically significant difference in the product margin response between firms connected to the government and privately owned firms.

5.2 | Country margin

Next we estimate the country extensive margin, which we define as the number of unique partner countries within the set of WTO member countries, respectively non-WTO member countries, that an average firm trades with in a particular HS 8-digit product code in a given month. Our motivation to include the discussion of the country margin stems from the fact that WTO membership grants benefits such as increased access to new markets, more predictability in member countries' trade policies, lower tariffs and potentially some non-tariff barriers. Additionally, Russia's accession to the WTO might increase its appeal as a trade partner for other countries, increasing the number of partners an average firm can trade with.

Similar to previous estimations, we use the following difference-in-differences specification to estimate the impact of Russia's WTO accession on the country margin:

$$\begin{aligned} \text{Country}_{fkm} &= \beta \text{Post}_t \times \text{WTOmember}_{mt} + \\ &+ X'_{mt} \gamma + \alpha_{fkm} + \alpha_t + \epsilon_{fmk} \end{aligned} \quad (3)$$

where *f*, *k*, *m*, and *t* stand for firm, HS 8-digit product code, country group, 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. We introduce this grouping of countries to be able to control for the effects of the economic sanctions imposed on Russia in March 2014, and the Russian retaliatory embargo introduced in August 2014.²⁵ Thus, the dependent variable *Country_{fmk}* denotes the number of foreign countries within a given country group *m* that firm *f* trades with in product *k* in a given time period *t*.

The coefficient β for the variable of interest, *Post_t × WTOmember_{mt}*, captures the effect of Russia's accession to the WTO on the firm-level country margin. The vector *X_{mt}* controls for

the set of time-varying macroeconomic variables that characterize country group m , such as the combined GDP of countries in group m and the (population-weighted) average distance between Russia and these countries interacted with the monthly oil price. Lastly, $\alpha_{\beta km}$ and α_t denote firm-product-country group fixed effects, respectively month-year fixed effects.

The results from estimating Equation (3) are presented in columns 1 and 4 of Table 4. We find that Russia's accession to the WTO resulted in the exporting firms increasing the number of foreign destinations by about 3%, while for the importing firms the effect is statistically significant but close to zero in magnitude.

As with the product margin, we examine whether the impact on the country margin differs between firms with some connection to the government and privately owned firms. To check this, we include the interaction term $Post_t \times WTO\ member_{mt} \times Connected\ firm_f$ described in detail in the previous subsection. These results are presented in column 2, respectively column 5 of Table 4 for the exporting and importing firms. We find that connectedness to the state significantly increases the number of partner countries that a firm trades with, in comparison to privately owned firms, for both exporting and importing firms. Government connectedness increases the number of export destinations by 16% after Russia's accession to the WTO versus 2% for privately owned firms. The number of trading partners for the privately owned importers does not experience a change, while governmentally connected importers increase that number by 6%.

Lastly, we examine whether the effects that we have estimated in our country margin analysis are due to the decrease in import tariffs or due to the decrease in trade policy uncertainty (or the weakening of other non-tariff barriers).²⁶ To do this, we rely on UNCTAD Trade Analysis Information System (TRAINS) data to collect information on Russia's average import tariffs at the HS 4-digit product code level. We construct a variable that measures the change in average tariff duty between 2011 and 2015, $\Delta Tariff_{HS4}$. This is an industry-specific variable meant to capture the extent of trade liberalization observed across industries during our sample period.²⁷ Next, we construct a triple interaction term $Post_t \times WTO\ member_{mt} \times \Delta Tariff_{HS4}$ to measure any changes in trade patterns that can be attributed to changes in import tariffs following Russia's accession to the WTO. We include in equation (3) the newly defined interaction term along with the original treatment variable of interest in order to separately identify the effect of tariff changes from non-tariff barriers (which would include trade policy uncertainty). These results are presented in column 3, respectively column 6 of Table 4 for exporting and importing firms.

We do not find evidence of a significant impact of the industry-specific tariff changes on the country margin of the firm-level trade following Russia's accession to the WTO. The interaction term coefficients are either statistically insignificant or are statistically significant but zero in magnitude. The baseline results capture the effects of the WTO accession due to changes in non-tariff barriers, which would include any reductions in trade policy uncertainty. These results are not surprising given that import tariffs generally take longer time post-accession to change to their new equilibrium levels (hence the small change in tariffs observed in our data). Yet changes in non-tariff trade barriers that include the decrease in trade policy uncertainty can happen immediately after WTO entry.

5.3 | Firm-level intensive margin

We complement the extensive margin analysis with the analysis of the intensive margin of trade, which we define as the value of a trade transaction carried out by a firm f in a foreign market j for

TABLE 4 Country margin of firm-level trade

	Exports		Imports		(6)	
	(1)	(2)	(3)	(4)		(5)
	Baseline specification	Government connectedness	Tariffs	Baseline specification	Government connectedness	Tariffs
$Post_t \times \text{WTO member}_{im}$	0.030 ^{***} [0.004]	0.026 ^{***} [0.004]	0.028 ^{***} [0.005]	0.007 ^{***} [0.001]	0.006 ^{***} [0.001]	0.008 ^{***} [0.001]
$Post_t \times \text{WTO member}_{im} \times \text{Connected firm}_y$		0.124 ^{***} [0.019]			0.053 ^{***} [0.008]	
$Post_t \times \text{WTO member}_{im} \times \Delta \text{Tariff}_{HS4}$			-0.001 [0.001]			-0.000 [*] [0.000]
$Post \text{ embargo}_t \times \text{sanct. country}_m$	0.025 ^{***} [0.004]	0.025 ^{***} [0.004]	0.026 ^{***} [0.004]	-0.004 ^{***} [0.001]	-0.005 ^{***} [0.001]	-0.003 ^{***} [0.001]
$Post \text{ sanctions}_t \times \text{sanct. country}_m$	0.007 [*] [0.004]	0.007 [*] [0.004]	0.007 [*] [0.004]	0.002 ^{***} [0.001]	0.002 ^{***} [0.001]	0.003 ^{***} [0.001]
Log cumulative quarterly GDP_{im}	0.419 ^{***} [0.048]	0.444 ^{***} [0.048]	0.403 ^{***} [0.050]	0.013 [0.012]	0.018 [0.012]	-0.065 ^{***} [0.013]
Log transport cost _{im}	0.095 ^{***} [0.013]	0.099 ^{***} [0.013]	0.091 ^{***} [0.013]	-0.038 ^{***} [0.004]	-0.038 ^{***} [0.004]	-0.048 ^{***} [0.005]
Firm-product-country group FE	Yes	Yes	Yes	Yes	Yes	Yes
Month-year time period FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,525,203	1,525,203	1,428,027	15,136,325	15,136,325	13,437,148
Number of firm-product-country group	195,623	195,623	183,976	1,882,679	1,882,679	1,685,174

Notes: Standard errors clustered at firm-product-country group level. The sample includes all firms that trade exclusively non-embargoed products. The reported coefficients are obtained by pseudo-Poisson maximum likelihood (PPML). The dependent variable represents the number of unique partner countries from group m that firm f exports to (imports from) product k in a given month-year 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. WTO member_{im} is equal to 1 if country group m consists of WTO members, and 0 otherwise. The variable of interest is $Post_t \times \text{WTO member}_{im}$ and represents an interaction term between a dummy variable equal to 1 in the month-year periods after Russia joins the WTO and the WTO membership status of the country group m . Connected firm_y is a dummy variable equal to 1 if a firm has connections to the Russian government and 0 otherwise. $\Delta \text{Tariff}_{HS4}$ is a continuous variable that captures the change in import tariffs measured at HS 4-digit product level from year 2011 to 2015. $\text{Post}_t \text{ sanctions}_t \times \text{sanct. country}_m$ accounts for the first wave of economic sanctions imposed on Russia, while $\text{Post}_t \text{ embargo}_t \times \text{sanct. country}_m$ captures the effect of the retaliatory embargo imposed by Russia. The estimation also controls for the cumulative quarterly GDP of all the partner countries within each group m and for the average transport costs (measured as the product of the average weighted distance between all trade partners within country group m and the monthly price of BRENT oil).

