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Abstract

We analyse the impact of the Russian food embargo on European and Russian trade patterns using a triple-difference estimation strategy. We quantify the effects on the value of trade, the trade price of products covered by the ban, and the new trade flows generated by the ban. Our results point to an average € 125 million loss in monthly EU28 exports to Russia due to the ban (with Lithuania, Poland, and Germany bearing the largest losses). However, only 45% of the drop in EU28 exports of banned products to Russia would be due to the ban. In addition, EU products banned from the Russian market were sold elsewhere at lower prices. The reorientation of EU exports to other markets translated into selling larger amounts to old trade partners, as well as in accessing new markets. EU member states were unevenly affected by the ban. Germany and Poland compensated their large losses on the Russian market by a strong increase in exports to other trade partners (mostly intra-EU), at the expense of other EU countries, such as France and Denmark.

Keywords: international trade, Russian embargo, trade diversion

JEL Classification: F13, F14, F17

L’embargo russe et les pertes de commerce

Résumé

Nous analysons l’impact de l’embargo alimentaire russe sur les flux commerciaux de l’UE et de la Russie avec un estimateur de triple différence. Nous quantifions les effets sur la valeur des échanges, le prix des produits bannis et les nouveaux flux commerciaux créés suite à l’embargo. Nos résultats indiquent que l’embargo a généré une perte d’exportations de l’UE28 vers la Russie de 125 millions d’euros par mois en moyenne (la Lituanie, la Pologne et l’Allemagne enregistrant les pertes les plus importantes). Cependant, seulement 45% de la baisse des exportations de produits banis de l’UE-28 vers la Russie seraient dus à l’embargo. En outre, les produits européens banis du marché russe ont été vendus ailleurs à des prix inférieurs. La réorientation des exportations de l’UE vers d’autres marchés s’est faite par une augmentation des ventes aux partenaires commerciaux habituels, ainsi que par l’accès à de nouveaux marchés. On trouve des effets hétérogènes à travers les Etats membres de l’UE. L’Allemagne et la Pologne ont compensé leurs grosses pertes sur le marché russe par une forte augmentation des exportations vers d’autres partenaires commerciaux (principalement intra-UE), au détriment d’autres pays de l’UE, tels que la France et le Danemark.

Mots-clés: commerce international, embargo russe, réorientation des échanges

Classification JEL: F13, F14, F17

Russian Food Embargo and the Lost Trade

1. Introduction

Political and economic relations between the Russian Federation and Western countries deteriorated gradually since early 2014. The European Union (EU) and United States (US) reacted to the Russian invasion into Ukraine and annexation of Crimea in February-March 2014 by introducing a range of diplomatic, commercial, and financial sanctions against Russia.[1] Over the following months, more countries introduced similar sanctions against Russia. In August 2014, Russia responded by banning the imports of a large number of food products from most of these countries. It covered most fruit and vegetables, meat, fish, and dairy products, amounting to one third of Russian agri-food imports prior to the ban.

This type of political event allows us to learn how the margins of trade (level of exports and the creation/cessation of new trade flows) adjust to large shocks. Indeed, in 2013, Russia imported around 40% of its overall food consumption, and used to be an attractive export destination.[2] Total Russian imports of banned products from targeted countries amounted to € 6.2 billion in 2013 (35% of Russian agri-food imports). The EU had the strongest commercial ties with Russia among countries targeted by the ban. In 2013, over 80% of the Russian imports of products covered by the ban originated from the EU (approximately € 5.2 billion, i.e. 4.5% of extra-EU28 exports of agri-food products).

A number of previous studies have evaluated the economic impact of the Russian embargo. Most of them use a computable general equilibrium (CGE) to estimate overall effects on aggregate production and welfare. Boulanger *et al.* (2016) and European Commission (2015) find that, despite uneven results across member states, the overall effect on EU is small. They estimate that the Russian embargo generated a 0.12% decline in extra-EU exports. Gohin (2016) shows that the pork ban had larger negative effects than the food ban, but results are sensitive to labor market assumptions of the CGE model. Oja (2015) uses an international input-output model with value-added trade data, and finds that the embargo had a low impact on Baltic countries' GDP. Havlik (2014) argues that Ukraine is the main victim of the conflict, and estimates the conflict-related damage at about 8% of its economy. Few works focus on the impact of the Russian embargo in terms of trade flows and of creation (cessation) of new (old) trade

[1] Their first measures consisted in suspending negotiations with Russia on various political and economic issues, introducing travel bans and asset freezes for a number of high officials and companies involved in actions against Ukraine, and installing a trade, investment and tourism ban with Crimea. These were later extended to economic and financial sanctions targeting key sectors of the Russian economy: banking and finance, oil, gas, energy, technology, and defense. These measures included restrictions on the access to capital markets, and on the provision of financial services and technological assistance to some of Russia's largest companies in the above-mentioned sectors, as well as a ban on exports of weapons, dual-use goods, military technology, and oil industry equipment to Russia.

[2] The Russian market absorbed 3% of the agri-food products sold worldwide in 2013.

relationships.

The objective of this paper is to quantify the direct and indirect impacts of the Russian food embargo on trade, and analyze the resulting reallocation of EU exports and Russian imports. To evaluate the economic consequences of the food ban, we need to estimate the counterfactual: what would have been the patterns of EU countries' exports and of Russian imports if the food ban had not been implemented? The quality of the evaluation is tied to how well we can estimate this counterfactual. Recent developments in trade literature show that structural gravity models can be used for counterfactual analysis to evaluate the effects of trade policy (Costinot and Rodriguez-Clare, 2014; Anderson *et al.*, 2015). The gravity equation can be estimated using time-varying product-exporter and product-importer fixed effects, and approximating bilateral trade barriers by a set of observable proxy variables (distance, contiguous borders, common language, colonial ties, etc.). We can estimate the effect of the Russian import ban by implementing this empirical strategy and introducing a dummy variable for the ban. The effect of the ban would thus result from comparing trade flows targeted by the ban, which represent the *treated* group, against flows not concerned by the ban, that constitute the *control* group. Such an identification strategy requires data varying in four dimensions: origin country, destination country, product and month. Observations in the treated group need to differ from those in the control group across these four dimensions.[3] However, there is no reliable data on global trade at this level of detail which would allow us to explore the variation in trade flows induced by the Russian ban across all these counterfactuals.[4]

To our knowledge, *monthly* data on global trade patterns are provided only by COMTRADE. However, this database covers only a fraction of global trade.[5] Depending on the year, this share ranges between 17% and 24% for trade in all products, and between 23% and 28% for trade in agri-food products.[6] Some of the world's largest exporters and importers, such as China, South Korea, Switzerland, Vietnam, and Indonesia, report very incomplete monthly data on their bilateral product-level exports. There are significant differences in the annual evolution of exports, computed from COMTRADE trade flows reported monthly and annually. This indicates that the global (indirect) effects on trade estimated by Crozet and Hinz (2016) suffer from a sample selection bias.[7] As a consequence, COMTRADE monthly data do not permit to

[3]Monthly data are required in order to have more than two time periods (pre- and post-treatment), and because the food ban was implemented in the middle of the year 2014.

[4]Crozet and Hinz (2016) adopted the gravity approach to estimate the overall impact of the conflict, i.e. the joint effect of Western sanctions and of the Russian embargo, on aggregate trade flows. Authors use monthly COMTRADE data which suffer from serious limits that we discuss below.

[5]This fraction decreases with the level of product product disaggregation.

[6]At the aggregate level, i.e. exports of all products to all destinations, the monthly data cover 88% to 94% of the annual exports in the COMTRADE database. This share is divided by four when one uses data on bilateral trade flows disaggregated at the HS 4-digit product level.

[7]By using a data sample that excludes non reported trade flows, Crozet and Hinz (2016) implicitly assume that these non reported trade flows followed the same evolution as flows included in the sample. This assumption is most likely violated by the data. Indeed, country-level export evolutions computed with annual and monthly

accurately estimate the effect of the embargo on global trade patterns.

To evaluate the effects of the Russian food embargo, we employ alternatively two databases giving information on bilateral monthly trade flows disaggregated by product. First, we use monthly data from COMEXT on bilateral product-level exports of EU countries to Russia and other destinations. In this case, we can exploit variations across three dimensions (destination, product, and month) to estimate the effects on the exports of EU countries. However, we lose variation across origins, as all EU countries are equally targeted by Russian import restrictions. Second, we use monthly data from Russian customs for Russia's product-level imports from each country. This database allows us to exploit variations across origin countries instead of destination countries. Both databases allow us to use a triple-difference estimation strategy and different sets of fixed effects to quantify the trade adjustments to the Russian food embargo.

First, we analyze the effect of the embargo from the point of view of EU exporting countries. Our estimations show that the embargo generated an average loss of EU28 exports to Russia of € 125 million per month. However, this represents only 45% of the overall loss in EU28 exports of banned products to Russia. Other factors, such as short-run evolutions of the Russian import demand and purchasing power, were responsible for the remaining 55%. We obtain very similar estimates of the EU export loss on the Russian market with COMEXT and Russian customs data, which confirms the robustness of our results. We identify a reorientation of European exports of banned products to alternative markets, translated into a 2% increase in the value of these flows. It appears that the losses of EU exports of banned products to Russia were entirely offset by the additional € 188 million average monthly sales on the EU market and € 42 million average monthly exports to third countries. We also find a large heterogeneity of the effect of the ban across EU member states.

Second, we analyze how the ban changed the Russian import patterns. We find important trade diversion effects also in terms of Russia's imports. The ban led to an average € 161 million drop in Russian monthly imports of banned products, mostly from EU countries. The direct effect of the ban was outweighed by the drop in Russian imports induced by other factors than the ban. Hence, we conclude that if the ban were lifted, exports to Russia of countries targeted by the ban would not return to their pre-ban level. The increase in Russia's imports from non-boycotted countries was smaller than the decrease in its imports from countries targeted by the ban, indicating that the ban also led to import substitution.

Third, Russian import restrictions generated important trade creation and diversion effects. We find that, the number of destination markets reached by EU exports increased after the Russian food embargo, the effect being stronger for banned products. This indicates that, the embargo led to a diversification of EU exports in terms of destination markets. On top of selling larger

COMTRADE data differ significantly for a number of large exporters.

amounts of banned goods to traditional trade partners, EU countries started exporting these products to new markets. New markets where smaller and more remote than EU's traditional partners. EU countries exported to these destinations smaller amounts of products, but at higher prices. Despite important effects in terms of the cessation of flows to Russia and the creation of new flows, most of the evolution in EU exports of banned products occurred at the intensive margin.

2. Russian food ban: history, data, and facts

In the first semester of 2014, European Union (EU), the United-States (US) and several other countries imposed sanctions on Russia in response to its annexation of Crimea and the city of Sevastopol,[8] as well as its intrusion into eastern Ukraine,[9] prompting an ongoing military conflict that has claimed the lives of thousands of civilians.[10] In August 2014, Russia retaliated by introducing an embargo on the imports of food products from countries that introduced economic and political sanctions against Russia (EU28, US, Canada, Norway and Australia).[11] The Russian food embargo was initially introduced for a one year.[12] In August 2015, Russia extended the embargo by another year and to five additional countries: Albania, Montenegro, Liechtenstein, Iceland, and Ukraine. The embargo was renewed again in June 2016 and June 2017 until end of 2018. The evolution of Russian import restrictions is described in Figure 1.

The Russian food embargo covers most of meat, fish, diary products, and non-processed vegetables and fruit. The list of products subject to the import ban were defined mostly at the 4-digit level of the Harmonized System (HS) classification.[13] Accordingly, we use trade data at this level of detail to estimate the impact of the ban. The full list of banned products is presented in Table A1 of Appendix A. The ban covers 48 product groups. Groups '1901' (flour) and '2106'

[8] Sevastopol was the main Soviet naval base in the Black Sea. After the collapse of the Soviet Union, the city continued to host the Russian and Ukrainian Black Sea fleets.

[9] EU's restrictive measures against Russia were meant as a strong warning against the "illegal annexation of territory and deliberate destabilisation of a neighbouring sovereign country", according to the EU Statement from 29 July 2014.

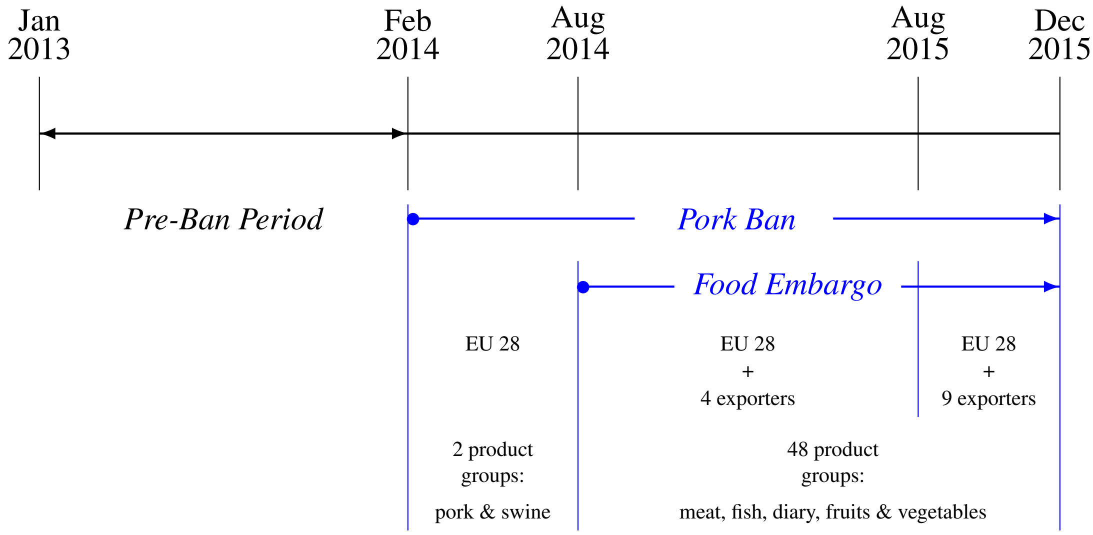
[10] The United Nations Human Rights Monitoring Mission in Ukraine (UNHMMU) reports that from 14 April 2014 to 15 November 2017 at least 2,523 civilians were killed in the conflict in Ukraine (OHCHR, 2017). An additional 298 civilians were killed as a result of the MH17 plane crash on 17 July 2014. The UNHMMU also reports at least 7,500 conflict-related casualties among Ukrainian law enforcement officers and armed forces, and separatist armed groups.

[11] Interestingly, the Russian embargo did not target all sanctioning countries: Japan, Switzerland, and New Zeeland were excluded for geopolitical reasons. At the same time, the embargo covered Australia before this country adopted restrictive measures against Russia. This non-reciprocity between Western sanctions and Russian counter-sanctions was ignored in the previous studies, including Dreger *et al.* (2016) and Crozet and Hinz (2016).

[12] EU and US sanctions against Russia were introduced for a six-month period, but were repeatedly extended since 2014, as Russia refused to withdraw from the occupied territories in Ukraine. In March 2015, the EU has linked the duration of sanctions to the complete implementation of the Minsk agreements (European Council Conclusions on external relations from 19 March 2015). The last renewal of European and American sanctions on Russia dates from December 2017.