* $p < .1$; ** $p < .05$; *** $p < .01$.

an HS 8-digit product k at time t . Our goal is to characterize any changes in trade values caused by Russia's WTO accession for the firms already active in particular product–country markets (i.e. trading in that product and market since before the accession). Towards this goal, we estimate the following difference-in-differences specification:

$$\begin{aligned} Trade_{fjkt} = & \beta Post_t \times WTOmember_{jt} + WTOmember_{jt} + \\ & + X'_{jt} \gamma + \alpha_{fjk} + \alpha_t + \epsilon_{fjkt} \end{aligned} \quad (4)$$

where f , j , k , and t stand for firm, foreign country, HS 8-digit product code, and month–year time period, respectively. $Trade_{fjkt}$ represents the value of an import or export transaction per firm–country–product–month. Similar to equation (2), the treatment variable that captures the effect of Russia's accession to the WTO on the intensive margin of firm-level trade is represented by the interaction term $Post_t \times WTOmember_{jt}$. The vector X_{jt} , as defined in the discussion of product margin, contains a set of time-varying country characteristics that influence trade patterns (i.e. the quarterly GDP of the partner country, the real exchange rate, the bilateral distance interacted with the monthly oil price, trends for the first wave of economic sanctions and for Russia's retaliatory food embargo, as well as proxies for the multilateral resistance terms). Lastly, α_{fjk} and α_t denote firm–country–product fixed effects, respectively month–year fixed effects.

We estimate Equation (4) and report the results in columns 1 and 4 of Table 5 for exporting, respectively for importing firms. Overall, we do not find any significant impact of Russia's WTO accession on the firm-level intensive margin of trade. This finding is consistent with several studies on the effect of the WTO membership on aggregate trade. Like Dutt et al. (2013), we find a significant effect of WTO membership on the extensive margin of firm-level trade (i.e. product and country margins) but not much of an effect on the intensive margin of trade.

Next, we perform two heterogeneity analyses for our intensive margin estimates. First, we check whether the intensive margin effects differ between privately owned firms and governmentally connected firms. We find no statistically significant differences between the two groups of firms (neither for exporting firms nor for importing firms). Second, we test whether the identified changes in the intensive margin of firm-level trade are due to reductions in Russia's tariff duties or are due to non-tariff trade barriers such as trade policy uncertainty. Once again, sector-specific changes in import tariffs do not seem to have an effect on the intensive margin of firm-level trade, nor do any changes in non-tariff barriers, which would include the reduction in trade policy uncertainty.

5.4 | Foreign trade frequency

Finally, we propose a less conventional exercise to analyze the impacts of Russia's accession to the WTO on the exporting and importing firms by analyzing their activity in terms of the frequency with which they engage in international transactions. We hypothesize that the reduction in trade policy uncertainty following Russia's WTO accession could lead firms to respond by trading more frequently (rather than trading higher volumes per transaction). To test this hypothesis, we estimate a similar regression model as before, given by the following equation:

$$\begin{aligned} Freq_{fjkh} = & \beta Post_h \times WTOmember_{jh} + \\ & + X'_{jh} \gamma + \alpha_{fjk} + \alpha_h + \epsilon_{fjkh} \end{aligned} \quad (5)$$

TABLE 5 Intensive margin of firm-level trade

	Exports		Imports			
	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline specification	Government connectedness	Tariffs	Baseline specification	Government connectedness	Tariffs
$Post_t \times WTOmember_{jt}$ WTO	-0.005 [0.106]	-0.033 [0.107]	0.012 [0.111]	0.035 [0.070]	0.036 [0.070]	0.026 [0.080]
$Post_t \times WTO member_{jt} \times Connected_{firm_j}$		0.136 [0.121]			-0.010 [0.075]	
$Post_t \times WTO member_{jt} \times \Delta Tariff_{HS4}$			0.009 [0.020]			-0.005 [0.006]
WTO member _{jt}	-0.023 [0.107]	0.011 [0.100]	-0.026 [0.110]	-0.106 [0.103]	-0.107 [0.103]	-0.036 [0.094]
$Post$ sanctions, \times sanct. country _j	n.a. ^a	0.001 [0.080]	0.002 [0.081]	0.040 [0.032]	0.040 [0.032]	0.045 [0.034]
$Post$ embargo, \times sanct. country _j	-0.097 [0.087]	-0.098 [0.077]	-0.099 [0.077]	0.000 [0.030]	0.000 [0.030]	-0.007 [0.033]
Log quarterly GDP _{jt}	1.665*** [0.514]	1.555*** [0.508]	1.682*** [0.514]	0.098 [0.163]	0.100 [0.164]	0.143 [0.176]
Log transport cost _{jt}	-0.030 [0.118]	-0.029 [0.118]	-0.035 [0.118]	-0.133*** [0.047]	-0.133*** [0.047]	-0.126*** [0.050]
Log exchange rate _{jt}	0.005 [0.119]	0.021 [0.130]	0.007 [0.128]	0.133* [0.070]	0.132* [0.070]	0.142* [0.077]
Importer-month-year FE (log)	0.011 [0.040]	0.011 [0.039]	0.010 [0.040]			
Exporter-month-year FE (log)				0.025***	0.025***	0.030**

(Continues)

TABLE 5 (Continued)

Exports		Imports			
(1)	(2)	(3)	(4)	(5)	(6)
Baseline specification	Government connectedness	Tariffs	Baseline specification	Government connectedness	Tariffs
Firm-product-country FE	Yes	Yes	Yes	Yes	Yes
Month-year time period FE	Yes	Yes	Yes	Yes	Yes
Observations	1,763,851	1,645,900	15,840,330	15,840,330	14,071,274
Number of firm-product-country groups	243,539	227,868	2,050,497	2,050,497	1,834,697

Notes: Standard errors clustered at firm-product-country level. The sample includes all firms that trade exclusively in non-embargoed products. The reported coefficients are obtained by pseudo-Poisson maximum likelihood (PPML). The dependent variable represents the value of an export (import) transaction that firm f trades with country j in product k in a given month-year time period t . The variable of interest is $Post_i \times WTO_member_j$, and represents an interaction term between a dummy variable equal to 1 in the month-year periods after Russia joins the WTO and the WTO membership status of the partner country j at time t . $Connected_firm_j$ is a dummy variable equal to 1 if a firm has connections to the Russian government and 0 otherwise. $\Delta Tariff_{HS}$ is a continuous variable that captures the change in import tariffs measured at HS 4-digit product level from year 2011 to 2015. $Post$ sanctions, \times sanct. country, accounts for the first wave of economic sanctions imposed on Russia, while $Post$ embargo, \times sanct. country, captures the effect of the retaliatory embargo imposed by Russia. The estimation also controls for the quarterly GDP of the partner country, for the bilateral transport costs (measured as the product of bilateral distance and the monthly price of BRENT oil), and for the exchange rate between the Russian rouble and country j 's foreign currency. Finally, to account for country-time specific effects typically controlled for in gravity model estimations, we include country-month-year fixed effects previously generated from bilateral country level gravity estimations based on monthly UN COMTRADE data.

^aDue to estimation convergence issues we are unable to control for the first wave of sanctions using $Post$ sanctions, \times sanct. country, variable.

* $p < .1$; ** $p < .05$; *** $p < .01$.

where f, j, k , and h index the firm, foreign country, HS 8-digit product code, and a half-year time period, respectively. 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 . We estimate the trade frequency regression over six-month time intervals because of the short length of our panel dataset spanning the period 2011–2015.²⁸ All the other variables and fixed effects are defined as before, with the mention that the time dimension for this specification is set to half year intervals, h , instead of month–year time periods, t , as before.

We estimate Equation (5) and report the results in columns 1 and 4 of Table 6 for exporting, respectively for importing firms. Interestingly, we find radically different results for the average frequency of export and import transactions. While the frequency of exporting to a WTO member country decreases on average by 1%, the average frequency of importing from a WTO member country increases by 3% following Russia's WTO accession. These results could be partially explained by the fact that exporting firms experienced an increase in both their product and country margins of larger magnitudes than importing firms, a strategy of diversification which could adversely impact the frequency of their trade transactions in a given product and foreign market. Importing firms, on the other hand, may have responded to the increased ease of trading with WTO member countries by increasing the frequency of their trade transactions.

Finally, we perform the same two heterogeneity analyses for the frequency estimates: (1) comparing governmentally connected firms to privately owned firms, and (2) differentiating between the contribution of tariffs versus non-tariff barriers (which include trade policy uncertainty). Regarding exercise (1), we find statistically significant differences between responses in trade frequency of the two groups of firms for both exporters and importers. The frequency of foreign trade transactions for private exporters decreases by 1% (the baseline results are determined by privately owned firms), while it increases by 11.7% for the firms with a connection to the government. Similarly, the increase in trade frequency for the governmentally connected importing firms is about twice as large as for the privately owned firms (6% versus 2.9%). Thus, governmentally connected firms increase their exporting and importing frequency after Russia joins the WTO. Regarding exercise (2), similar to the country extensive margin and to the intensive margin of firm-level trade, we find that our baseline results are determined by a reduction in non-tariff barriers and/or trade uncertainty, while the change in industry-specific import tariffs had little to no significant effect on the frequency of firm-level trade.

6 | ROBUSTNESS CHECKS AND SENSITIVITY ANALYSES

In this section, we report a set of robustness exercises and sensitivity analyses that are meant to increase the confidence in our estimation results as well as to verify their sensitivity across different subsamples of data.

6.1 | WTO versus non-WTO sample

In our first robustness exercise, we check whether there are any effects of Russia's WTO accession on trade with non-WTO member countries. The goal is to understand whether Russia's WTO membership had any spillover effects on trade with non-WTO countries. This exercise is motivated by the fact that the aggregate trends illustrated in Figures 3 and 4 seem to suggest the possibility of trade diversion away from the non-WTO member countries.

To investigate this hypothesis, we re-estimate the regression Equations (2)–(4) for two separate subsamples: one consisting of trade flows with only non-WTO member countries and the second one consisting of trade flows with only WTO member countries. To capture the changes in trade post accession in the two separate subsamples, our treatment variable of interest becomes $Post_t$ (i.e. a dummy variable that takes the value of 1 after Russia joined the WTO in August 2012). The country dimension of the original treatment variable needs to be removed due to the splitting of the sample by the WTO membership status of partner countries. To exploit some heterogeneity in treatment across sectors (and to reassure of the correct identification of the WTO membership effect), we also include in the estimation the interaction term $Post_t \times \Delta Tariff_{HS4}$, to capture any changes in the dependent variable due to the drop in tariffs associated with Russia's WTO membership. To control for seasonality we include month fixed effects. Note that because the variable of interest has only one dimension of variation—time—we cannot include period (i.e. month–year) fixed effects to control for any macroeconomic shocks. For this reason, in addition to the usual country-specific characteristics used in the previous estimations, we also include a vector of time-varying control variables such as Russia's quarterly GDP level or the monthly level of oil prices to account for the omitted period fixed effects.²⁹

The results from our estimations on the two country subsamples for exporting firms, respectively for importing firms, are presented in Table 7, respectively Table 8. After carefully controlling for the main determinants of trade and for any pre-existing trends, we do not find evidence for an impact of Russia's WTO accession on imports from the non-WTO member countries. We do, however, identify a small and statistically significant positive effect on the country margin of firm-level exports. That is, we find that after Russia joins the WTO, exporting firms begin to export, on average, to 1% more non-WTO member countries, which translates to an increase of about 0.1 partner countries. It remains unclear whether this effect is an artifact of the caveat surrounding this robustness exercise—that is, the fact that the treatment variable (i.e. $Post_t$) does not correspond exactly to the treatment variable in the main model specifications (i.e. $Post_t \times WTOmember_{jt}$) and could conflate any other contemporaneous time trends. Another potential explanation for this finding is the possibility that some liberalization benefits from Russia's WTO accession impacted all international transactions irrespective of the membership status of the foreign trade partner. For example, it could be the case that an increase in the stability or predictability of Russia's trade policy (which is ensured by its WTO membership) positively affects trade with all foreign countries. Taken all together, we find that Russia's accession to the WTO impacted Russian firms that trade with the WTO member countries in the direction expected from our hypotheses, and had no or very limited spillover effects onto trade with the non-WTO countries along the various firm-level margins.

6.2 | Timing of the treatment variable

In our second robustness exercise, we discuss the sensitivity of our findings to the timing of our treatment variable. Russia's accession to the WTO was a lengthy and uncertain process, however the possibility of becoming a WTO member became real once the existing members voted in favor of the country's adherence in December 2011. One might argue that if an important benefit of the WTO membership lies in the reduction of trade policy uncertainty, perhaps such uncertainty gets resolved at the notification stage rather than at the time when the membership went into effect. In our analysis so far, we chose the date of Russia's official entry into the WTO as the start of our treatment period. This was done in order to remain consistent with the work of the previous literature, but also because

TABLE 6 Transaction frequency of firm-level trade

	Exports		Imports			
	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline specification	Government connectedness	Tariffs	Baseline specification	Government connectedness	Tariffs
$Post_t \times WTOmember_{jt}$	-0.014 ^{***} [0.005]	-0.017 ^{***} [0.005]	0.006 [0.005]	0.030 ^{***} [0.005]	0.029 ^{***} [0.005]	0.037 ^{***} [0.006]
$Post_t \times WTO\ member_{jt} \times Connected\ firm_y$		0.127 ^{***} [0.013]			0.029 ^{***} [0.009]	
$Post_t \times WTO\ member_{jt} \times \Delta Tariff_{jst4}$			0.006 ^{***} [0.001]			-0.002 ^{***} [0.000]
WTO member _{jt}	0.053 ^{***} [0.012]	0.056 ^{***} [0.012]	0.055 ^{***} [0.013]	-0.122 ^{***} [0.024]	-0.122 ^{***} [0.024]	-0.137 ^{***} [0.025]
$Post\ embargo_{jt} \times sanct.\ country_j$	0.022 ^{***} [0.004]	0.022 ^{***} [0.004]	0.019 ^{***} [0.004]	0.004 ^{**} [0.002]	0.004 ^{**} [0.002]	0.004 ^{***} [0.002]
$Post\ sanctions_t \times sanct.\ country_j$	0.030 ^{***} [0.004]	0.029 ^{***} [0.004]	0.032 ^{***} [0.004]	0.002 [0.001]	0.002 [0.001]	0.002 [0.002]
Log GDP _{jt}	0.176 ^{***} [0.021]	0.177 ^{***} [0.021]	0.168 ^{***} [0.022]	-0.071 ^{***} [0.011]	-0.071 ^{***} [0.011]	-0.051 ^{***} [0.011]
Log transport cost _{jt}	-0.018 ^{***} [0.005]	-0.017 ^{***} [0.005]	-0.017 ^{***} [0.005]	0.026 ^{***} [0.002]	0.026 ^{***} [0.002]	0.025 ^{***} [0.002]
Log exchange rate _{jt}	0.062 ^{***} [0.008]	0.061 ^{***} [0.008]	0.082 ^{***} [0.008]	0.035 ^{***} [0.005]	0.035 ^{***} [0.005]	0.035 ^{***} [0.005]
Importer-half year FE (log)	0.065 ^{***} [0.003]	0.066 ^{***} [0.003]	0.061 ^{***} [0.003]			

(Continues)

TABLE 6 (Continued)

	Exports		Imports			
	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline specification	Government connectedness	Tariffs	Baseline specification	Government connectedness	Tariffs
Exporter-half year FE (log)				0.018*** [0.001]	0.018*** [0.001]	0.015*** [0.001]
Firm-product-country FE	Yes	Yes	Yes	Yes	Yes	Yes
Biannual time period FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	741,397	741,397	693,164	6,138,185	6,138,185	5,508,063
Number of firm-product-country groups	202,270	202,270	189,674	1,668,395	1,668,395	1,497,315