[13] The Decrees of the Russian Government *N* 778 from 7 August 2014 and *N* 842 from 13 August 2015.

Figure 1: The evolution of Russian import restrictions on agri-food products



(food preparations) were subject to a partial import ban. Within each of these two groups, in 2013 banned products accounted for 65% and 85% of EU exports to Russia. Therefore, in our estimations we consider that all products in these groups were subject to the ban. The official list of products covered by the ban includes also a small number of exceptions defined only descriptively, e.g. dairy products for infants, soy milk, salmon and trout fry, seed potatoes. We cannot identify these exceptions in the trade data, even at the highest level of product disaggregation.[14] Nevertheless, excluded products represents only a small fraction of the products within the corresponding HS4 product groups. Therefore, treating all products from these HS4 groups as banned induces a negligible bias. The list of products covered by the Russian was marginally adjusted over the time, mainly by adding products excluded from the embargo.

By the time Russia introduced the food embargo, EU swine and pork were already refused access to the Russian market. In February 2014, Russia initiated a total EU-wide ban on live pigs, fresh pork, and other pig products, motivating this by the detection of isolated cases of African swine fever (ASF) in wild boar at the Lithuanian and Polish borders with Belarus. However, Russia continued to import the same products from Belarus and Ukraine, despite notified ASF cases in these countries. In April 2014, after failed bilateral discussions, the EU initiated a trade dispute at the WTO over the Russian pork ban. In August 2016, the assigned WTO panel declared that the Russian pork ban has violated the SPS Agreement, and has called upon the removal of Russian import restrictions. This decision, initially contested by Russia, was confirmed by the WTO's Appellate Body in February 2017. In December 2017, after Russia failed to implement the WTO ruling on pigs and pork, the EU sought authorization to impose retaliatory measures worth € 1.39 billion per year, corresponding to the amount of lost sales of

[14]The EU 8-digit Combined Nomenclature, and the Russian 10-digit Commodity Nomenclature for Foreign Economic Activities.

EU pork producers.[15] The claim was contested by Russia in January 2018 and the case remains unsolved. However, since most of products targeted by the pork ban were included in the food embargo, lifting the former would have a minor impact on the EU pork sector.[16] Moreover, in October 2017, Russia extended the food embargo to all products targeted by the pork ban.[17]

To assess of food ban on trade, we focus on monthly bilateral trade flows in all agri-food products in HS chapters 1 to 23. Our analysis covers three full years: from January 2013 to December 2015. Hence, our analysis considers the last thirteen months before the pork ban (from January 2013 to February 2014, pre-ban period), the 6 months with exclusively the pork ban (from February 2014 to July 2014), and the seventeen first months after the introduction of food embargo (including the pork ban).

Data on EU exports to each destination and for each product come from the COMEXT database, and cover 193 trade partners and 194 4-digit HS product groups. In 2013, Russia was the largest destination of EU exports of agri-food products on the extra-EU market. It counted for around 9% of the Union's extra-EU exports and 3% of its total exports (including intra-EU flows). EU exports to Russia decreased in February 2014, when the country introduced import restrictions on EU pork and swine products, and more severely in August 2014, when Russia initiated an extensive food ban against Western countries. However, the EU exports to Russia of products targeted by these measures were already following a negative trend in the pre-ban period (the upper part of Figure 2). After the introduction of the food embargo, EU exports to Russia decreased also for non-banned products. The Russia's share in EU agri-food exports dropped by more than half over the three-year period of our investigation. Hence, our approach to evaluate the effect of Russian embargo has to control for biases in post-intervention period comparisons between the treatment and control group that could result from permanent differences between these groups. It is worth stressing that the embargo did not have a sizeable effect at the aggregated level. Indeed, the EU exports of banned products to all destinations combined had an almost flat evolution (the lower part of Figure 2). This suggests that EU countries successfully reoriented their exports banned from the Russian market to other countries.

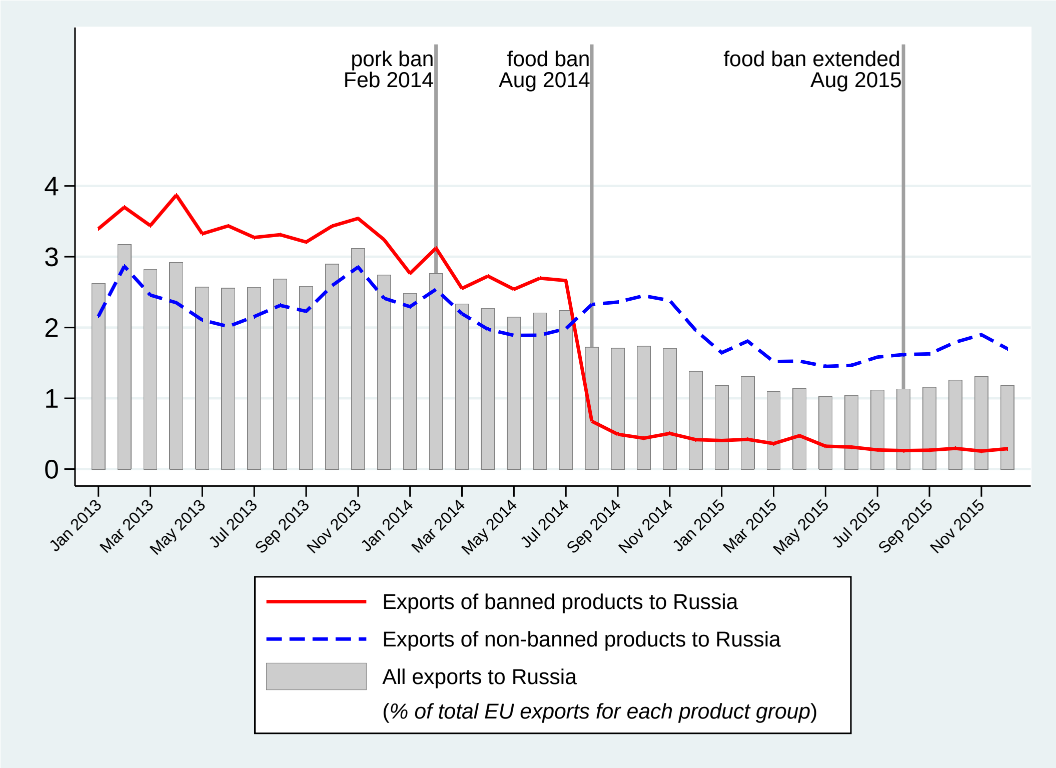
Data on Russian imports come from the Federal Customs' Service, and cover imports from 179 partner countries and of 189 4-digit HS product categories. From this database, we confirm that Russian import demand declined in 2015. The Russian market absorbed 3% of the agri-food products sold worldwide in 2013. In 2015, Russia accounted for only 1.8% of the global agri-

[15] Recourse to Article 22.2 of the DSU by the European Union, WT/DS475/17, circulated on 20 December 2017.

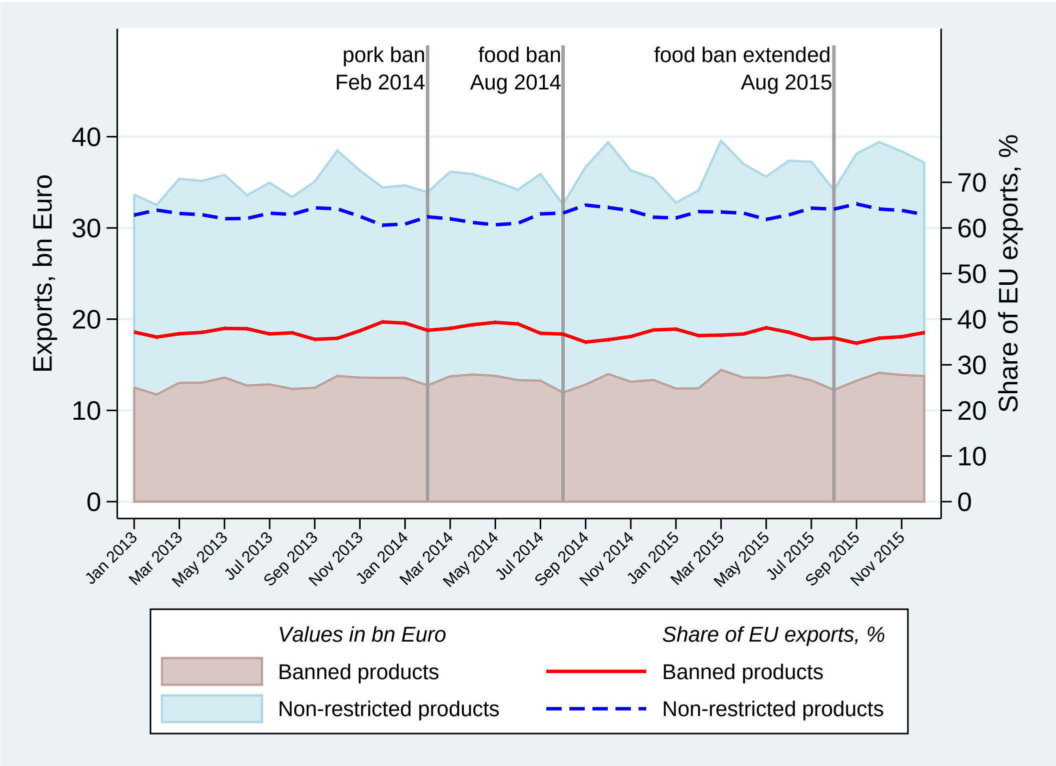
[16] The Russian ban on pork imports from the EU covered all products in HS4 groups '0103' and '0203'. Only products from group 0103 were not included in the Russian food ban. In 2013, these products represented only 1.7% of the EU exports to Russia in the two product groups.

[17] The Decree of the Russian Government *N* 1292 from 25 October 2017 extended the Russian food embargo to HS4 group '0103' (live swine), as well as groups '0206' (edible meat offal), '0209' (pig and poultry fat), '1501' (processed pig and poultry fat), '1502' (bovine fat), '1503' (other animal fat). In May 2017 the embargo was also extended to HS4 group '2501' (salt).

Figure 2: EU28 monthly exports of banned and non-banned agri-food products



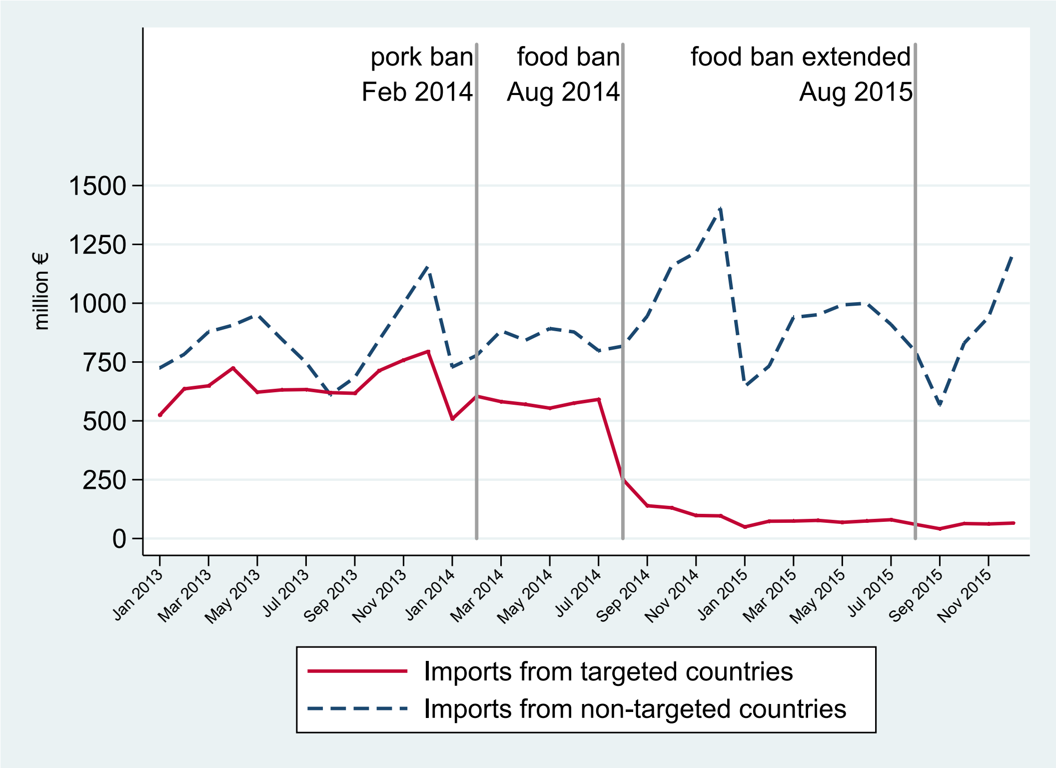
(a) Share of exports to Russia



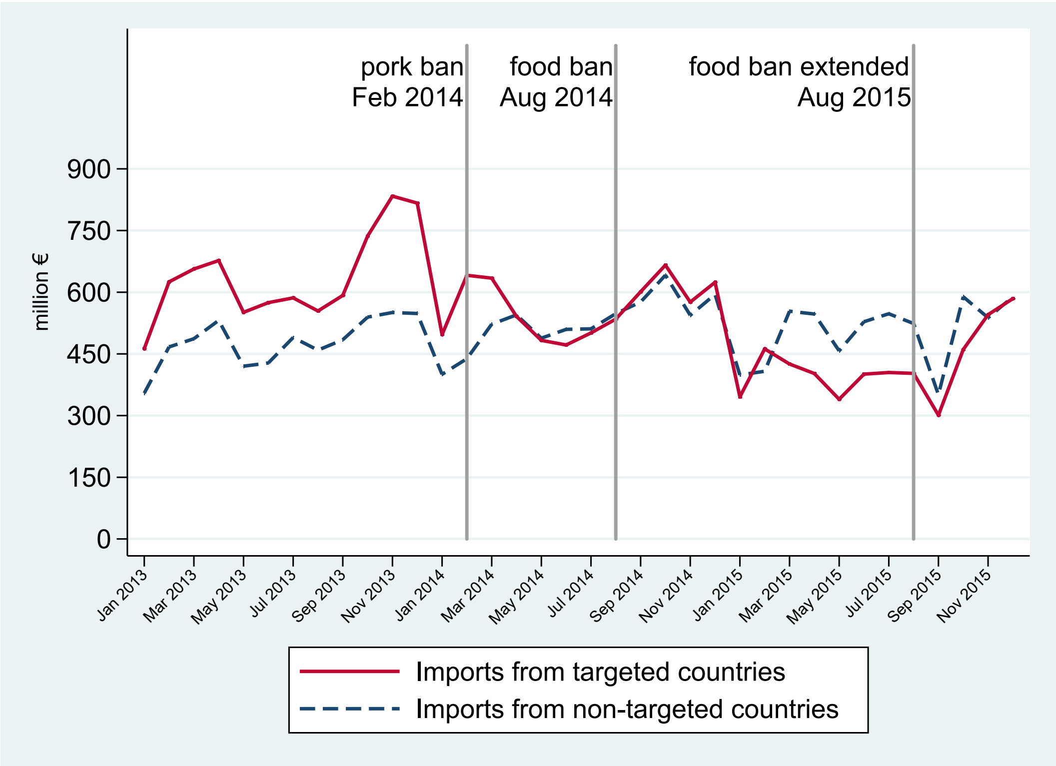
(b) EU28 overall exports

Notes: Authors' computation using COMEXT 4-digit HS trade data, chapters 1 to 23.