Notes: Standard errors clustered at firm-product-country level. The sample includes all firms that trade exclusively in non-embargoed products. The reported coefficients are obtained by pseudo-Poisson maximum likelihood (PPML). The dependent variable represents the number of months in a given half year period h that firm f exports (imports) product k to (from) country j . The variable of interest is $Posr_{jt} \times WTO\ member_{jt}$ and represents an interaction term between a dummy variable equal to 1 in the half-year periods after Russia joins the WTO and the WTO membership status of the partner country j during period h . $Connected\ firm_{jt}$ is a dummy variable equal to 1 if a firm has connections to the Russian government and 0 otherwise. $\Delta Tariff_{RUS4}$ is a continuous variable that captures the change in import tariffs measured at HS 4-digit product level from year 2011 to 2015. $Posr\ sanctions_j \times sanct.\ country$ accounts for the first wave of economic sanctions imposed on Russia, while $Posr\ embargo_j \times sanct.\ country$ captures the effect of the retaliatory embargo imposed by Russia. The estimation also controls for the half-year GDP of the partner country, for the bilateral transport costs (measured as the product of bilateral distance and the monthly price of BRENT oil), and for the exchange rate between the Russian rouble and country j 's foreign currency in a given half-year time period h . Finally, to account for country-time specific effects typically controlled for in gravity model estimations, we include country x half-year fixed effects previously generated from bilateral country level gravity estimations based on UN COMTRADE data measured over half-year periods.

* $p < .1$; ** $p < .05$; *** $p < .01$.

TABLE 7 WTO versus non-WTO sample: Exports

	Product margin		Country margin		Intensive margin	
	(1)	(2)	(3)	(4)	(5)	(6)
	Non-WTO	WTO	Non-WTO	WTO	Non-WTO	WTO
$Post_t$	0.015 [0.022]	0.031 ^{***} [0.010]	0.010 ^{**} [0.005]	0.001 [0.003]	-0.029 [0.109]	-0.037 [0.045]
$Post_t \times \Delta Tariff_{HS4}$			0.007 ^{***} [0.002]	-0.001 [0.001]	-0.049 [0.045]	0.006 [0.020]
$Post embargo_t \times sanct. country_j$		0.019 [0.015]		-0.002 [0.003]		-0.109 [*] [0.064]
$Post sanctions_t \times sanct. country_j$		0.065 ^{***} [0.016]		0.016 ^{***} [0.004]		0.039 [0.061]
Log quarterly GDP _{jt}	0.111 [0.226]	0.263 ^{***} [0.097]	0.251 ^{***} [0.045]	0.681 ^{***} [0.048]	0.401 [0.903]	1.516 ^{***} [0.522]
Log transport cost _{jt}	-0.074 [0.074]	0.017 [0.024]	-0.049 [0.054]	0.451 ^{***} [0.047]	0.506 ^{**} [0.205]	-0.174 [0.123]
Log exchange rate _{jt}	0.131 [0.119]	0.017 [0.022]			-0.278 [0.307]	0.129 [0.126]
Log quarterly GDP Russia _t	-2.580 ^{***} [0.855]	-1.261 ^{***} [0.289]	-1.042 ^{***} [0.090]	-0.816 ^{***} [0.058]	1.952 [2.995]	1.217 [0.760]
Log BRENT oil price _t	0.803 [0.593]	-0.145 [0.186]	0.448 [0.442]	-3.871 ^{***} [0.404]	-3.917 ^{**} [1.865]	2.034 ^{***} [1.020]
$Post embargo_t$	0.014 [0.032]		0.007 [*] [0.004]		-0.088 [0.146]	
$Post sanctions_t$	0.049 [0.031]		0.012 ^{***} [0.004]		-0.081 [0.165]	
Importer-month-year FE (log)	-0.035 [0.027]	0.048 ^{***} [0.015]			-0.002 [0.040]	-0.055 [0.077]
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-country FE	Yes	Yes	No	No	No	No
Firm-product-country FE	No	No	No	No	Yes	Yes
Firm-product-country group FE	No	No	Yes	Yes	No	No
Observations	111,344	573,495	248,782	1,179,245	255,085	1,389,579
Number of firm-country groups	11,875	55,493				
Number of firm-product-country groups					39,623	189,020

TABLE 7 (Continued)

	Product margin		Country margin		Intensive margin	
	(1)	(2)	(3)	(4)	(5)	(6)
	Non-WTO	WTO	Non-WTO	WTO	Non-WTO	WTO
Number of firm–product–country group m groups			35,982	147,994		

Notes: All samples include all firms that export exclusively in non-embargoed products. This table compares the impact of Russia's accession to the WTO on the subset of countries that are WTO members versus non-members. The WTO sample includes firm transactions that involve only destination countries that are WTO members at the time of the export transaction. The non-WTO sample includes firm transactions that involve only destination countries that are not WTO members at the time of the export transaction. The reported coefficients are obtained by pseudo-Poisson maximum likelihood (PPML). The dependent variable in columns (1) and (2) is the product margin of trade, that is, the number of HS 8-digit products firm f exports to country j in a given month–year period t . The dependent variable in columns (3) and (4) is the country margin of trade, that is, the number of WTO member countries, respectively non-WTO member countries, that firm f exports product k to in a given month–year period t . Finally, the dependent variable in columns (5) and (6) is the intensive margin of trade, that is the value of an export transaction within firm f –product k –country j group in a given month–year period t . The variable of interest is $Post_t$, which is a dummy variable equal to 1 after Russia joins the WTO. Given that the country dimension of our original treatment variable disappears once, we separate the samples by the WTO membership status of the partner country, only the temporal dimension of the treatment variable remains. All the other variables are as described in previous tables.

* $p < .1$; ** $p < .05$; *** $p < .01$.

TABLE 8 WTO versus non-WTO sample: Imports

	Product margin		Country margin		Intensive margin	
	(1)	(2)	(3)	(4)	(5)	(6)
	Non-WTO	WTO	Non-WTO	WTO	Non-WTO	WTO
$Post_t$	−0.015 [0.056]	0.060*** [0.005]	−0.000 [0.001]	0.005*** [0.000]	−0.019 [0.062]	−0.030** [0.014]
$Post_t \times \Delta Tariff_{HS4}$			0.000 [0.000]	−0.000 [0.000]	0.000 [0.022]	−0.004 [0.006]
$Post embargo_t \times sanct. country_j$		0.012 [0.007]		−0.003*** [0.000]		−0.038 [0.028]
$Post sanctions_t \times sanct. country_j$		−0.030*** [0.006]		0.005*** [0.000]		−0.032 [0.028]
Log quarterly GDP $_{jt}$	1.208*** [0.423]	0.018 [0.077]	−0.013 [0.012]	0.017* [0.009]	0.709 [1.062]	−0.101 [0.163]
Log transport cost $_{jt}$	0.085 [0.075]	0.012 [0.016]	−0.060*** [0.018]	−0.033*** [0.008]	−0.130 [0.140]	−0.125** [0.049]
Log exchange rate $_{jt}$	0.475* [0.245]	0.045** [0.020]			0.048 [0.269]	0.043 [0.068]
Log quarterly GDP Russia $_t$	0.635 [1.190]	0.873*** [0.115]	−0.007 [0.016]	0.101*** [0.010]	−1.499 [1.272]	0.131 [0.253]

TABLE 8 (Continued)