Figure 3: Russia's monthly imports from countries targeted or not by the ban



(a) Banned products



(b) Non-banned products

Notes: Authors' computation using Russia's 4-digit HS foreign trade data, chapters 1 to 23.

food market. Three main reasons may explain this relative decline: (i) the sanctions introduced by Western countries in 2014; (ii) the strong drop in the world market price for oil since June 2014; and (iii) the sharp depreciation of the ruble in late 2014 - early 2015 (see Appendix B). In the first four months after the implementation of the food embargo (August to November 2014), the decrease in Russian imports from targeted countries was accompanied by an increase in imports from other origins (Figure 3). However, the strong decrease in the purchasing power of Russian consumers in the late 2014 resulted into a sharp contraction of Russian imports which, despite short periods of positive growth, did not return to their pre-ban level.

3. The effects of the embargo on exports

3.1. Empirical strategy

To assess the effects of barriers to trade on exports (imports), the literature has extensively used the gravity equation. The gravity model of international trade predicts that bilateral trade flows depend on the size of origin and destination countries and on bilateral trade costs (distance, trade policy,...). To estimate the impact of the Russian import restrictions on international trade flows, we can develop a structural gravity model based on a constant elasticity of substitution (CES) expenditure structure.

In each country, consumers have identical Cobb-Douglas preferences over differentiated products, given by:

$$U_{jt} = \prod_k \left(\sum_i \left\{ [\theta^k_{ijt} q^k_{ijt}]^{\frac{\sigma^k - 1}{\sigma^k}} \right\}^{\frac{\sigma^k}{\sigma^k - 1}} \right)^{\mu^k_j} , \tag{1}$$

where q^k_{ijt} is the demand at time t for product k in country j imported from country i, U_{jt} is a strictly increasing and strictly concave upper-tier utility function twice continuously differentiable in all its arguments, σ^k is the elasticity of substitution of product k, and μ_{jk} are the standard expenditure shares, with $\sum_k \mu_{jk} = 1$. The budget constraint faced by a consumer in destination j is given by $\sum_i \sum_k p^k_{ijt} q^k_{ijt} = \mu^k_j R_{jt} \equiv E^k_{jt}$, where p^k_{ijt} is the price of product k imported from country i prevailing in country j, R_{jt} denotes total income, and E^k_{jt} aggregate expenditure for product k. Using the first-order conditions for utility maximization, the export sales $y^k_{ijt} \equiv p^k_{ijt} q^k_{ijt}$ are:

$$y^k_{ijt} = [\theta^k_{ijt}]^{\sigma^k - 1} E^k_{jt} [P^k_{jt}]^{\sigma^k - 1} [p^k_{ijt}]^{1 - \sigma_k} , \tag{2}$$

where P^k_{jt} is the price index (also known as the inward multilateral resistance terms, see Anderson and van Wincoop, 2003) given by

$$P^k_{jt} = \left\{ \sum_i (\theta^k_{ijt})^{\sigma^k - 1} [p^k_{ijt}]^{1 - \sigma^k} \right\}^{\frac{1}{1 - \sigma^k}} . \tag{3}$$

We model the embargo as a drop in consumers' valuation of banned products from targeted trade partners:

$$\theta_{ijt}^k = \theta_{ij}^k \exp[-\beta BAN_{i\in I_B, j=RU, k\in K_B, t\in T_B}] \,. \tag{4}$$

Dummy variable $BAN_{i\in I_B, j=RU,\, k\in K_B,\, t\in T_B}$ identifies trade flows directly targeted by the Russian ban: exports to Russia ($j = RU$) by countries targeted by the Russian ban ($i \in I_B$,) of banned products ($k \in K_B$) in months covered by the ban ($t \in T_B$). We assume that the other trade frictions raise the price of product k of country i delivered in destination j by a standard constant 'iceberg melting' factor $\tau_{ij}^k > 1$ (iceberg trade cost). Hence, $p_{ijt}^k = p_{it}^k \tau_{ij}^k$, where τ_{ij}^k is the trade cost between the exporting country and the destination country.

Each country's supply is sold locally or exported: $\sum_j \left\{ y_{ijt}^k \right\} \equiv S_{it}^k$, where S_{it}^k is the overall supply of country i in product k. Using these assumptions in (2), we reach a gravity-type expression of export sales:

$$y_{ijt}^k = \frac{E_{jt}^k}{(P_{jt}^k)^{1-\sigma^k}} \frac{S_{it}^k}{(\Psi_{it}^k)^{1-\sigma^k}} \left(\frac{\tau_{ij}^k}{\theta_{ij}^k} \right)^{1-\sigma^k} \exp[-(\sigma^k - 1)\beta BAN_{i\in I_B, j=RU, k\in K_B, t\in T_B}] \,, \tag{5}$$

where Ψ_{it}^k corresponds to the outward multilateral resistance index (see Anderson and van Wincoop, 2003).[18]

The structural gravity equation is traditionally estimated using time-varying exporter and importer fixed effects to control for $E_{jt}^k [P_{jt}^k]^{\sigma^k - 1}$ and, respectively, $S_{it}^k [\Psi_{it}^k]^{\sigma^k - 1}$, while bilateral trade costs τ_{ij}^k are approximated by a set of observable proxy variables (distance, contiguous borders, common language, colonial ties, etc.). We could estimate the effect of the embargo with this empirical strategy by comparing trade flows targeted by the ban, which represent the *treated* group, against flows not concerned by the ban, that constitute the *control* group. In our model, observations in the treated group differ from those in the control group across four dimensions (origin, destination, product, and month). However, the absence of reliable data on global trade at this level of detail does not permit to explore the variation in trade flows induced by the Russian ban across all these counterfactuals. As mentioned in the introduction, COMTRADE data on bilateral trade monthly flows at the HS 4-digit product level suffers from serious limits.

To evaluate the effects of the Russian food embargo, two databases giving information on bilateral monthly trade flows disaggregated by product can be alternatively used. First, we use monthly data from COMEXT on bilateral product-level exports of EU countries to Russia and other destinations. In this case, we can exploit variations across three dimensions (destination, product, and month) to estimate the effects on the exports of EU countries. However, we lose variation across origins, as all EU countries are equally targeted by the Russian import restrictions. Alternatively, we will use monthly data on Russian imports from Russian customs. This

[18] In our case, we have $[\Psi_{it}^k]^{1-\sigma^k} = \sum_j \left\{ [\theta_{ijt}^k]^{\sigma_k} \, [\tau_{ij}^k]^{1-\sigma^k} \, E_{jt}^k \, [P_{jt}^k]^{\sigma^k - 1} \right\}$.

database allows us to exploit variations across origin countries instead of destination countries. In this subsection, we present our identification strategy for COMEXT data. The analysis on Russian customs data is reported in subsection 3.3.

The COMEXT database covers monthly exports of each EU country i to each destination market j (including other EU member states and Russia), for each agri-food product k of the HS 4-digit classification. We use a triple difference approach to correctly estimate the effect of the Russian pork ban and food embargo. We estimate equation (5) in the logarithmic form, and employ different sets of fixed effects to control for supply (α_i), demand (ρ_j), product features (ϕ_k), and bilateral variables (τ_{ij}). We add interaction variables of counterfactuals that vary between the treated and control groups to separate the effect of the Russian embargo (ban) from other coincidental changes in the data. Hence, the model to be estimated can be written as follows:

$$\begin{aligned} \ln y_{ijt}^{k} &= \alpha_i + \rho_j + \phi_k + \lambda_t + \tau_{ij} + \beta_0 \cdot BAN_{j=RU,\, k\in K_B,\, t\in T_B} \\ &\quad + \beta_1 \left(I_{j=RU} \cdot I_{k\in K_B}\right) + \beta_2 \left(I_{j=RU} \cdot I_{t\in T_B}\right) + \beta_3 \left(I_{k\in K_B} \cdot I_{t\in T_B}\right) + \epsilon_{ijkt} \ , \end{aligned} \tag{6}$$

where λ_t is a monthly dummy, whereas $I_{j=RU}$, $I_{k\in K_B}$, and $I_{t\in T_B}$ are indicator variables for exports to Russia, exports of products covered by the embargo, and, respectively, exports during the embargo period. Since Russian import restrictions covered all EU member states, the ban dummy is constant for all exporters in our panel: $BAN_{i\in I_B, j=RU,\, k\in K_B,\, t\in T_B} = BAN_{j=RU,\, k\in K_B,\, t\in T_B}$. In this setting, the treated group are the EU exports of banned products to Russia during the ban ($BAN_{j=RU,\, k\in K_B,\, t\in T_B} = 1$). These flows differ from other export flows in the panel across destinations, products, and time.[19]

Parameter β_0 captures the overall effect of the embargo. It reflects the change in the level of EU exports of banned products to Russia induced by the embargo. More precisely, we have:

$$\begin{aligned} \hat{\beta}_0 &= \left(E\left[y_{ijkt}|BAN_{j=RU,\, k\in K_B,\, t\in T_B}=1\right] - E\left[y_{ijkt}|I_{j=RU,\, k\in K_B,\, t\notin T_B}=1\right]\right) \\ &\quad - \left(E\left[y_{ijkt}|I_{j=RU,\, k\notin K_B,\, t\in T_B}=1\right] - E\left[y_{ijkt}|I_{j=RU,\, k\notin K_B,\, t\notin T_B}=1\right]\right) \\ &\quad - \left(E\left[y_{ijkt}|I_{j\neq RU,\, k\in K_B,\, t\in T_B}=1\right] - E\left[y_{ijkt}|I_{j\neq RU,\, k\in K_B,\, t\notin T_B}=1\right]\right) \ . \end{aligned} \tag{7}$$

The triple difference approach permits to correct for the change in the evolution of EU exports to Russia of non-banned products that coincided with the introduction of the embargo (that captures the changes in $E_{jt}^{k}[P_{jt}^{k}]^{\sigma^k-1}$ for $j = RU$ and corresponds to $\hat{\beta}_2$),[20] and in the evolution

[19] Note that we cannot use importer and exporter fixed effects that vary by time and products ($[.]_{it}^{k}$ and $[.]_{jt}^{k}$) together with product-specific bilateral effects ($[.]_{ij}^{k}$) in (6). In this case, the effect of the ban (parameter β_0) would be fully absorbed by the fixed effects that identify exports to Russia, the latter being collinear with the ban dummy. Therefore, we use fixed effects with lower variability.

[20] Remember that key assumption for any triple difference strategy is that the outcome in treatment and control groups follows the same time trend in the absence of the treatment. Indeed, the triple difference estimate is an unbiased estimate of the effect of the Russian ban if the average change would have been the same for treatment and control groups in absence of the ban. This is the "parallel trend" assumption which is likely to hold in our

of EU exports of banned products to other destination markets (that captures the changes in $S_{it}^k[\Psi_{it}^k]^{\sigma^k-1}$ for $i \in EU$ and corresponds to $\hat{\beta}_3$).[21] This approach also controls for the difference in the average level of export flows in the treated and in the control group before the ban ($\hat{\beta}_1$).

In (6), we disregard time variations in the data that differ across origin countries, destination countries (except for Russia), and products (e.g. product-specific shifts in global demand and price). We control for time-varying characteristics of supply and demand by using time-varying importer, exporter, and product fixed effects:

$$\begin{aligned} \ln y_{ijt}^k &= \alpha_{it} + \rho_{jt} + \phi_{kt} + \tau_{ij} + \beta_0 \cdot BAN_{j=RU,\, k\in K_B,\, t\in T_B} \\ &\quad + \beta_1 \left(I_{j=RU} \cdot I_{k\in K_B}\right) + \epsilon_{ijkt}\,. \end{aligned} \tag{8}$$

Still, in (6) and (8), we do not control for product-specific bilateral variables, such as import tariffs and the product quality perceived by consumers, reflected by term $\tau_{ij}^k/\theta_{ij}^k$ in (5). To remedy this, we consider origin-by-destination-by-product fixed effects (η_{ijk}):

$$\begin{aligned} \ln y_{ijt}^k &= \eta_{ijk} + \lambda_t + \beta_0 \cdot BAN_{j=RU,\, k\in K_B,\, t\in T_B} \\ &\quad + \beta_2 \left(I_{j=RU} \cdot I_{t\in T_B}\right) + \beta_3 \left(I_{k\in K_B} \cdot I_{t\in T_B}\right) + \epsilon_{ijkt}\,. \end{aligned} \tag{9}$$

Equation (9) estimates the *inter-temporal* effect of the embargo, for a given product and pair of countries. In this specification, parameter β_0 reflects the average difference between the EU exports of banned products to Russia in a month with embargo relative to a month without embargo.

Alternatively, we can assess the embargo-induced changes in export flows *across products*. For that, we estimate (6) with monthly bilateral fixed effects and product dummies:

$$\begin{aligned} \ln y_{ijt}^k &= \tau_{ijt} + \phi_k + \beta_0 \cdot BAN_{j=RU,\, k\in K_B,\, t\in T_B} \\ &\quad + \beta_1 \left(I_{j=RU} \cdot I_{k\in K_B}\right) + \beta_3 \left(I_{k\in K_B} \cdot I_{t\in T_B}\right) + \epsilon_{ijkt}\,. \end{aligned} \tag{10}$$

Parameter β_0 in captures the difference in EU exports to the Russian market of banned products relative to the rest.[22]

case, as we consider a short time window.

[21]The different evolution of the above mentioned flows, displayed in Figure A2 of Appendix C, confirms the need for this correction and for the use of a triple difference estimator.

[22]Note that we could also estimate the embargo-induced changes in export flows *across destinations* by considering origin-by-product-by-month fixed effects and destination fixed effects. This specification assumes that each country has an equal demand for products from all destinations, that is highly unrealistic. As a result, we do not provide results associated with this set of fixed effects.

Table 1: Average effect of the pork ban and the food embargo on EU exports

		Explained variable: ln exports			
	Coef	(1)	(2)	(3)	(4)
Exports of banned products to Russia during the ban period	β_0	-1.24*** (0.31)	-1.23*** (0.39)	-1.63*** (0.24)	-1.13*** (0.26)
Exports of banned products to Russia	β_1	0.26 (0.19)	0.26 (0.19)		0.26 (0.19)
Exports to Russia during the ban period	β_2	-0.22*** (0.06)		-0.24*** (0.04)	
Exports of banned products during the ban period	β_3	0.02** (0.01)		0.02*** (0.01)	0.02** (0.01)
Fixed effects		i,j,k,t,ij	it,jt,kt,ij	ijk, t	ijt, k
R^2		0.38	0.39	0.83	0.41
Number of observations		3,220,498			

Notes: Clustered (by country pairs) standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

3.2. Results from COMEXT data

The estimates of equations (6) and (8) are displayed in the first and second column of Table 1. Our estimates of parameters β_0 and β_1 reported in column (1) are similar to those in column (2). According to our results, the embargo led to a 71% $[= 100 - \exp(-1.24) \cdot 100]$ drop in EU exports of banned products to Russia.[23] Meanwhile, EU exports of other products to this market contracted by 20% $[= 100 - \exp(-0.22) \cdot 100]$. This effect is not directly linked to the embargo. It was, most likely, induced by the decrease in the purchasing power of Russian consumers. Indeed, the introduction of the food embargo was shortly followed by a strong devaluation of the Russian ruble, and a sharp drop in the global price of oil that led to a strong contraction of Russian export revenues (Figure A1 of Appendix B), the peak of these evolutions occurring in the late 2014 - early 2015. We also find an average 2% $[= 100 - \exp(0.02) \cdot 100]$ increase in EU exports of banned products to other countries (including the intra-EU market). This result indicates that EU members reoriented their exports of products banned from the Russian market to alternative destinations. The statistically non significant estimate of β_1 shows that the level of EU exports to Russia of products covered by the ban was comparable to the level of other EU exports.