	Product margin		Country margin		Intensive margin	
	(1)	(2)	(3)	(4)	(5)	(6)
	Non-WTO	WTO	Non-WTO	WTO	Non-WTO	WTO
Log BRENT oil price,	-0.307	-0.063	0.492 ^{***}	0.276 ^{***}	1.538	1.570 ^{***}
	[0.654]	[0.129]	[0.149]	[0.068]	[1.190]	[0.385]
Embargo time,	0.052		-0.003 ^{**}		-0.068	
	[0.084]		[0.001]		[0.075]	
Post sanctions,	-0.192 ^{***}		-0.000		-0.128 [*]	
	[0.049]		[0.001]		[0.075]	
Exporter-month-year FE (log)	-0.011	0.072 ^{***}			-0.023 [*]	0.055 ^{***}
	[0.015]	[0.011]			[0.013]	[0.016]
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-country FE	Yes	Yes	No	No	No	No
Firm-product-country FE	No	No	No	No	Yes	Yes
Firm-product-country group FE	No	No	Yes	Yes	No	No
Observations	38,605	2,105,581	256,039	13,181,064	229,441	13,841,369
Number of firm-country groups	3,789	174,289				
Number of firm-product- country groups					42,713	1,792,097
Number of firm-product- country group <i>m</i> groups			45,988	1,639,203		

Notes: All samples include all firms that import exclusively non-embargoed products. This table compares the impact of Russia's accession to the WTO on the subset of countries that are WTO members versus non-members. The WTO sample includes firm transactions that only involve foreign countries that are WTO members at the time of the import transaction. The non-WTO sample includes firm transactions that only involve foreign countries that are not WTO members at the time of the import transaction. The reported coefficients are obtained by pseudo-Poisson maximum likelihood (PPML). The dependent variable in columns (1) and (2) is the product margin of trade, that is, the number of HS 8-digit products firm f imports from country j in a given month-year period t . The dependent variable in columns (3) and (4) is the country margin of trade, that is, the number of WTO member countries, respectively non-WTO member countries, that firm f imports product k from in a given month-year period t . Finally, the dependent variable in columns (5) and (6) is the intensive margin of trade, that is, the value of an import transaction within firm f - product k -country j group in a given month-year period t . The variable of interest is $Post_t$, which is a dummy variable equal to 1 after Russia joins the WTO. Given that the country dimension of our original treatment variable disappears once we separate the samples by the WTO membership status of the partner country, only the temporal dimension of the treatment variable remains. All the other variables are as described in previous tables.

* $p < .1$; ** $p < .05$; *** $p < .01$.

effective WTO membership brings with it certainty about the stability and predictability of members' international trade policy. Nevertheless, a great benefit of our monthly level dataset is the ability to examine empirically whether Russia's notification of its approval to enter the WTO was the time when trade policy uncertainty was resolved. In particular, we want to see if there is any evidence that Russian firms have responded to the WTO notification in anticipation of the country's future

adherence. Such a data exercise would also give us another glimpse into the validity of the parallel trends assumption.

To conduct this analysis, we define a new variable, *Notification_t*, which takes the value of 1 after Russia's accession was approved by the WTO (December 2011) but before Russia officially became a member (August 2012). We then interact this new dummy variable with an indicator for the membership status of the partner country *j*. We re-estimate Equations (1)–(4) and include this new interaction term, *Notification_t × WTO member_{jt}*, in addition to the existing treatment variable, *Post_t × WTO member_{jt}*. The goal of this exercise is to capture any changes in the various firm-level trade margins happening in the interval between the notification and the start of the WTO membership for transactions with WTO member countries compared to non-WTO member countries.

These estimates are reported in Table 9. Our results suggest that total firm-level trade responds positively to the notification of Russia's acceptance into the WTO: the effect on both export and import transactions is positive and significant at 5% significance level. The total trade flows capture the extensive product margin and the intensive margin combined. However, no specific firm-level margin seems to individually respond to the notification news. We interpret our findings to show that while each of these margins responds positively to the notification of Russia's acceptance into the WTO, each individual response is too small to be statistically significant. The combined (extensive + intensive margin) effect, however, surpasses the threshold and becomes significant. More importantly, the trade effects of WTO membership observed after the country's official accession remain large and significant even when controlling for the notification period. These findings point to the fact that although Russian firms might have responded positively to the country's notification of acceptance, the period of internal ratification into law still involved some uncertainty. It was only after the full membership went into effect that trading firms could fully benefit from the certainty of Russia's WTO commitments and from the predictability of other members' trade policy.

6.3 | Interplay between liberalization and protection

Our last data exercise is a sensitivity analysis meant to address the concern that Russia's accession to the WTO disproportionately impacted firms that trade in embargoed products, all of which are agricultural goods.

Several studies argue that the WTO membership had a substantial impact on the agricultural sector because of its heavy reliance on government subsidies.³⁰ The agricultural sector was also the focus of many discussions during the bilateral negotiations process because of the strategic interests surrounding this sector (Anderson et al., 2001). Following Russia's WTO accession, many agricultural enterprises—including producers of grain, dairy, and produce—voiced their concerns about the inability to withstand the increased foreign competition.

In August 2014, two years after Russia's entry into the WTO, the government imposed an embargo that prohibited the import of 48 agricultural products from 38 foreign countries who were targeted for their economic sanctions against Russia.³¹ The embargo—still in effect today—was imposed in retaliation to the post-Crimean sanctions that the 27 EU countries, the United States, the United Kingdom, Canada, Australia, and several other non-EU countries imposed on Russia in response to its military intervention in Ukraine. However, one wonders if the retaliatory embargo was also a protectionist response to the increase in import competition affecting the agricultural sector following Russia's WTO accession.

To examine whether the selection of embargoed products was driven by protectionist motives intended to benefit the more vulnerable agricultural sector, we focus our attention on those Russian firms

TABLE 9 The timing of Russia's accession to the WTO

	Aggregate firm-level trade		Product margin		Country margin		Intensive margin	
	Exports (1)	Imports (2)	Exports (3)	Imports (4)	Exports (5)	Imports (6)	Exports (7)	Imports (8)
$Post_t \times WTOmember_{jt}$	0.585 ^{***} [0.281]	0.170 ^{**} [0.076]	0.079 ^{**} [0.037]	0.042 [0.055]	0.030 ^{***} [0.005]	0.007 ^{***} [0.001]	0.102 [0.134]	0.065 [0.083]
Notification _t × WTO member _{jt}	0.318 ^{***} [0.118]	0.107 ^{**} [0.054]	0.060 [0.041]	-0.030 [0.046]	-0.000 [0.004]	-0.000 [0.001]	0.144 [0.129]	0.059 [0.038]
WTO member _{jt}	-0.427 ^{**} [0.183]	-0.554 ^{***} [0.158]	-0.030 [0.050]	-0.657 ^{***} [0.159]			-0.118 [0.132]	-0.136 [0.110]
$Post\ sanctions_t \times sanct.\ country_j$	-0.003 [0.120]	0.051 [0.043]	0.031 [*] [0.017]	0.011 [0.012]	0.007 [*] [0.004]	0.002 ^{***} [0.001]		0.040 [0.032]
$Post\ embargo_t \times sanct.\ country_j$	-0.153 [0.098]	0.001 [0.036]	0.050 ^{***} [0.016]	-0.008 [0.011]	0.025 ^{***} [0.004]	-0.004 ^{***} [0.001]	-0.098 [0.087]	0.000 [0.030]
$Post\ sanctions_t$							-0.439 [0.938]	
Log quarterly GDP _{jt}	1.953 ^{***} [0.612]	0.128 [0.207]	0.149 [0.091]	0.200 ^{***} [0.077]	0.419 ^{***} [0.048]	0.013 [0.012]	1.672 ^{***} [0.513]	0.100 [0.163]
Log transport cost _{jt}	0.040 [0.214]	-0.169 ^{***} [0.063]	-0.004 [0.022]	0.002 [0.016]	0.095 ^{***} [0.013]	-0.038 ^{***} [0.004]	-0.028 [0.118]	-0.132 ^{***} [0.047]
Log exchange rate _{jt}	0.079 [0.167]	0.147 [0.094]	0.025 [0.024]	-0.038 [0.024]			0.006 [0.118]	0.133 [*] [0.070]
Importer-month-year FE (log)	0.027 [0.053]		0.022 [0.014]				0.011 [0.040]	
Exporter-month-year FE (log)		0.030 [*] [0.018]		0.026 ^{***} [0.008]				0.026 ^{**} [0.011]

(Continues)

TABLE 9 (Continued)

	Aggregate firm-level trade		Product margin		Country margin		Intensive margin	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Month-year FE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm-country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-product-country FE	Yes	Yes	Yes	Yes	No	No	No	No
Firm-product-country FE	No	No	No	No	Yes	Yes	No	No
Observations	No	No	No	No	No	No	Yes	Yes
Number of firm-country groups	685,160	2,144,233	685,162	2,144,233	1,525,203	15,136,196	1,763,851	15,840,330
Number of firm-product-country group <i>m</i> groups	66,914	178,012	66,915	178,012				
Number of firm-product-country groups					195,623	1,882,650	243,539	2,050,497

Notes: All samples include all firms that trade exclusively in non-embargoed products. This Table provides results of the analysis of the timing of the treatment variable. We check whether using Russia's notification of WTO acceptance in December 2011 as treatment variable as opposed to Russia's formal WTO accession in August 2012 changes our results. The reported coefficients are obtained by Pseudo-Poisson Maximum Likelihood (PPML). The dependent variable in columns (1) and (2) is the firm-level aggregate trade volume with country *j* at time *t*. The dependent variable in columns (3) and (4) is the product margin of trade, that is, the number of HS 8-digit products firm *f* trades with country *j* in a given month-year period *t*. The dependent variable in columns (5) and (6) is the country margin of trade, that is, the number of WTO member countries, respectively non-WTO member countries, that firm *f* trade product *k* in a given month-year period *t*. Finally, the dependent variable in columns (7) and (8) is the intensive margin of trade, that is, the value of a trade transaction within firm *f*-product *k*-country *j* group in a given month-year period *t*. The first variable of interest is $Post_t \times WTO\ member_j$ and represents an interaction term between a dummy variable equal to 1 in the month-year periods after Russia officially joins the WTO (after August 2012) and the WTO membership status of the partner country *j* at time *t*. The second variable of interest is $Notification_t \times WTO\ member_j$ and represents an interaction term between a dummy variable equal to 1 in the month-year periods after Russia received a formal notification of acceptance from the WTO but before it actually joined the WTO (i.e. the period between December 2011 and August 2012) and the WTO membership status of the partner country *j*. All the other variables are as described in previous tables.

* $p < .1$; ** $p < .05$; *** $p < .01$.

TABLE 10 WTO trade effects for firms that trade in at least one embargoed product

	Product margin		Country margin		Intensive margin		Frequency	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
$Post_t \times WTOmember_{jt}$	-0.050 [0.042]	0.208*** [0.063]	0.078*** [0.008]	0.005*** [0.001]	0.103 [0.102]	0.168*** [0.045]		
$Post_t \times WTOmember_{jt}$							-0.066*** [0.009]	0.126*** [0.008]
WTO member _{jt}	0.194* [0.117]	0.114 [0.229]			-0.035 [0.094]	-0.407** [0.185]	0.092*** [0.017]	-0.183*** [0.069]
Embargo direct effect _{jt}	0.003 [0.056]	-0.564*** [0.070]	-0.026 [0.019]	-0.101*** [0.010]	0.141 [0.130]	-0.351*** [0.063]	-0.021 [0.022]	-0.454*** [0.010]
$Post$ embargo, \times sanct. country _j	0.053 [0.033]	0.040 [0.044]	0.067*** [0.009]	-0.006*** [0.002]	0.019 [0.093]	-0.012 [0.042]	0.048*** [0.010]	0.005 [0.004]
$Post$ sanctions, \times sanct. country _j	-0.065 [0.045]	0.102** [0.047]	0.006 [0.008]	-0.008*** [0.002]	-0.122* [0.066]	-0.007 [0.023]	-0.012 [0.010]	0.017*** [0.004]
$Post$ embargo, \times emb. good _k	-0.139*** [0.029]	0.103** [0.048]	-0.013 [0.012]	-0.009** [0.004]	-0.016 [0.073]	0.131*** [0.044]	-0.030*** [0.010]	0.010* [0.006]
Log quarterly GDP _{jt}	-0.578* [0.300]	0.755*** [0.246]	1.244*** [0.097]	-0.020 [0.033]	0.856* [0.444]	0.046 [0.159]	0.032 [0.046]	0.099*** [0.028]
Log transport cost _{jt}	0.105** [0.047]	-0.021 [0.057]	0.306*** [0.024]	-0.007 [0.011]	-0.049 [0.075]	-0.124** [0.058]	-0.025** [0.010]	-0.033*** [0.006]
Log exchange rate _{jt}	0.000 [0.035]	-0.155*** [0.051]			0.233** [0.105]	-0.003 [0.044]	0.010 [0.016]	-0.082*** [0.014]
Importer-half year FE (log)	0.044 [0.029]	-0.034 [0.029]			-0.023 [0.039]		0.091*** [0.007]	

(Continues)

TABLE 10 (Continued)

	Product margin		Country margin		Intensive margin		Frequency	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Exporter-half year FE (log)						0.037 ^{***} [0.013]		-0.008 ^{***} [0.003]
Month-year FE	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Biannual time period FE	No	No	No	No	No	No	Yes	Yes
Firm-country-embargoed good group FE	Yes	Yes	No	No	No	No	No	No
Firm-product-country FE	No	No	No	No	Yes	Yes	Yes	Yes
Firm-product-country group FE	No	No	Yes	Yes	No	No	No	No
Observations	93,299	450,769	314,247	2,706,849	392,253	2,804,588	148,442	1,041,066
Number of firm-country-emb. good groups	8,190	37,468						
Number of firm-product-country groups					50,547	415,480	38,318	318,815
Number of firm-product-country group <i>m</i> groups			39,251	382,678				

Notes: All samples include all firms that trade in at least one embargoed product sometimes during the sample period. The reported coefficients are obtained by pseudo-Poisson maximum likelihood (PPML). The dependent variable in columns (1) and (2) is the product margin of trade, that is, the number of HS 8-digit products, separated by their embargoed status, that firm *f* trades with country *j* in a given month-year period *t*. The dependent variable in columns (3) and (4) is the country margin of trade, that is, the number of WTO member countries, respectively non-WTO member countries, that firm *f* trades product *k* with in a given month-year period *t*. The dependent variable in columns (5) and (6) is the intensive margin of trade, that is, the value of a trade transaction within the firm *f*-product *k*-country *j* group in a given month-year period *t*. Finally, the dependent variable in columns (7) and (8) is the number of months in a given half year period *h* that firm *f* trades product *k* with country *j*. The variable of interest is *Post_{it} × WTO member_{jt}* in columns 1–6, respectively *Post_{it} × WTO member_{jt}* in columns (7) and (8). Both variables represent an interaction term between a dummy variable equal to 1 in the time periods after Russia's accession to the WTO and the WTO membership status of a foreign partner country *j* at time *t*, respectively during period *h*. *Embargo direct effect_{jt}* is an indicator variable equal to 1 if the foreign country *j* is one of the sanctioning countries targeted by the Russian retaliatory embargo and if the HS 8-digit product being traded is an embargoed good. All the other variables are as described in previous tables.