In column (3), we estimate the *inter-temporal* effect of the embargo given by (9), using as controls the full set of product-specific bilateral fixed effects and monthly dummies. Our results indicate that EU exports of banned products to Russia during the embargo were on average 80% ($[= 100 - \exp(-1.63) \cdot 100]$) lower than in the pre-ban period. Similarly to results in the first

[23] The model predicts that EU exports of banned products to Russia were equal to 29% $[= \exp(-1.24) \cdot 100]$ of the level of reference export flows (not concerned by the ban). This means that the ban let to a 71% $[= 100\% - 29\%]$ drop in flows targeted by the ban.

two columns of Table 1, we find a 21% decrease in the EU exports of non-banned products to Russia, and a slight increase in the EU exports to other trade partners.

The last specification in Table 1 reflects the embargo-induced changes in export flows *across products* according to (10). We compare the EU exports of banned and non-banned products for a given country pair and month. Our estimates show that, during the embargo period, EU exports of banned products to Russia were on average 68% ($[= 100 - \exp(-1.13) \cdot 100]$) smaller in value terms than EU exports of non-banned products to this market.

It is worth stressing that, according to estimates in Table 1, the effect of the Russian embargo appears to be stronger across the inter-temporal dimension than across products. This indicates that most of the embargo effect estimated in the first two columns of the table comes from monthly variations in export flows. However, differences in the magnitude of effects in the four columns are not statistically significant, and are very much attenuated when expressed in percentage terms.

The differentiated impacts of the pork ban and the food embargo. During the analysed period, EU exports were subject to two partially overlapping import restrictions on the Russian market: the pork ban and the food embargo. Equations (6), (8), (9), and (10) estimate the average (joint) effect of the two measures, assuming a similar evolution of trade flows for products affected by either import restriction. To allow for a differentiated impact of the pork ban and the food embargo, we estimate the following equation:

$$\begin{aligned} \ln y_{ijt}^{k} \;=\; & \text{FE} + \beta_0^P PorkBAN_{j=RU,k\in K_{PB},t\in T_{PB}} + \beta_0^F FoodBAN_{j=RU,k\in K_{FB},t\in T_{FB}} \\ & + \beta_1^P \left(I_{j=RU} \cdot I_{k\in K_{PB}}\right) + \beta_2^P \left(I_{j=RU} \cdot I_{t\in T_{PB}}\right) + \beta_3^P \left(I_{k\in K_{PB}} \cdot I_{t\in T_{PB}}\right) \\ & + \beta_1^F \left(I_{j=RU} \cdot I_{k\in K_{FB}}\right) + \beta_2^F \left(I_{j=RU} \cdot I_{t\in T_{FB}}\right) + \beta_3^F \left(I_{k\in K_{FB}} \cdot I_{t\in T_{FB}}\right) + \epsilon_{ijkt} \,, \end{aligned} \tag{11}$$

where FE represent the different sets of fixed effects. Dummies $PorkBAN_{k\in K_{PB},t\in T_{PB}}$ and $FoodBAN_{k\in K_{FB},t\in T_{FB}}$ reflect the exports targeted by the pork ban and, respectively, the food embargo. Similarly, $I_{k\in K_{PB}}$, $I_{k\in K_{FB}}$, $I_{t\in T_{PB}}$, and $I_{t\in T_{FB}}$ refer to the list of products and of months covered by the two import restrictions.

We report results in Table 2. We use the same sets of fixed effects as in the corresponding columns of Table 1. Parameters do not differ significantly across specifications. The pork ban had a stronger effect on individual EU exports than the food embargo. The former led to an almost complete cessation of EU swine and pork exports to Russia (the value of these exports dropped by 97%), while the latter generated a milder 70% drop in EU exports of banned food products to Russia. The global demand for EU exports also evolved differently for products covered by the two import restrictions. It shrank by 8% for swine and pork, but registered a

Table 2: Pork ban and food embargo effects on EU exports

	Coef	Explained variable: ln exports			
		(1)	(2)	(3)	(4)
		The pork embargo			
Exports of pork & swine to Russia during the pork ban	β_0^P	-3.51*** (0.38)	-3.49*** (0.33)	-3.42*** (0.37)	-3.36*** (0.30)
Exports of pork & swine to Russia	β_1^P	0.72** (0.29)	0.72*** (0.28)		0.72*** (0.27)
Exports to Russia during the pork ban	β_2^P	-0.10*** (0.03)		-0.08*** (0.02)	
Exports of pork & swine during the pork ban	β_3^P	-0.08** (0.04)		-0.04* (0.03)	-0.05 (0.04)
		The food embargo			
Exports of banned food products to Russia during the food embargo	β_0^F	-1.20*** (0.31)	-1.20*** (0.30)	-1.59*** (0.24)	-1.09*** (0.26)
Exports of banned food products to Russia	β_1^F	0.25 (0.19)	0.25 (0.19)		0.24 (0.19)
Exports to Russia during the food embargo	β_2^F	-0.15** (0.07)		-0.19*** (0.04)	
Exports of banned food products during the food embargo	β_3^F	0.02** (0.01)		0.02*** (0.01)	0.02** (0.01)
Fixed effects		i,j,k,t,ij	it,jt,kt,ij	ijk, t	ijt, k
R^2		0.38	0.39	0.83	0.41
Number of observations		3,220,498			

Notes: Clustered (by country pairs) standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

slight 2% increase for products under the food embargo. Meanwhile, overall EU exports to the Russian market decreased by 9% during the first months of the pork ban, and by 21% after the introduction of the food embargo.[24] The positive estimate for β_1^P shows that EU exports of pork and swine to Russia represented an important component of EU exports. They were on average twice as large as EU exports of other products to other destinations: $2.05 = \exp(0.72)$.

The effects on volume and price. The effects discussed above reflect the sum of evolutions of EU exports in physical terms and in prices. In Appendix C, we compare volume and price evolutions of Eu exports. We replicate estimations from Table 2 on the quantity of agri-food products exported by EU countries transformed in ton equivalents and on their corresponding unit values (Table A2). Unit values are computed for each individual export flow by dividing the monetary value of the flow by its volume in tons. For a given pair of countries and HS 4-digit product code, the unit value reflects each month the average price at which these products

[24]The last figure is obtained by summing parameters β_2^P and β_2^F: $100 - \exp(-0.10 - 0.15) \cdot 100 = 21\%$.

were exchanged between sellers and buyers from the two countries. Effects on the volume of EU exports are very similar to those in value terms, while the corresponding shifts in prices are mostly in the opposite direction. EU products banned from the Russian market were sold at a lower price to other destinations. The drop in the export price was particularly strong for pork and swine products: 8%. The flat global demand for these products in volume terms did not permit EU producers to find alternative markets for the products they used to export to Russia. Price cuts were less important for products under the food embargo, as the demand for these products in volume terms increased after the introduction of the Russian embargo. Different evolutions for products covered by the pork ban and by the food embargo are partially explained by the gap in the price at which they were sold on the Russian market relative to other destinations even prior to the ban/embargo. EU pork and swine exported to Russia were on average 31% more expensive than similar EU products exported to other countries. On the contrary, the price of banned food products exported to Russia was 13% lower than on alternative markets. Meanwhile, the drop in EU exports to Russia for non-banned products was not accompanied by a change in their export price. The loss in the purchasing power of Russian consumers translated into lower volumes of imports at unchanged prices.

How large was the EU export loss generated by the Russian pork ban and food embargo? To answer this question, we estimate the level of counterfactual flows in the absence of the embargo, aggregate flows at country level, and compute the change in exports for different types of flows. Our preferred equation is (9), estimated in column (3) of Table 1 (and its equivalent reported in column (3) of Table 2). Product-specific country-pair effects included in estimation control for cross-product variations in supply, demand, and trade costs. This eliminates most of any possibly omitted variable bias, and yields the most accurate estimate of β_0. This specification also yields the highest fit of the data. Therefore, we use this specification to compute the impact of the embargo at the aggregate level.

Let $\hat{y}_{ijt}^k$ denote the level of exports predicted by (9). The change (loss or gain) in export sales is computed as follows:

- EU exports of banned products to Russia:
  - the part due to the ban: $\sum_{i,j=RU,k\in K_B}\left[1-\exp(-\hat{\beta}_0)\right]\hat{y}_{ijt}^k$;
  - the part due to other factors: $\sum_{i,j=RU,k\in K_B}\left[1-\exp(-\hat{\beta}_2-\hat{\beta}_3)\right]\hat{y}_{ijt}^k\exp(-\hat{\beta}_0)$;
- EU exports of non-banned products to Russia: $\sum_{i,j=RU,k\notin K_B}\left[1-\exp(-\hat{\beta}_2)\right]\hat{y}_{ijt}^k$;
- EU exports of banned products to other countries: $\sum_{i,j\neq RU,k\in K_B}\left[1-\exp(-\hat{\beta}_3)\right]\hat{y}_{ijt}^k$.

The overall change in EU exports after the introduction of ban is obtained as the sum of these amounts and is equal to $\sum_{i,j,k}\left[1-\exp(-\hat{\beta}_0-\hat{\beta}_2-\hat{\beta}_3)\right]\cdot\hat{y}_{ijt}^k$. These estimates rely on the assumption that, in the absence of the ban, all EU export flows would have followed the same evolutionary trend. We compute changes in exports for each month covered by the ban ($t \in T_B$) and take the average across months. We show results in the second line of Table 3.

We find that the Russian import ban led to an average monthly loss in EU exports of banned products to Russia of € 124.7 m.[25] Evolutions specific to the destination country (Russia) and to the exported products, such as the decline in the Russian import demand adjusted by the growing global demand for EU products subject to the ban, generated an additional € 38.6 m loss in these export flows.[26] Estimated export losses or gains in terms of non-banned products and on other destination markets were entirely driven by factors not linked to the ban (short-term changes in the economic environment). We find that each month of the ban the EU lost, on average, € 89.7 m worth of exports of non-banned products to Russia.[27] At the same time, EU monthly exports of banned products to other markets than Russia increased, on average, by € 230.5 m.[28] Most of this increase (€ 188.2 m) comes from larger exports to EU partners. Thus, the loss in EU exports of banned products to Russia was fully canceled out by positive evolutions on other markets. Note, that these effects are quite small when compared to the average value of EU monthly exports, which amounted to nearly € 35 bn in the year preceding the ban (including intra-EU trade). The total loss in EU exports to Russia, induced by the Russian embargo or other factors, represents only 0.7% of this amount. Even when we disregard intra-EU flows, this loss corresponds to only 2.8% of the extra-EU agri-food exports. This share increases to 3.6% when we refer only to extra-EU exports in products covered by the Russian ban. Thus, the overall change in EU exports (all products and all factors combined) during the ban period is estimated at an average € -22.6 m per month $[= -124.7 - 38.6 - 89.7 + 230.5]$.

In Table 3, we decompose the change in exports of banned products to Russia and other markets across the main groups of products covered by the Russian embargo. More than half of the loss in EU exports to Russia are in food preparations included in HS4 product groups '1901' and '2106'. The rest of the export loss on the Russian market was almost evenly distributed across diary products, fruit, and vegetables. Export losses in meat and fish products and preparations are insignificant. Except for food preparations, the increase in exports to alternative markets, inside and outside the EU, largely exceeded the export loss suffered on the Russian market. This indicates that EU countries found alternative buyers for their prior exports to Russia in most product groups. As for food preparations, EU managed to sell elsewhere only 31% of its exports to Russia. This product group also displays the largest relative increase in exports to extra-EU markets: 40%. The share for the other product groups listed in Table 3 is two to four times smaller.

[25] € 124.7 m $= \sum_{t\in T_B} \left[\sum_{i,j=RU,k\in K_B}[1-\exp(1.63)]\cdot \hat{y}^k_{ijt}\right]/17$.

[26] € 38.6 m $= \sum_{t\in T_B} \left[\sum_{i,j=RU,k\in K_B}[1-\exp(0.24-0.02)]\cdot \hat{y}^k_{ijt}\cdot\exp(1.63)\right]/17$.

[27] € 89.7 m $= \sum_{t\in T_B} \left[\sum_{i,j=RU,k\notin K_B}[1-\exp(0.24)]\cdot \hat{y}^k_{ijt}\right]/17$.

[28] € 230.5 m $= \sum_{t\in T_B} \left[\sum_{i,j\neq RU,k\in K_B}[1-\exp(-0.02)]\cdot \hat{y}^k_{ijt}\right]/17$.

Table 3: Changes in EU exports during the Russian embargo by products (€ m)

	average monthly exports of EU28		change in EU28 monthly exports of banned products to			
Sector	total	extra-EU	Russia*	other mkts†	intra-EU	extra-EU
All agri-food products	34,892	9,083				
Banned products	20,279	4,492	-124.7	230.5	188.2	42.3
– Meat products	3,529	551	-1.5	64.0	55.5	8.5
– Diary products	3,216	761	-12.9	57.1	45.5	11.6
– Fruit	1,956	317	-16.1	26.3	23.4	2.9
– Vegetables	1,643	250	-11.2	24.2	21.6	2.6
– Fish products	1,472	274	-4.3	27.2	23.3	4.0
– Food preparations	1,697	749	-78.7	31.7	19.0	12.7

Notes: Changes in EU exports computed from equation (9), decomposed by groups of products. *We report only the change in exports induced by the ban. †This change in exports is generated by other factors than the ban.

3.3. Results from Russian customs data

We now analyze the effect of the embargo on exports of targeted countries from panel data covering Russian monthly imports in all products from HS chapters 1-23, defined at the 4-digit level, from all trade partners. Since our data panel contains a single importing country (Russia), we explore variation across all dimensions except destination markets. This database allows us to better control for changes in Russian demand for each product. The time-varying product fixed effect (ϕ_{kt}) is common for all countries (targeted and non-targeted countries) and is specific to Russia. In addition, from this database, we can identify the effect of the Russian embargo on other targeted countries. The embargo effect on individual trade flows is obtained by estimating a triple difference equation, similar to equation (11):

$$\begin{aligned} \ln y_{it}^{k} &= \gamma_0^P \cdot PorkBAN_{i\in I_{PB},k\in K_{PB},t\in T_{PB}} + \gamma_0^F \cdot FoodBAN_{i\in I_{FB},k\in K_{FB},t\in T_{FB}} \\ &\quad + \alpha_{it} + \phi_{kt} + \omega_{ik} + v_{it}^{k}. \end{aligned} \tag{12}$$

Variables $PorkBAN_{i\in I_{PB},k\in K_{PB},t\in T_{PB}}$ and $FoodBAN_{i\in I_{FB},k\in K_{FB},t\in T_{FB}}$ are the dummies for the set of countries and products targeted by the pork ban and by the food embargo, respectively. Time-varying product-specific fixed effects ϕ_{kt} permit to control for the heterogeneity of the Russian import demand for different food products and across time. Similarly, country-specific effects α_{it} capture variations across origin countries in the level of food supply and in trade costs for reaching the Russian market. Fixed effects ω_{ik} reflect the different valuation of imported products by Russian consumers, after controlling for product- and country-specific characteristics (e.g. their valuation of French wine vs. wine from other origins). These demand shifters can be interpreted as quality indicators. A large positive ω_{ik} indicates a higher Russian demand for product k from source country i relative to alternative origins.