* $p < .1$; ** $p < .05$; *** $p < .01$.

that trade in at least one embargoed product (who have been excluded from the main estimation sample). We re-estimate Equations (2)–(4) for this new sample of firms to analyze their responses along the extensive and intensive margins. To control for the negative effects of the retaliatory embargo affecting trade transactions taking place after August 2014, we include in all our estimations the variable *Embargo direct effect*_{ikt}, which represents an indicator variable that takes the value of 1 after August 2014 if a given cross-border transaction is for an embargoed product *k* traded with foreign country *j* that is sanctioning Russia and is, as a result, targeted by the retaliatory embargo.³² As the variable *Embargo direct effect*_{ikt} is essentially a triple interaction term, we also add to the regression model the pairwise interaction terms, *Post embargo*_t × *Sanct. country*_j and *Post embargo*_t × *Embargo*_k, to account for any potential underlying trends affecting the sanctioning countries, respectively the embargoed products.³³

The estimation results are reported in Table 10. We find highly significant positive impacts of the WTO entry on all the margins of firm-level trade for importing firms that trade in at least one embargoed product: a significant increase in the frequency of imports, an increase in the average number of products imported, and a significant increase in the average import flow within a firm–product–country group. The impacts of the WTO accession on exporting firms is similar to our main estimates: an increase in the number of partner countries and a significant decrease in the frequency of exporting. Thus, firms that trade in at least one embargoed product experience larger effects from Russia's WTO accession than firms that trade exclusively in non-embargoed goods. The largest benefit for the Russian importers that trade in at least one embargoed product comes from a 23% increase in the average number of imported products (i.e. product margin). Additionally, these importers increase their average value of an import transaction by about 17% and enjoy increased frequency of imports.

Given our estimates, it seems that the Russian retaliatory embargo targeted a very specific vulnerable domestic sector (i.e. agriculture) whose imports increased rapidly following the country's WTO accession.³⁴ Because protectionist policies are against WTO regulations, the retaliatory embargo may have been a convenient way for the Russian government to kill two birds with one stone—retaliate against foreign countries sanctioning Russia and at the same time protect the domestic agricultural production from increased foreign competition.

One caveat of our findings is that we do not have data on the domestic production and sales of these firms and thus we cannot directly test whether Russian agricultural producers were negatively impacted by the increased imports of agricultural products. Our findings, however, confirm that import competition increased for embargoed products, which leads us to conjecture that Russia's retaliatory embargo may have been intended as a protectionist policy.

7 | 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 (2004) paper, Russian exporters and importers experience significant trade changes as a result of the country's accession to the WTO. These effects are economically small and vary significantly across trade margins, with the extensive margin of trade being more responsive to trade liberalization than the intensive margin. We also find that exporters are more impacted by the WTO membership. These effects include an increase in the average number of HS 8-digit products exported and in the average number of export destinations. Additionally, we find that importers who trade in at least one product that was subject to Russia's retaliatory embargo experience the largest consequences of Russia's accession to the WTO. This may serve as suggestive evidence that the retaliatory embargo targeting agricultural

products might have been intended as a protectionist policy in order to help a vulnerable domestic industry impacted by the WTO membership. Because protectionist policies are against WTO provisions, the embargo was a convenient way for Russia to kill two birds with one stone—retaliate against the countries sanctioning Russia's foreign policy actions and also protect the domestic agricultural production.

Our findings are in line with the aggregate results found in the literature in that, like Dutt et al. (2013), we find a strong effect of WTO membership on the extensive margin of trade 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 OLS estimation method and using instead the PPML method.

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

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from VedStat, <http://www.ved-stat.ru>. Restrictions apply to the availability of these data.

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ENDNOTES

- ¹ Even though Russian exporters already benefited from MFN tariff levels prior to the country's WTO membership, the threat of reversal to non-preferential tariff levels was a deterrent to investments and trade. The certainty of MFN tariffs was only ensured after accession. It is this stability and predictability of partner country policies that explains the reduction in trade policy uncertainty associated with the WTO membership, and what fuels long-term trade growth. In support of this argument, Groppo and Piermartini (2014) show empirically that the WTO commitments of member countries as well as the monitoring function of the WTO are factors that play a direct role in reducing trade policy uncertainty (as measured by the likelihood of member countries to increase import tariffs).
- ² Some of the most prominent papers that investigate the impacts of trade liberalization on firm-level margins are Melitz (2003), Chaney (2008), Helpman et al. (2008), and Bernard et al. (2011), among others.
- ³ The embargo has been proven to have adverse impacts on Russia's foreign trade (Miromanova, 2019). To alleviate concerns about correctly identifying the firm-level trade effects of the WTO membership, our econometric analysis separates the firms that trade in at least one embargoed good from those that do not, in addition to paying close attention to controlling for macroeconomic trends and spillover effects of the embargo.
- ⁴ International trade is an important component of Russia's economy, accounting for 24 percent of its GDP in 2017. Worldwide, Russia ranked 14th in exports of merchandise and 22nd in imports of merchandise for year 2018.
- ⁵ Dutt (2020) finds significant effects of the WTO on both extensive and intensive margins of trade but the effect on the former is more prominent, which is in line with our findings.
- ⁶ Utilizing PPML estimation method allows us to account for a large amount of zeros typically present in the trade data.

- ⁷ For example, Chowdhury (2004) concentrates on the analysis of the negotiations, and emphasizes that some of the serious barriers to Russia's membership in the WTO are 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 the WTO, including the tariff schedules, foreign investment liberalization, and non-tariff barriers. Lissovlik and Lissovlik (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.
- ⁸ 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 estimate the potential for an increase in trade between the Commonwealth of Independent States (CIS) and the European Union (EU). They use their estimates to back out the potential benefits of joining the WTO.
- ⁹ Even if one might consider that Russia's entry into the WTO was just a matter of time, the actual timing of the accession was a large source of uncertainty as were the details of the membership and of the commitments undertaken. Furthermore, existing WTO members could have reverted the import tariffs to non-preferential levels at any point in time prior to Russia's official date of accession. Any uncertainties concerning countries' trade policies were eliminated once Russia became a full WTO member.
- ¹⁰ The weighted average tariff in 2011 was 9.5% across all products, 17.5% for agricultural products, and 8.1% for manufactured products.
- ¹¹ This information is obtained from the WTO Russian Federation member profile. The averages do not include zero tariff lines.
- ¹² For more information on the anti-Russia sanctions and the retaliatory embargo see the Online Appendix of this paper and Miromanova (2019).
- ¹³ The dataset is acquired through the Russian analytical agency VedStat, <http://www.ved-stat.ru>.
- ¹⁴ While the five-year sample period limits our findings to short-run effects of Russia's accession to the WTO, for model identification purposes, the monthly frequency of the data provides sufficient data points from the pre-accession period to identify average firm-level trade patterns prior to the policy change (i.e. pre-treatment behavior). Furthermore, the absence of any differential trends in the pre-accession period between trade with WTO, respectively non-WTO member countries—as illustrated in Figures 3–5—serves as additional confirmation that the short pre-accession period is not problematic for model identification.
- ¹⁵ The provider of the data performed the conversion of all HS codes for all transactions in the dataset to the HS 2012 system.
- ¹⁶ We have opted for this approach for several reasons. First, this seems to be the more common approach in the literature in spite of the findings in Tomz et al. (2007). Second, we think that for a short panel dataset like ours, the distinction between de facto and de jure membership is not as consequential as in the case of long time-series cross-country studies. This is mostly because the group of former colonies and newly independent states, who were among the countries receiving de facto membership, generally transitioned into full membership status by year 2011, which is the start of our sample period.
- ¹⁷ <https://www.investing.com/currencies/usd-rub-historical-data>.
- ¹⁸ The large difference in the number of exporting and importing firms, amplified by the difference in the number of foreign countries accessed and products traded, explains the significant difference in size between the export and the import samples. For example, firms in the export sample trade, on average, in 4 HS 8-digit product codes in a given month (averaged across all countries), while firms in the import sample trade in 11 HS 8-digit product codes.
- ¹⁹ Although the number of non-WTO member countries is small compared to the number of WTO member countries, we do not think that this is a big concern for our difference-in-differences identification strategy for two reasons. First, some of Russia's key trade partners such as Belarus and Kazakhstan are non-WTO member countries. Second, any systematic differences between WTO member and non-member countries are carefully controlled for in our empirical analysis using country fixed effects as well as time-varying country characteristics. In fact, as Figures 3–5 illustrate,