Column (3) of Table 4 reports the estimates of equation (12). For comparison purposes, in columns (1) and (2) we show the estimates of (12) using different sets of fixed effects. Estimated parameter γ_0^P, corresponding to the effect of the pork ban, is statistically significant in all specifications. Differently, we obtain uneven values for the effect of the food embargo (parameter γ_0^F) in the three columns of Table 4. Results in columns (1) and (2) find no significant difference between the level of Russian imports of banned food products from countries targeted by the ban relative to imports from alternative source countries. However, when we control for all sources of potential bias (column (3)), estimated parameter γ_0^F becomes statistically significant. After the introduction of the ban, Russian imports of banned food products from targeted countries decreased by 68% $[= 100 - \exp(-1.15) \cdot 100]$. We find an even stronger decrease in imports of EU pork and swine products: by 96% $[= 100 - \exp(-3.13) \cdot 100]$.[29] The decrease in Russian imports was driven by a drop in imported quantities, results being similar when we replicate estimates in Table 4 on quantities, whereas effects on average prices (unit values) are less significant.[30] In column (1) we also find a 16% decrease in Russian imports of non-banned products from countries targeted by the ban. This confirms that the decrease in the Russian import demand was induced by other factors than the ban, such that the strong devaluation of the Russian ruble and the sharp drop in the oil price.

In Table 5 we report the evolution of Russian imports of banned and non-banned products from three groups of countries targeted by the ban and for non-banned countries. We estimate the change in Russian imports from each group using the most robust specification (with the largest set of fixed effects) and allow the effect of the ban to differ across groups. Accordingly, for the change in Russian imports from EU countries we estimate:

$$\ln y_{it}^k = \alpha_{it} + \phi_{kt} + \omega_{ik} + \gamma_0 \cdot BAN_{i \in I_B, k \in K_B, t \in T_B} + \gamma_{0,EU} \cdot BAN_{i \in EU, k \in K_B, t \in T_B} + \upsilon_{ikt}. \quad (13)$$

We estimate a similar equation for non-EU countries targeted by the Russian embargo from August 2014, for countries included under the Russian embargo in August 2015, and for the group of non-banned countries. We separate the change in imports directly induced by the ban from the change due to other factors.[31]

With Russian customs data, we find that the ban-induced loss in EU28 exports to Russia amounted to € 121.7 m per month on average. This value is very close to the € 124.7 m loss estimated with COMEXT data. This points to the robustness of our results, despite the differences between our analyzes with the two data sources. Indeed, treatment and control groups

[29]We also estimated the *inter-temporal* and the *inter-product* effect of the ban, similarly to our analysis with COMEXT data. Since Russian customs data does not permit to explore the bilateral dimension of trade, the inter-temporal effect is obtained using fixed effects ik and t in (12), and the inter-product effect using fixed effects it and k in (12). Obtained parameter estimates are very similar to the ones in column (3) and, respectively, in column (1) of Table 4.

[30]Results for imported quantities and unit values of imported goods can be provided upon request.

[31]These estimates are not reported in the paper, but can be provided upon request.

Table 4: Pork ban and food embargo effects on Russian imports

		Explained variable: ln imports		
	Coef	(1)	(2)	(3)
		The pork ban		
Imports of pork & swine from EU28 during the pork ban	γ_0^P	-1.47** (0.58)	-2.45*** (0.39)	-3.13*** (0.39)
Imports of pork & swine from EU28		0.10 (0.74)	0.12 (0.79)	
Imports of pork & swine during the pork ban		-0.76 (0.51)		
Imports of from EU28 during the pork ban		0.09 (0.06)		
		The food embargo		
Imports of banned food products from targeted countries during the food ban	γ_0^F	-0.32 (0.21)	0.31 (0.29)	-1.15*** (0.17)
Imports of banned food products from targeted countries		-0.02 (0.31)	-0.09 (0.32)	
Imports of banned food products during the food ban		0.47*** (0.07)		
Imports from targeted countries during the food ban		-0.17** (0.07)		
Fixed effects		i, k, t	it, kt	it, kt, ik
R^2		0.33	0.37	0.85
Number of observations			106,451	

Notes: Clustered (by country) standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

in estimations with COMEXT data and with Russian customs data only partially overlap.[32] Moreover, unlike our estimations with COMEXT data, results from Russian customs data do not exclude possible trade diversion effects.[33] Hence, the estimated treatment effect with Russian customs data is most likely downward biased in absolute terms, and can be interpreted as a lower bound of the true causal effect of the Russian food ban.[34] On the opposite, the export loss

[32]The analysis relying on Russian customs data uses a wider treatment group, that encompasses Russian imports of banned products from EU countries (the treatment group of the analysis with COMEXT data) and from other targeted countries. With the COMEXT database, our control group consists of EU exports of non-banned products to Russia and of EU exports (of banned and non-banned products) to third countries. When we use Russian customs data, the control group comprises Russian imports of non-banned products from EU and other targeted countries and Russian imports (of both banned and non-banned products) from countries not targeted by the ban.

[33]The triple difference approach used in both analyzes assumes that the control group is not affected by the ban. This assumption is verified with COMEXT data, where we allow EU exports of banned products to Russia and to other countries to follow different evolutions, but not with Russian customs data, where we cannot separate evolutions in the demand from evolutions in the supply of banned products. In the latter case, the control group (Russian imports from third countries) can be positively affected by the diversion of imports from targeted countries to third countries.

[34]To explore this issue, we also estimated the embargo effect using Russian imports exclusively from non-targeted countries. Details are reported in Table A4 of Appendix D. Results show an average € 182.5 m gain in

Table 5: Changes in Russian imports during the embargo (€ m)

Source country	average monthly agri-food imports*	change in monthly imports: banned products total	banned products due to ban	non-banned products	all products
European Union 28	940	-268.6	-121.7	-82.6	-351.1
Banned since Aug 2014†	221	-138.0	-37.2	-10.2	-148.2
Banned since Aug 2015‡	138	-14.7	-2.2	-27.3	-42.0
Not banned	1,325	172.7		38.8	211.5

Notes: *Data for 2013, the year before the ban; †Countries targeted by the Russian embargo since August 2014b (other than EU28): Australia, Canada, Norway, and USA; ‡ Countries targeted by the Russian embargo since August 2015: Albania, Iceland, Liechtenstein, Montenegro, and Ukraine.

estimated with COMEXT data can be regarded as the upper bound of the true effect of the ban.

Results in Table 5 show that the EU bare most of the negative effect of the ban. Other countries targeted by the Russian food embargo register smaller losses, as Russia was not a major destination of their exports of banned products. We also find that that Russian imports dropped significantly due to other factors than the ban, which generated a strong decline in Russia's overall import demand. Our calculations reveal that *only* $45\%[= (-121.7)/(-268.6)]$ *of the drop in EU28 exports can be explained by the Russian food ban.* This share is even smaller for other countries targeted by the ban, pointing to the important role of non-ban factors, such as short-term evolutions that affected the Russian economy.

Table 5 indicates that non-boycotted countries have experienced an average increase of € 172.7 m in their monthly exports of banned product to Russia during the embargo. These gains are inflated by a 22% appreciation of the € against the \$ during the ban period. When we account for \$/€ exchange rate variations, the average monthly export gain amounts to \$ 84.2 m. Although the embargo generated important trade diversion effects, Russia's larger imports from non-boycotted countries did not compensate for ceased imports from boycotted countries. We find a strong decrease in Russia's overall imports of both banned (€ -259 m) and non-banned products (€ -79 m). This suggests that Russian consumers switched to cheaper imported products, turned to domestically-produced substitutes, decreased their consumption level, or adopted a combination of these strategies.[35]

monthly exports of non-targeted countries to Russia in products covered by the ban.

[35] In Appendix E we provide evidence for the decrease in the average price of Russian imports of non-banned products. For Russian imports of banned products, this trend is outweighed by the higher trade cost associated with imports from more distant non-banned countries. According to ROSSTAT (Russian Federal State Statistics Service), in the first year of the ban, food price inflation reached 18%, with even higher price increases for selected food products, such as fish, diary products and fruit. ROSSTAT also reports structural changes in the Russian food demand: the consumption of meat, diary and fruit (more expensive food products) decreased, while it increased for vegetables and potatoes (cheaper products).

4. Trade diversion effects

In this section, we study the impacts of the Russian food embargo on trade patterns. We distinguish adjustments along the intensive margin (for targeted countries, in the export value per product to alternative destinations; for Russia, in the value of product-specific imports from alternative source countries) and along the extensive margin (in the number of trade partners per product for EU countries and Russia).

4.1. Heterogeneous responses of EU countries at the intensive margin

In this subsection, we question whether EU countries were heterogeneously affected by the ban. First, we evaluate the difference among EU countries in the direct consequences of the Russian embargo, as well as in its indirect effects (the change in exports to other destinations) using COMEXT data.

To estimate the change in the aggregate level of exports for each EU member country, we allow the evolution of exports of each country to differ from that of the rest of the EU. For each EU member country m, we estimate the following equation on the entire sample of EU exports:

$$\begin{aligned}\ln y_{ijt}^{k} \;=\;& \eta_{ijk} + \lambda_t + \beta_0 \cdot BAN_{j=RU,\, k\in K_B,\, t\in T_B} + \beta_{m,0} \cdot BAN_{i=m, j=RU,\, k\in K_B,\, t\in T_B} \\ &+ \beta_2 \left(I_{j=RU} \cdot I_{t\in T_B}\right) + \beta_{m,2} \left(I_{i=m} \cdot I_{j=RU} \cdot I_{t\in T_B}\right) \\ &+ \beta_3 \left(I_{k\in K_B} \cdot I_{t\in T_B}\right) + \beta_{m,3} \left(I_{i=m} \cdot I_{k\in K_B} \cdot I_{t\in T_B}\right) + e_{ijkt}\,. \end{aligned} \tag{14}$$

The aggregate effect on each type of exports of country m is obtained by summing the average EU effect, reflected by parameter β_0, β_2, or β_3, and the corresponding individual effect $\beta_{m,0}$, $\beta_{m,2}$, or $\beta_{m,3}$.

We report country-level evolutions in Table 6 and rank countries by the average level of their exports to Russia in 2013. The largest loss in exports of banned products to Russia were registered for Lithuania, Poland, and Germany. Lithuania, followed by Estonia, suffered the largest loss in relative terms, due to the heavy orientation of their exports to the Russian market prior to the ban.[36] Unlike Germany and Poland, who compensated their losses on the Russian market by a strong increase in exports to other trade partners (mostly intra-EU), Baltic countries reoriented only a small fraction of the banned products they used to export to Russia. Countries selling large volumes of agri-food products on the Russian market - Netherlands, Germany, and Latvia - have lost the most in terms of exports of non-banned products. Other EU countries were marginally affected by the Russian import restrictions.

Table 6 reveals important dissimilarities in the global demand for products covered by the Rus-

[36] In 2013, Russia's share in agri-food exports was equal to 32% for Lithuania and to 20% for Estonia. At the same time, only 2.8% of all EU exports and 3.7% of the extra-EU exports went to Russia.

Table 6: Changes in aggregate EU exports during the Russian embargo (€ m)

	average monthly agri-food exports	change in exports banned products to Russia	non-banned products to Russia	banned products other mkts	banned products intra-EU	all products all mkts
EU 28	**34,892**	**-124.7**	**-89.7**	**230.5**	**188.2**	**-22.6**
Netherlands	5,559	-5.1	-22.1	39.4	30.5	6.5
Germany	5,140	-23.6	-20.6	38.5	33.5	-17.2
France	4,729	-5.9	-2.8	-36.7	-27.5	-46.6
Spain	3,020	-1.5	-1.8	107.3	92.5	104.0
Belgium	2,742	-6.7	0.4	17.8	16.2	11.8
Italy	2,713	-4.8	-7.5	43.1	33.8	29.6
United Kingdom	1,928	-0.1	-1.3	8.3	6.2	6.6
Poland	1,526	-27.3	-0.9	94.7	81.5	69.3
Denmark	1,364	-1.0	-4.4	-73.1	-53.8	-84.8
Ireland	830	-1.6	-1.2	9.7	7.3	4.2
Austria	817	-6.0	-1.2	5.3	4.7	-3.0
Hungary	615	-0.1	0.8	2.6	2.1	3.4
Sweden	596	-0.3	-1.1	-27.8	-25.0	-29.3
Czech Republic	472	-0.2	-1.6	2.5	2.4	0.6
Portugal	425	0.0	-0.6	17.0	12.7	16.4
Romania	382	0.0	-0.6	0.7	0.6	0.1
Greece	373	0.0	-1.3	-7.8	-6.5	-9.1
Lithuania	360	-36.4	-8.3	1.8	1.4	-53.1
Bulgaria	300	0.0	-0.3	0.6	0.5	0.2
Slovakia	273	0.0	0.1	1.0	1.0	1.1
Latvia	182	-2.1	-14.2	0.6	0.5	-16.8
Finland	123	-2.0	-2.0	-3.7	-2.3	-8.8
Slovenia	121	0.0	-0.1	0.6	0.4	0.1
Estonia	98	-3.7	-4.3	0.5	0.4	-9.5
Croatia	88	-0.1	-0.1	0.5	0.2	0.2
Luxembourg	73	0.1	-0.1	0.8	0.8	0.7
Cyprus	23	0.0	0.0	0.2	0.2	0.2
Malta	18	0.0	0.0	0.1	0.0	0.1

Notes: Country-specific results obtained from estimating equation (14) on the entire sample for each EU member state m.

sian ban across EU member countries. Denmark, France, and Sweden were confronted with a strong decline in the foreign demand for their products. At the other end of the spectrum, Spain, Poland, and Italy largely expanded their exports, both on the intra-EU and extra-EU markets. The total change in EU exports during the ban period also varies greatly across countries. Spanish and Polish exports display the strongest positive evolutions of monthly exports, with an average increase of € 104 m, and respectively € 69 m. We observe the largest decline in exports for Denmark, Lithuania, and France.

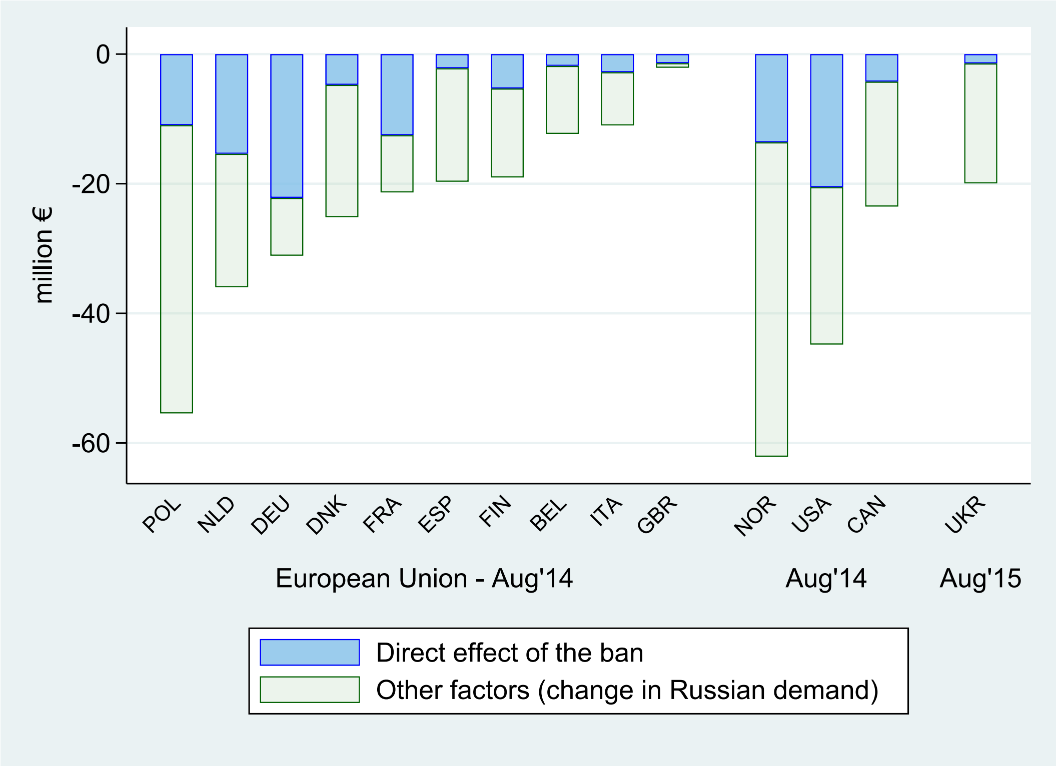
We use a similar approach and the trade specification in column (3) of Table 2 to separate the change in exports induced by the pork ban and the food embargo. Results are resumed in Table A3 of Appendix C. Most of the change in the exports of banned products reported in Table 6 is attributed to the food embargo, which covered a larger panel of products. The average loss in EU exports to Russia of pork and swine amounted to only € 4 m per month; the remaining € 120.7 m correspond to the export loss of products targeted by the food embargo. The decreasing global demand for EU pork and swine (on other markets than Russia) did not permit EU producers to find alternative buyers for all pork and swine products they used to export to the Russian market. The EU exports of pork and swine decreased both on the intra-EU market (€ -51.5 m), and on third markets (€ -11.5 m). Differently, the EU exports of products under the food embargo were successfully reoriented to EU (€ $+208.5$ m) and extra-EU trade partners (€ $+47.8$ m). Assuming that EU exports to Russia were reoriented to other markets proportionally to the evolution of EU's overall exports to these destinations, we conclude that 81% of the flows targeted by the Russian embargo were sold on the intra-EU market, and only 19% to extra-EU countries. Our estimates also show that EU monthly exports of non-banned products to Russia decreased on average by € 32.9 m between February and July 2014, and by € 102.0 m afterward. This result reflects the gradual contraction of Russia's import demand for EU agri-food products.

Contribution of the food embargo to the drop in each EU member country's exports to Russia (Russian customs data). According to results reported in Table 5, the contribution of the Russian food embargo to the drop in EU28 exports is relatively low (45%on average). However, the role played by the Russian ban can largely vary across member states. We estimate (13) separately for each EU28 country and report in Figure 4 the country-specific change in exports to Russia caused by the ban and by other concomitant factors.[37] Other factors – associated mainly with the evolution of Russian demand – play a key role in the fall of exports to Russia. For most EU countries supplying at least 1% of the Russian agri-food imports prior to the ban (pictured in Figure 4), over half of the export loss was generated by evolutions independent from the introduction of the ban. This suggests that these countries' exports to Russia would have dropped considerably even in the absence of the ban. The direct effect of the ban was particularly strong for Germany and France, accounting for 71% and respectively 59% of their loss of exports to Russia. Heterogeneous results across EU countries are explained by differences in the structure of EU countries' exports by products, coupled with uneven evolutions of the Russian import demand for specific products. Thus, the small relative change in Russian imports from Germany and France point to the good resilience to non-embargo factors of these countries' exports to Russia.

Non-EU countries targeted by the Russian ban were, on average, less affected by the embargo (Figure 4). For Norway, who bears the largest loss of exports of banned (mainly fish) products to Russia (€ -62 m), only one fifth of the loss is attributed to the ban. The relative contribution

[37]See Appendix F for details.

Figure 4: The change in Russian monthly imports from target countries



Notes: Bars indicate the estimated change in Russian monthly imports after the introduction of the ban. Only countries that accounted for 1% or more of Russia's overall imports in 2013 or 2015 are displayed. 'Aug'14' are non-EU countries under the Russian ban since August 2014: Australia, Canada, Norway, and USA; 'Aug'15' are countries targeted by the Russian ban since August 2015: Albania, Iceland, Liechtenstein, Montenegro, and Ukraine.

of the direct ban effect was even smaller for Canada (18%). Only for the United States this share was close to the EU share (46%).

Who benefited from the Russian ban? (Russian customs data). The embargo produced important structural changes in Russian imports (Table 5). Russia switched to imports from non-banned countries for both banned and non-banned products. Within this group of countries, the largest gains are obtained by Belarus and Brazil, countries in the top of Russian import sources of agri-food products even prior to the embargo. Not all non-boycotted profited from the ban to increase their exports to Russia. For some of countries supplying large amounts of agri-food products to the Russian market, the exports of banned products remained unchanged (Turkey) or even declined (Ecuador).[38] Table A6 in Appendix F shows the average change in exports for Russia's main trade partners not targeted by the ban. We obtain quite similar changes in exports to Russia when we restrict the analysis to the sample of countries not targeted by the ban.[39]

[38]Our analysis covers only years 2013-2015. Therefore, the lack of an increase in Russian imports from Turkey was not affected by the ban on fruits and vegetables (mainly citrus and tomatoes) originating from this country that Russia introduced in January 2016, extended in March of the same year, and partially lifted in November 2017.

[39]This analysis is presented in Appendix D.

4.2. Did EU countries redirect their exports to new trade partners?

Estimations in section 3.2 evaluate the direct and indirect impacts of the ban in terms of the value of exports, i.e. at the intensive margin of trade. After the introduction of the embargo, an European country that exported a banned product to Russia prior to the embargo may redirect these exports to another market to which it used to export the same product, or to a country where it never exported it before. The latter reflects the effect of the embargo at the extensive trade margin. In this section we use COMEXT trade data to analyse this type of adjustments in EU exports induced by the Russian ban.

The variation in the number of export flows in an average month before and during the embargo and in their cumulative value (Table A7 of Appendix G) points to important trade creation and diversion effects of the Russian embargo. Two-thirds of the number of export flows of banned products from a EU country to Russia ended after the introduction of the embargo. This represented an average export loss of € 367 m per month. Meanwhile, the number of export flows to other destinations increased by 7% (1,757 new monthly flows on average), and their cumulative value by € 652 m.

To measure the effect of the embargo on the extensive margin, we estimate its impact on the number of destination markets by exporting country and product, N_{it}^k. We exclude EU exports to Russia when computing variable N_{it}^k.[40] The number of destinations of product-specific exports of EU countries increased after the introduction of the ban, for both banned and non-banned products (Figure A4 of Appendix G). To understand how much of this increase was due to the ban, we need to control for other factors through estimations. Since variable N_{it}^k varies across three dimensions (origins, products, and months), we employ a difference-in-difference approach and estimate the following model:

$$\begin{aligned} N_{it}^k &= \exp(\alpha_i + \phi_k + \delta_0^P \cdot PorkBAN_{k\in K_{PB},t\in T_{PB}} + \delta_1^P \cdot I_{t\in T_{PB}} \\ &\quad + \delta_0^F \cdot FoodBAN_{k\in K_{FB},t\in T_{FB}} + \delta_1^F \cdot I_{t\in T_{FB}} + \varepsilon_{ikt}) \,. \end{aligned} \quad (15)$$

Dummies $PorkBAN_{k\in K_B,t\in T_B}$ and $FoodBAN_{k\in K_B,t\in T_B}$ take the value one for products subject to Russian import restrictions in months when these restrictions apply, and zero in the rest. $I_{t\in T_{PB}}$ and $I_{t\in T_{FB}}$ indicate the time periods covered by the pork ban and, respectively, the food embargo. They control for differences in the average number of destination markets before and during the ban/embargo for non-banned products. Differences across exporters and products

[40]During the Russian pork ban and food embargo, EU countries continued to export to Russia a small amount of products in the HS4 codes covered by the ban, but excluded from the list of banned products (e.g. baby food). Therefore, some of these export flows did not completely cease after the introduction of Russian import restrictions. In addition, EU exports of banned products to Russia decreased gradually over the first month of the ban. Russia introduced the food embargo on August 7th, 2014. Products shipped between 1st and 6st August 2014 were not subject to the ban. These flows may downgrade the change in the export strategy of EU exporters. To avoid this, we exclude exports to Russia when computing variable N_{it}^k.

Table 7: The embargo effect on EU export destinations: Poisson estimations

		Explained variable: number of flows (N_{it}^k)			
	Coef	(1)	(2)	(3)	(4)
Ban period	δ_1	0.06***	0.06***		
		(0.01)	(0.01)		
Exports of banned products during the ban period	δ_0	0.01***	0.01***		
		(0.00)	(0.00)		
Pork ban (Feb 2014 – Dec 2015)	δ_1^P			0.04***	0.04***
				(0.01)	(0.01)
Exports of pork & swine during the pork ban	δ_0^P			0.01	0.01
				(0.00)	(0.00)
Food embargo (Aug 2014 – Dec 2015)	δ_1^F			0.03***	0.03***
				(0.01)	(0.01)
Exports of banned food products during the food embargo	δ_0^F			0.01***	0.01***
				(0.00)	(0.00)
Fixed effects		i, k	ik	i, k	ik
Number of observations		168,565			

Notes: Clustered (by country) standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
N_{it}^k is computed by excluding exports to Russia.

are captured by time-invariant fixed effects α_i and ϕ_k. Positive estimates of parameters δ_0^P and δ_0^F indicate that during the ban/embargo EU countries started exporting banned products to new markets.

We estimate equation (15) with the Poisson estimator and report results in Table 7. We use two specifications for each equation: one with exporter and product fixed effects, and another with exporter $\times$ product fixed effects. We also show the average effects of the pork ban and the food embargo (first two columns of Table 7). Results confirm that there has been an overall increase in the number of destination countries reached by European exporters during the ban period. In the first months after the introduction of the pork ban (February to July 2014), the number of product-specific destinations for EU exports of non-banned products increased, on average, by 4% $[= 100 \times (\exp(0.04) - 1)]$. After the introduction of the food ban (August 2014 - December 2015), this number increased by another 3% $[= 100 \times (\exp(0.03) - 1)]$. Among banned products, we observe a significant rise in the number of destinations only for products under the food embargo (by 8% $[= 100 \times (\exp(0.04 + 0.03 + 0.01) - 1)]$), but not for products targeted by the pork ban. This finding contrasts with the evolution of the number of export markets in Figure A4, which mixes effects generated by the Russian import ban and by other factors. Thus, the geographical reorientation of EU exports subject to the Russian food embargo was achieved through selling larger amounts of banned goods to other countries where the EU was already exporting them, and through accessing new markets. We find no change in the extensive margin for EU exports covered by the Russian pork ban.

Characteristics of new trade partners. We now discuss the characteristics of new trade partners created during the embargo period. 18% of the EU export flows in products subject to the ban were established after the introduction of the Russian embargo. To compare new and incumbent export flows, we estimate the following specification on different characteristics z_{ijt}^k of export flows and trade partners:

$$\begin{aligned} \ln z_{i,j\neq RU,t\in T_B}^k &= \alpha_{ikt} + \xi_1 \cdot NEW_{ijkt} \\ &\quad + \xi_2^P \cdot (NEW_{ijkt} \cdot I_{k\in K_{PB}}) + \xi_2^F \cdot (NEW_{ijkt} \cdot I_{k\in K_{FB}}) + \varepsilon_{ijkt} \, . \end{aligned} \tag{16}$$

We consider only the sub-panel of EU exports observed after the introduction of the ban (incumbent and new) and exclude trade with Russia. NEW_{ijkt} is a dummy taking the value one for flows created after the introduction of the Russian embargo and zero for incumbent flows, while α_{ikt} are time-varying product $\times$ exporter fixed effects.[41]

We estimate equation (16) on five characteristics of EU export flows: the monetary value in € thousand, the quantity in tons, the unit value in € thousand per ton, the distance between the EU exporting country and the destination market, and the importing country GDP.[42] Results are displayed in Table 8. We find that EU countries' exports to new markets were smaller, both in monetary and physical terms, and encompassed more expensive products than their exports to regular trade partners. For products covered by the Russian ban, the amount of exports to new markets were even lower. However, the price differential between new and incumbent exports is much attenuated for banned products. New markets were also more remote and smaller than EU's usual partners, differences being similar for banned non-banned products.

Next, we question how EU countries chose new markets among available export destinations. For that, we compare trade relationships created over the ban period to potential destinations (that remained nil after the introduction of the Russian embargo). We focus only on exports of banned products that were nil before the introduction of the ban, and estimate the following specification:

$$I\left[y_{i,j\neq RU,t\in T_B}^{k\in K_B} > 0 \mid y_{i,j\neq RU,t\notin T_B}^{k\in K_B} = 0\right] = \alpha_{ik} + \nu_1 \ln dist_{ij} + \nu_2 \ln GDP_{j,2013} + \varepsilon_{ijkt} \, . \tag{17}$$

We consider only possible potential trade relationships. For each EU country, we exclude products that it never exports, and for each importing country, products that it never imports.[43] Equation (17) disregards monthly variations in the data. Here, the time dimension resumes to

[41] We intentionally include fixed effects that disregard the importer (j) dimension of the data. In this way, all data variation across destinations will be captured by parameters ξ_1 and ξ_2.

[42] Unit values, obtained by dividing the monetary value of a trade flow by its quantity equivalent, are a proxy for average prices. Distances are obtained from the CEPII *geodist* database. Data on GDPs are from World Bank's WDI database.

[43] In this way we exclude trade flows that are nil for other reasons than trade policy, such as banana exports by Iceland and pork imports by Saudi Arabia.