- any underlying differences between the treatment and control groups are successfully removed from the data (i.e. parallel trends assumption).
- ²⁰ A standard control variable in a gravity equation model is a preferential trade agreements indicator. We omit such a variable from our estimations because during the sample period 2011–2015, Russia did not sign any new preferential trade agreements. Thus, the country fixed effects implicitly control for the preferential status of Russia's trade partners.
- ²¹ Although the estimation sample excludes firms that trade in embargoed goods, it is possible for the retaliatory embargo to influence trade in other product categories and to an extent that differs from the impact of the first wave of economic sanctions. To allow the estimation model to assign different coefficient magnitudes to the trade effects of sanctions and counter-sanctions, we include both interaction terms $Post\ sanctions_i \times sanct.\ country_j$ and $Post\ embargo_i \times sanct.\ country_j$ as control variables in the regression.
- ²² Groppo and Piermartini (2014) provide empirical evidence to show that the WTO commitments of member countries as well as the monitoring function of the WTO are factors that play a direct role in reducing trade policy uncertainty (as measured by the likelihood of an increase in import tariffs).
- ²³ We check the consistency of our estimations by using the OLS estimator as opposed to the PPML estimator (which is our preferred estimation method). We re-estimate the estimation Equations (2)–(5) using OLS. We find that the majority of OLS estimators of the coefficient of interest $Post_i \times WTOmember_{jt}$ have similar significance levels and signs as the PPML results. However, the magnitude of the coefficients varies. The OLS results tend to overestimate the effect of the accession to the WTO, which is consistent with findings in the literature (Santos Silva & Tenreiro, 2006).
- ²⁴ Specifically, information was sourced from: (1) the list of firms maintained by Dmitri Puchkarev, BKS Express <https://bcs-express.ru/novosti-i-analitika/kompanii-s-gosudarstvennym-uchastiem-skol-ko-ikh>, and (2) the official list of government enterprises that participate in programs of innovative development, maintained by the Russian government, <http://old.economy.gov.ru/minec/about/structure/depIno/2015070303540>
- ²⁵ We consider it necessary to separate between WTO member countries that sanction or not Russia over the Crimea conflict in order to maintain consistency across model specifications in the use of controls for the first wave of sanctions and for Russia's retaliatory response.
- ²⁶ We do not report a similar exercise for the product margin of firm-level trade since the dependent variable in those specifications represents the count of all products traded by a firm in a given market and thus there is no unique tariff line that would correspond to such a unit of analysis.
- ²⁷ During our sample period there was no change in the MFN tariff levels faced by Russian exporters in foreign markets. So, we will use $\Delta Tariff_{HS4}$ constructed using Russia's import tariffs in export regressions. Our motivation to do that is to proxy for the degree of trade liberalization experienced by a particular Russian industry. It is possible that through industry shake-out and resource reallocations, exporters may also be directly impacted by an increase in trade openness at the industry level.
- ²⁸ In unreported results we have also experimented with year-long time periods over which trade frequency is defined and the results are qualitatively similar.
- ²⁹ We have also experimented with separate month and year fixed effects and obtained qualitatively similar results, which are available upon request. For the results reported in the paper, we decided to leave out the year fixed effects (and replace them with time-varying controls) in order to allow for more data variation for model identification.
- ³⁰ It is quite common for agricultural exports to decline once countries join the WTO (Erten & Leight, 2019).
- ³¹ The list of the embargoed products is available in the Appendix Table A2. It includes dairy products, meat and meat products, fish and fish products, vegetables and fruits. A more detailed history and description of the embargo policy is provided in the Online Appendix of the paper.
- ³² The variable Embargo direct effect $_{ikt}$ is constructed as an interaction term $Sanct.\ country_j \times Embargo_k \times Post\ embargo_{it}$, where $Sanct.\ country_j$ equals 1 if foreign country j imposed economic sanctions on Russia thus becoming a target of the retaliatory embargo, $Embargo_k$ equals 1 if product k is embargoed, and $Post\ embargo_{it}$ equals 1 for all time periods after August 2014 when the retaliatory embargo entered into effect.
- ³³ Notice that the third pairwise interaction term, $Sanct.\ country_j \times Embargo_k$, is captured by the regression fixed effects.

³⁴ In unreported results available upon request, we verified that the increase in trade for embargoed products happened prior to the start of the embargo period, thus supporting the conjecture that the growth in trade may have triggered the protectionist actions of the retaliatory embargo. The average treatment effects reported in Table 10 are similar in magnitude to the trade effects that we estimated for the period immediately following the WTO accession but prior to the embargo period.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the Supporting Information section.

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APPENDIX A

TABLE A1 List of WTO and non-WTO member countries present in the sample

WTO member countries			Non-WTO member countries
Albania	Ghana	Oman	Afghanistan
Angola	Greece	Pakistan	Algeria
Antigua and Barbuda	Grenada	Panama	American Samoa
Argentina	Guatemala	Papua New Guinea	Andorra
Armenia	Guinea	Paraguay	Anguilla
Australia	Guinea-BissauXXX	Peru	Azerbaijan*
Austria	Guyana	Philippines	Bahamas
Bahrain	Honduras	Poland	Belarus*
Bangladesh	Hong Kong	Portugal	Bosnia Herzegovina
Barbados	Hungary	Qatar	British Indian Ocean Territories
Belgium	Iceland	Republic of Korea	British Virgin Islands
Belize	India	Romania	Cayman Islands
Benin	Indonesia	Saint Kitts and Nevis	Curacao
Bermuda	Ireland	Saint Vincent and the Grenadines	Democratic People's Republic of Korea
Bolivia	Israel	Samoa	Equatorial Guinea
Botswana	Italy	Saudi Arabia	Eritrea
Brazil	Jamaica	Senegal	Ethiopia
Brunei Darussalam	Japan	Sierra Leone	Faeroe Islands
Bulgaria	Jordan	Singapore	French Guiana
Burkina Faso	Kenya	Slovakia	Gibraltar
Burundi	Kuwait	Slovenia	Greenland
Cambodia	Kyrgyzstan	South Africa	Iran
Cameroon	Latvia	Spain	Iraq
Canada	Lesotho	Sri Lanka	Kazakhstan*
Central African Republic	Liechtenstein	Suriname	Lao People's Democratic Republic
Chad	Lithuania	Sweden	Lebanon
Chile	Luxembourg	Switzerland*	Liberia
China*	Macao	Thailand	Libya
Colombia	Madagascar	The Former Yugoslav Republic of Macedonia	Marshall Islands
Comoros	Malawi	Togo	Mayotte
Congo	Malaysia	Trinidad and Tobago	Monaco

(Continues)

TABLE A1 (Continued)

WTO member countries			Non-WTO member countries
Costa Rica	Maldives	Tunisia	New Caledonia
Cote d'Ivoire	Mali	Turkey	Puerto Rico
Croatia	Malta	Uganda	
Cuba	Mauritania	Ukraine	San Marino
Cyprus*	Mauritius	United Arab Emirates	Sao Tome and Principe
Czech Republic	Mexico	United Kingdom*	Serbia*
Dem. Rep. of the Congo	Moldova	United Republic of Tanzania	Seychelles
Denmark	Mongolia	United States*	Somalia
Djibouti	Montenegro	Uruguay	South Sudan
Dominica	Morocco	Vanuatu	State of Palestine
Dominican Republic	Mozambique	Venezuela	Sudan
Ecuador	Myanmar	Viet Nam	Syria
Egypt	Namibia	Zambia	Tajikistan*
El Salvador	Nepal	Zimbabwe	Turkmenistan
Estonia	Netherlands		Turks and Caicos Islands
Finland	New Zealand		US Virgin Islands
France	Nicaragua		Uzbekistan*
Gabon	Niger		Yemen
Georgia	Nigeria		
Germany*	Norway		

*Russia's top six WTO member and top six non-WTO member partner countries in in terms of aggregate value of trade (exports and imports).

TABLE A2 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

(Continues)

TABLE A2 (Continued)

Sanctioned products	Description
0704	Cabbages, cauliflowers, kohlrabi, kale and similar edible brassicas, fresh or chilled
0705	Lettuce (<i>Lactuca sativa</i>) and chicory (<i>Cichorium</i> 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 (e.g. 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

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