Table 8: New vs. incumbent EU export flows: the pork ban and the food embargo

	Explained variable:				
	$\ln y_{ijkt}$	$\ln q_{ijkt}$	$\ln UV_{ijkt}$	$\ln dist_{ij}$	$\ln gdp_j$
New flows	-1.90***	-1.52***	0.14***	0.86***	-0.94***
	(0.06)	(0.05)	(0.01)	(0.03)	(0.06)
New flows × products under the pork ban	0.22	0.05	0.01	0.00	0.04
	(0.19)	(0.16)	(0.05)	(0.07)	(0.16)
New flows × products under the food embargo	-0.17***	-0.12**	-0.11***	-0.02	-0.05
	(0.05)	(0.05)	(0.02)	(0.02)	(0.05)
Fixed effects	ikt	ikt	ikt	ikt	ikt
Number of observations	3,119,908	2,773,404	2,773,404	3,119,908	3,090,342
Pseudo R^2, without fixed effects	0.30	0.30	0.64	0.30	0.11

Notes: Explained variables are: y_{ijkt} – the monetary value of exports, q_{ijkt} – the volume of exports in tons, UV_{ijkt} – the unit value, $dist_{ij}$ – the distance to the destination market, gdp_i – the 2013 GDP of the destination country, all expressed in logs. Standard errors clustered by country pairs in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The estimation sample excludes exports to Russia.

two moments: *before* and *after* the introduction of the ban. Changes in trade patterns across this dimension are taken into account in the very construction of the explained variable.

Table 9 displays results from estimating (17) with linear probability and Logit estimators. In columns (1) and (4) variations across destination markets are attributed to distance and economic size (GDP in the year before the embargo). Unsurprisingly, EU countries were more likely to start exporting to nearby and larger markets. This finding is confirmed when we use additional controls. In columns (2) and (5), we use product-level importer-fixed effects to better capture the import demand. In columns (3) and (6), we add a dummy for intra-EU flows. We find that a 1% increase in the distance to the export market reduces the probability to start exporting to this destination by 4%. A similar change in importer's GDP increases this probability by 1%. EU countries were three times more likely to start exporting products subject to the Russian ban to another EU member than to an extra-EU partner. Effects are similar for products covered by the pork band and the food embargo.

4.3. Did Russia turn to alternative source countries?

After the introduction of the embargo, Russia may have increased its imports from its regular trade partners not targeted by the ban, or started buying from new supply countries. In this subsection, we question whether the embargo led to the creation of new trade relationships for Russia, and analyze these flows using Russian customs trade data. To reach our goal, we start by analyzing how the number of Russia's import sources, N_t^k, evolved after the introduction of the embargo. We omit countries targeted by the pork ban or the food embargo to ensure that our results are not affected by the drop in N_t^k due to the ban/embargo. Figure A5 of Appendix G shows an increase in the number of import sources for products covered by the pork ban, but

Table 9: New vs. nil (potential) EU export flows of banned products

	Explained variable: New exports (dummy)					
	Linear probability			Logit (odds ratios)		
	(1)	(2)	(3)	(4)	(5)	(6)
ln Distance	-0.04***	-0.06***	-0.03***	0.38***	0.43***	0.47***
	(0.00)	(0.01)	(0.00)	(0.02)	(0.03)	(0.03)
ln GDP importer, 2013	0.01***		0.01***	1.44***		1.40***
	(0.00)		(0.00)	(0.03)		(0.03)
Intra-EU			0.06***			3.07***
			(0.01)			(0.35)
Fixed effects	ik	ik, jk	ik	ik	ik, jk	ik
Number of observations	161,819	167,388	161,819	161,819	167,388	161,819
Pseudo R^2, excl. fixed effects	0.09	0.18	0.09	0.13	0.06	0.15

Notes: The estimation sample covers exports of banned products that were nil in the pre-ban period, excluding exports to Russia. The explained variable is a dummy equal to one for export flows created after the introduction of the ban and to zero for products that remained nil. Standard errors clustered by country pairs in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

not for those subject to the food embargo and for non-banned products. These observations are confirmed by descriptive statistics in Table A8 of Appendix G. While Russia's average monthly imports of banned products from targeted countries decreased by 69% in terms of the number of flows and by 81% in terms of their value, we do not observe a counterbalancing increase in imports from other countries, except for pork and swine products.

For a more accurate analysis, we estimate the impact of the ban on the number of countries not targeted by the ban from which Russia imported each product in each month:

$$\begin{aligned} N_t^k &= \exp(\varphi_k + \zeta_0^P \cdot PorkBAN_{k\in K_{PB},t\in T_{PB}} + \zeta_1^P \cdot I_{t\in T_{PB}} \\ &\quad + \zeta_0^F \cdot FoodBAN_{k\in K_{FB},t\in T_{FB}} + \zeta_1^F \cdot I_{t\in T_{FB}} + \varepsilon_{ikt})\,. \end{aligned} \tag{18}$$

Similarly to (15), we use a difference-in-difference approach and control for the evolution of the number of Russia's import sources of non-banned products. We employ a Poisson estimator and report results in the first column of Table 10. In column (2) we add monthly fixed effects into the estimation. None of the estimated parameters is statistically significant, pointing to the absence of an effect at the extensive margin. In the last two columns of Table 10, we estimate separately the effect of the pork ban and of the food embargo. We find an increase in the number of origin countries from which Russia imported pork and swine products (after February 2014, when the pork ban issued), but no effect for the imports of products subject to the food embargo (introduced in August 2014). These results are in line with the descriptive statistics presented above. To substitute the banned imports of European pork and swine, Russia turned to new source countries (e.g. Argentina, China). It did not adopt the same strategy for products subject to the food embargo, the number of non-targeted countries from which Russia imported these products remaining unchanged. As for non-banned products, results in Table 10 show that the

Table 10: The embargo effect on Russian import sources: Poisson estimations

		Explained variable: number of flows (N_t^k)			
	Coef	(1)	(2)	(3)	(4)
Ban period	ζ_1	-0.01			
		(0.01)			
Imports of banned products during the ban period	ζ_0	-0.02	-0.02		
		(0.03)	(0.03)		
Pork ban (Feb 2014 – Dec 2015)	ζ_1^P			0.05***	
				(0.01)	
Imports of pork & swine during the pork ban	ζ_0^P			0.29*	0.29*
				(0.16)	(0.16)
Food embargo (Aug 2014 – Dec 2015)	ζ_1^F			-0.05***	
				(0.01)	
Imports of banned food products during the food embargo	ζ_0^F			-0.02	-0.02
				(0.03)	(0.03)
Fixed effects		k	k, t	k	k, t
Number of observations		6,804			

Notes: Clustered (by country) standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
N_t^k is computed by excluding countries targeted by the ban.

initial positive trend in the number of import sources, observed between February and July 2014, was undermined by an opposite evolution after the introduction of the food embargo.

Russia's new import flows. Newly established flows accounted for a similar share of Russian imports of banned and non-banned products (19%). A simple estimation permits to highlight how Russia's new imports differ from its incumbent flows for different characteristics z_{it}^k:

$$\begin{aligned} \ln z^k_{i \notin I_B, t \in T_B} &= \alpha_{kt} + \xi_1 \cdot NEW_{ikt} \\ &+ \xi_2^P \cdot (NEW_{ikt} \cdot I_{k \in K_{PB}}) + \xi_2^F \cdot (NEW_{ikt} \cdot I_{k \in K_{FB}}) + \varepsilon_{ikt} \,. \end{aligned} \tag{19}$$

NEW_{ikt} is a dummy taking the value one for flows created after the introduction of the Russian embargo and zero for incumbent flows, and α_{kt} are time-varying product effects. We drop the subscript j in (19) since we focus exclusively on Russian imports ($j = RU$). Results from estimating (19) on Russian imports from non-banned countries in months with the ban are reported in Table 11. Our findings are similar to the ones for European exports. Russia imported smaller amounts and more expensive products from new source countries, than from its usual trade partners. Russia's newly established import flows also involved partners of smaller economic size (GDP). Differences between new and incumbent flows were similar for banned and non-banned products, with a few exceptions. Russia's new suppliers of banned food products were on average more remotely situated than new suppliers of non-banned products, and than Russia's regular trade partners. For banned pork and swine products, Russia did not turn to

Table 11: New vs. incumbent Russian imports

	Explained variable:				
	$\ln y_{ikt}$	$\ln q_{ikt}$	$\ln UV_{ikt}$	$\ln dist_i$	$\ln gdp_i$
New flows	-2.53***	-3.15***	0.62***	0.24	-0.80**
	(0.21)	(0.30)	(0.12)	(0.20)	(0.35)
New flows × products under	0.97	1.35	-0.39*	0.13	1.96
the pork ban	(1.36)	(1.36)	(0.21)	(0.55)	(1.35)
New flows × products under	0.19	0.32	-0.13	-0.26**	0.11
the food embargo	(0.34)	(0.43)	(0.14)	(0.11)	(0.36)
Fixed effects	kt	kt	kt	kt	kt
Number of observations	52,839	52,835	52,835	52,839	52,166
Pseudo R^2, without fixed effects	0.30	0.35	0.64	0.18	0.12

Notes: y_{ikt} is the monetary value of imports, q_{ikt} – the volume of imports, UV_{ikt} – the unit value, $dist_i$ – the distance from the source country, gdp_i – the 2013 GDP of the source country. All explained variables are in logs. Standard errors clustered by country pairs in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The estimation sample excludes imports from countries targeted by the Russian ban, i.e. 48% of observations in the data panel.

more remote import sources and, therefore, did not pay a higher price.

Lastly, we identify how Russia chose its new import sources of products covered by the ban. For that, we compare Russian imports of banned products created after the introduction of the ban with flows that remained nil throughout the entire studied period. For the latter, we consider only plausible import sources, i.e. country × product pairs with positive trade values in at least one month in our data panel. As previously, we exclude countries directly targeted by the Russian ban. The resulting sub-sample counts 3,615 country × product pairs, of which only 204 became positive after the introduction of the ban. More specifically, we estimate the following equation:

$$I\left[y_{ik}(t \in T_B) > 0 \mid y_{ik}(t \notin T_B) = 0\right] = \alpha_k + \nu_1 \ln dist_i + \nu_2 \ln gdp_{i,2013} + \varepsilon_{ikt} \,. \qquad (20)$$

Results from estimating (20) with linear probability and Logit models are shown in Table 12. Among all potential import sources, Russia started importing from closer and larger trade partners. This result characterizes mainly the imports of products covered by the food embargo.[44] Prior to the ban, most of Russia's imports of pork and swine originated from EU countries. Alternative import sources (not targeted by the ban) to which Russia could switch were smaller and/or more faraway, implying larger trade costs. Therefore, most effects are statistically non-significant for Russian imports of pork and swine.

[44] Separate effects on pork and food products can be provided upon request.

Table 12: New vs. nil (potential) Russian imports of banned products

	Explained variable: New exports (dummy)	
	Linear probability	Logit (odds ratios)
	(1)	(2)
ln Distance	-0.07***	-1.44***
	(0.02)	(0.17)
ln GDP importer, 2013	0.01***	0.35***
	(0.00)	(0.04)
Fixed effects	k	k
Number of observations	3,615	3,615
Pseudo R^2, excl. fixed effects	0.08	0.15

Notes: The estimation samples covers imports of banned products that were nil in the pre-ban period, excluding imports from countries targeted by the ban. The explained variable is a dummy equal to one for import flows created after the introduction of the ban and to zero for products that remained nil. Standard errors clustered by country pairs in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4.4. The contribution of intensive and extensive margins

We decompose the change in trade induced by the ban into the evolution of the average value of individual trade flows (intensive margin) and the number of trade flows (extensive margin) for exporting country i. Let $Y_{i,t}$ denote the overall value of i's exports in month t, $y_{i,t}$ the average value of i's product-level exports to a specific destination, and $N_{i,t}$ the number of product-specific destinations of i's exports. Let $(\text{BAN} = 1)$ refer to observations under the ban, and $(\text{BAN} = 0)$ denote counterfactuals in the absence of the ban. Then, the relative change in i's exports due to the ban can be decomposed as follows:

$$\begin{aligned}\frac{Y_{i,t}(\text{BAN}=1) - Y_{i,t}(\text{BAN}=0)}{Y_{i,t}(\text{BAN}=0)} &= \frac{y_{i,t}(\text{BAN}=1)\cdot N_{i,t}(\text{BAN}=1) - y_{i,t}(\text{BAN}=0)\cdot N_{i,t}(\text{BAN}=0)}{y_{i,t}(\text{BAN}=0)\cdot N_{i,t}(\text{BAN}=0)} \\ &= \frac{\Delta y_{i,t}}{y_{i,t}(\text{BAN}=0)}\cdot\frac{N_{i,t}(\text{BAN}=1)}{N_{i,t}(\text{BAN}=0)} + \frac{\Delta N_{i,t}}{N_{i,t}(\text{BAN}=0)} \\ &= \underbrace{\left(\exp(\hat{\beta}_0) - 1\right)\cdot\exp(\hat{\delta}_0)}_{\text{Intensive margin}} + \underbrace{\left(\exp(\hat{\delta}_0) - 1\right)}_{\text{Extensive margin}}\;. \end{aligned} \tag{21}$$

$\Delta y_{i,t} = y_{i,t}(\text{BAN} = 1) - y_{i,t}(\text{BAN} = 0)$ is the embargo-induced change in the value of trade flows, and $\Delta N_{i,t} = N_{i,t}(\text{BAN} = 1) - N_{i,t}(\text{BAN} = 0)$ is the change in the number of export destinations. Parameters $\hat{\beta}_0$ and $\hat{\delta}_0$ reflect the effect of the ban on the value of exports $y_{i,t}$, respectively on the number of export flows $N_{i,t}$ (the coefficients of the ban dummy). Hence, $\Delta y_{i,t} = (\exp(\hat{\beta}_0) - 1)\cdot y_{i,t}(\text{BAN}=0)$, and $\Delta N_{i,t} = (\exp(\hat{\delta}_0) - 1)\cdot N_{i,t}(\text{BAN}=0)$.

According to (21), the relative contribution of the intensive margin, $IntM$, is equal to the estimated ban-induced change in the value of individual export flows, divided by the counterfactual value of these flows in the absence of the ban, times the ratio between the number of export destinations under the ban and in the absence of the ban. The contribution of the extensive margin,

$ExtM$, is obtained as the ban-induced change in the number of export destinations, divided by the counterfactual number of export destinations in the absence of the ban.

Combining the estimated effect of the ban on the intensive margin (column (3) of Table 1) with its effect on the extensive margin extensive (column (2) of Table 7), we can compute the contribution of each margin to the change in EU exports induced by the ban. For this exercise, we need to use the extensive margin estimate including Russia. We replicate the estimation in column (2) of Table 7 on the overall number of export destinations, including Russia, and obtain very similar results. For the EU28, $IntM_{EU} = (\exp(-1.63) - 1) \cdot \exp(0.06) = -85.4\%$, and $ExtM_{EU} = (\exp(-0.06) - 1) = 6.2\%$. The intensive margin accounted for most of the ban-induced drop in EU exports, only marginally attenuated by the positive extensive margin.

We perform a similar decomposition of the embargo-induced change in Russian imports.[45] We obtain a strong negative impact of the ban on the number of Russia's import sources that include targeted countries ($\hat{\zeta}_0 = -0.43$). We use this result and estimates on the value of imports (column (3) of Table 4) to compute the contribution of the intensive and extensive margins to the overall change in Russian imports induced by the ban. Unlike for EU exports, the ban led to a negative change, both in the value of Russian imports, and in the number of partner countries. The contribution of the extensive margin was also higher for Russian imports ($ExtM_{RU} = -35.0\%$). Still, over half of the decrease in Russian imports resulted from evolutions at the intensive margin ($IntM_{RU} = -45.5\%$).

5. Conclusion

We find that the embargo led to an average 80% drop in the value of EU export flows of banned products to Russia. We estimate the overall loss of EU28 exports of banned countries to Russia at an average € 125 million per month. The embargo is responsible for less than half of the drop in EU exports of banned products to Russia. Non-ban factors have generated an even larger EU export loss than the loss directly attributed to the embargo. These factors are likely the drop in oil prices and the depreciation of the Russian ruble, and determined an overall contraction of Russian imports, of both banned and non-banned products, both from countries targeted by the ban and the rest, in months following the introduction of the embargo. Therefore, even if Russian import restrictions were eliminated, EU exports to Russia of agri-food products (covered or not by the ban) would not return to their pre-ban level. Meanwhile, overall EU exports of products under the Russian ban increased, suggesting that at the aggregate level the EU successfully redirected its exports banned from the Russian market.

[45]
$$\frac{Y_{RU,t}(\text{BAN}=1) - Y_{RU,t}(\text{BAN}=0)}{Y_{RU,t}(\text{BAN}=0)} = \left(\exp(\hat{\gamma}_0) - 1) \cdot \exp(\hat{\zeta}_0\right) + \left(\exp(\hat{\zeta}_0) - 1\right).$$

The effect of the ban varied significantly across EU member countries. The largest loss in exports of banned products to Russia were registered for Lithuania, Poland, and Germany, whereas other EU countries were marginally affected by Russian import restrictions. However, Germany and Poland compensated their losses on the Russian market by a strong increase in exports to other trade partners (mostly intra-EU), at the expense of countries such as Denmark and France. Baltic countries reoriented only a small fraction of the banned products they used to export to Russia.

References

Anderson, J. E., Larch, M., and Yotov, Y. V. (2015). Estimating General Equilibrium Trade Policy Effects: GE PPML. CESifo Working Paper Series 5592. 26 p.

Anderson, J. E. and van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, 93(1):170–192.

Boulanger, P., Dudu, H., Ferrari, E., and Philippidis, G. (2016). Russian Roulette at the Trade Table: A Specific Factors CGE Analysis of an Agri-food Import Ban. *Journal of Agricultural Economics*, 67(2):272–291.

Costinot, A. and Rodriguez-Clare, A. (2014). *Handbook of International Economics*, volume 4, Chapter 4: Trade Theory with Numbers: Quantifying the Consequences of Globalization: 197–261. Elsevier.

Crozet, M. and Hinz, J. (2016). Collateral Damage: The Impact of the Sanctions on Sanctioning Countries' Exports. CEPII Working Paper 2016-16. 59 p.

Dreger, C., Kholodilin, K. A., Ulbricht, D., and Fidrmuc, J. (2016). Between the hammer and the anvil: The impact of economic sanctions and oil prices on Russia's ruble. *Journal of Comparative Economics*, 44(2):295–308.

European Commission (2015). The Economic Impact of the Russian Import Ban: A CGE Analysis. DG TRADE Chief Economist Note 2015-3.

Havlik, P. (2014). Economic Consequences of the Ukraine Conflict. WIIW Policy Note/Policy Report November 2014.

OHCHR (2017). Report on the human rights situation in Ukraine - 16 August to 15 November 2017. Office of the United Nations High Commissioner for Human Rights. 44 p.

Oja, K. (2015). No milk for the bear: the impact on the Baltic states of Russia's counter-sanctions. *Baltic Journal of Economics*, 15(1):38–49.

Appendix A The extend of the Russian pork ban and food embargo

Table A1: The list of products covered by the Russian pork ban and food embargo

HS code	Product name
The pork ban:	
0103	Swine; live
0203	Meat of swine; fresh, chilled or frozen
The food embargo:	
0201	Meat of bovine animals, fresh or chilled
0202	Meat of bovine animals, frozen
0203	Meat of swine; fresh, chilled or frozen
0207	Meat and edible offal of poultry
0210	Meat, salted, in brine, dried or smoked
0301 - 0308	Fish and crustaceans, molluscs and other aquatic invertebrates
0401 - 0406	Milk and diary products
0701 - 0714	Vegetables and edible roots and tubers
0801 - 0811, 0813	Fruit and nuts
1601	Sausages and similar products, of meat, meat offal or blood
1901	Food preparations, including cheeses and curd, based on vegetable fats
2106	Food preparations, based on vegetable fats and containing milk

Source: The Decrees of the Russian Government *N* 778 from 7 August 2014 and *N* 842 from 13 August 2015.

Appendix B Non-ban factors concurrent with the ban

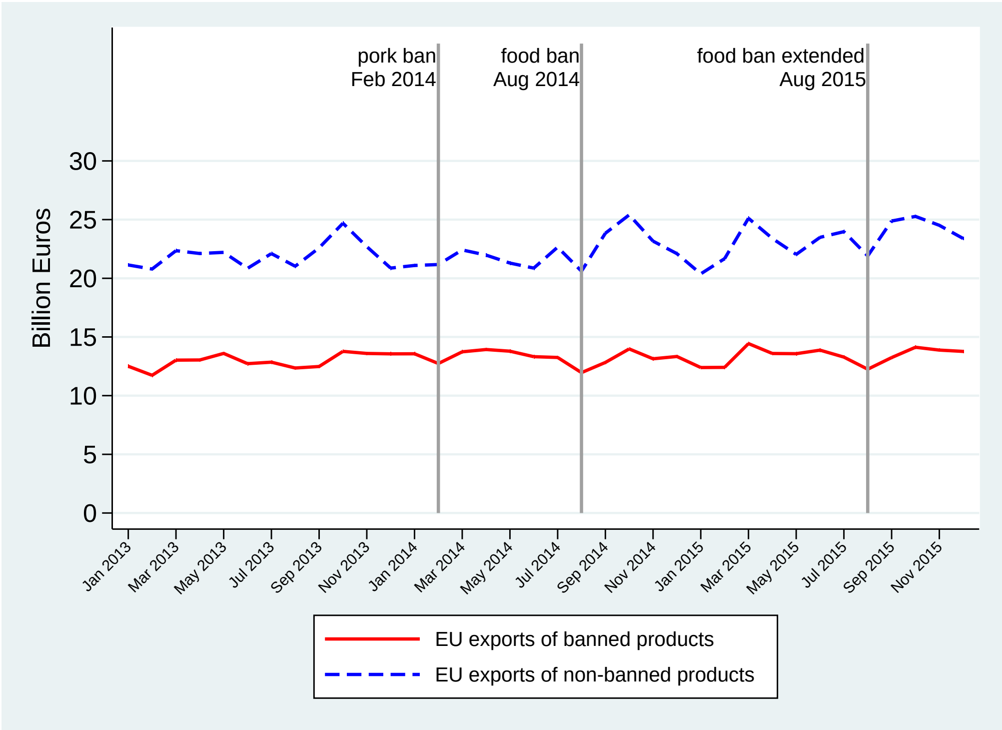
Figure A1: Evolution of factors affecting the purchasing power of Russian consumers

(a) The exchange rate of the Russian Ruble against the US Dollar

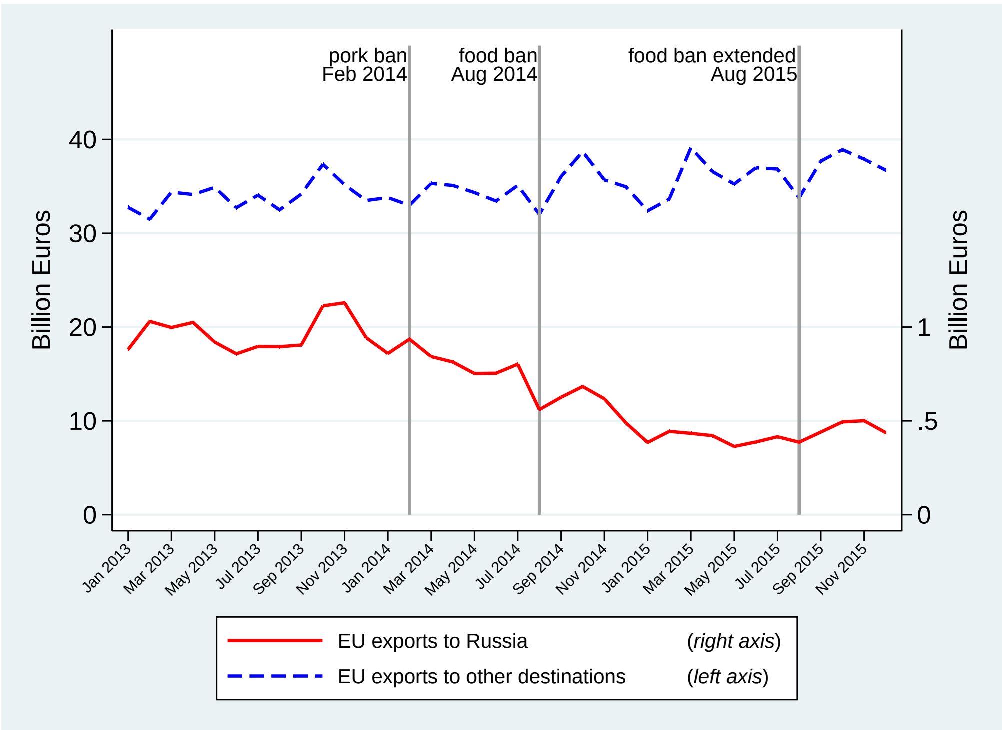
(b) The price of crude oil ($ per barrel)

Appendix C The evolution of EU exports

Figure A2: Trends in EU exports



(a) By group of products



(b) By destination

Notes: Authors' computation using COMEXT 4-digit HS trade data for products in chapters 1 to 23.

Table A2: The effect of the embargo on quantities and unit values, EU exports (tons)

	QUANTITIES Explained variable: ln exports (tons)				UNIT VALUES Explained variable: ln exports (€ K per ton)			
	The pork embargo				*The pork embargo*			
Exports of pork & swine to Russia during the pork ban	-3.36*** (0.47)	-3.31*** (0.42)	-3.36*** (0.36)	-3.21*** (0.34)	-0.07 (0.17)	-0.09 (0.17)	0.05 (0.14)	-0.10 (0.17)
Exports of pork & swine to Russia	0.52* (0.28)	0.52* (0.27)		0.52* (0.27)	0.27*** (0.08)	0.27*** (0.07)		0.28*** (0.08)
Exports to Russia during the pork ban	-0.10*** (0.02)		-0.08*** (0.02)		0.00 (0.01)		0.00 (0.01)	
Exports of pork & swine during the pork ban	0.01 (0.03)		0.04* (0.03)	0.02 (0.03)	-0.09*** (0.01)		-0.08*** (0.01)	-0.09*** (0.01)
	The food embargo				*The food embargo*			
Exports of banned food products to Russia during the food embargo	-1.05*** (0.27)	-1.05*** (0.25)	-1.48*** (0.21)	-0.95*** (0.23)	0.16** (0.07)	0.16** (0.07)	0.12** (0.06)	0.14** (0.07)
Exports of banned food products to Russia	0.34* (0.19)	0.34* (0.19)		0.33* (0.19)	-0.13*** (0.04)	-0.13*** (0.04)		-0.13*** (0.04)
Exports to Russia during the food embargo	-0.13** (0.05)		-0.18*** (0.04)		0.00 (0.01)		0.00 (0.01)	
Exports of banned food products during the food embargo	0.02*** (0.01)		0.02*** (0.01)	0.02*** (0.01)	-0.01*** (0.00)		-0.01*** (0.00)	-0.01** (0.00)
Fixed effects	i,j,k,t,ij	it,jt,kt,ij	ijk, t	ijt, k	i,j,k,t,ij	it,jt,kt,ij	ijk, t	ijt, k
R^2	0.38	0.39	0.85	0.40	0.56	0.56	0.84	0.57
Number of observations	2,856,433				2,856,433			

Notes: Clustered (by country pairs) standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: Changes in aggregate EU exports during the Russian pork ban and food embargo (€ m)

	average monthly exports	average monthly change in exports of							
		banned pork & swine products			banned food products			non-banned	all products
		to Russia	other mkts	intra-EU	to Russia	other mkts	intra-EU	prod to Russia	to all mkts
EU 28	**34,892**	**-4.0**	**-62.9**	**-51.5**	**-120.7**	**256.3**	**208.5**	**-102.0**	**-73.9**
Netherlands	5,559	-0.5	0.0	0.0	-4.0	43.3	33.3	-21.1	9.4
Germany	5,140	-1.3	0.0	0.0	-23.2	42.3	36.7	-23.2	-21.1
France	4,729	-0.4	0.0	0.0	-5.8	-32.2	-24.1	-4.2	-44.6
Spain	3,020	0.0	-14.3	-11.5	-1.5	124.9	107.3	-2.4	107.0
Belgium	2,742	0.0	0.0	0.0	-6.8	19.8	18.1	0.3	13.7
Italy	2,713	0.0	0.0	0.0	-4.6	45.8	36.0	-7.7	31.3
United Kingdom	1,928	0.0	0.0	0.0	-0.1	9.5	7.1	-0.9	8.2
Poland	1,526	0.0	0.0	0.0	-27.4	97.0	83.5	-1.8	69.7
Denmark	1,364	0.0	0.0	0.0	-1.0	-67.2	-48.0	-3.9	-78.9
Ireland	830	-1.6	11.6	8.7	-0.3	10.9	8.3	-1.1	18.9
Austria	817	0.0	0.0	0.0	-5.6	6.0	5.3	-1.4	-2.5
Hungary	615	0.0	0.0	0.0	-0.1	2.8	2.2	0.5	3.3
Sweden	596	0.0	0.0	0.0	-0.3	-31.8	-28.7	-1.3	-33.7
Czech Republic	472	0.0	0.0	0.0	-0.2	2.8	2.6	-1.7	0.7
Portugal	425	0.0	-0.6	-0.4	0.0	15.8	11.7	-0.3	14.8
Romania	382	0.0	0.0	0.0	0.0	0.8	0.7	-0.6	0.1
Greece	373	0.0	0.0	0.0	0.0	-7.2	-6.1	-1.2	-8.6
Lithuania	360	0.0	0.0	0.0	-36.3	2.0	1.6	-8.5	-174.9
Bulgaria	300	0.0	0.0	0.0	0.0	0.7	0.6	-0.4	0.2
Slovakia	273	0.0	0.0	0.0	0.0	1.0	1.0	0.1	1.1
Latvia	182	0.0	-1.2	-1.2	-2.0	0.6	0.6	-13.4	-18.6
Finland	123	0.0	0.0	0.0	-1.9	0.8	0.5	-2.2	-4.4
Slovenia	121	0.0	0.0	0.0	0.0	0.7	0.4	-0.2	0.0
Estonia	98	0.0	0.0	0.0	-3.4	0.6	0.5	-3.8	-9.3
Croatia	88	0.0	0.0	0.0	0.0	0.5	0.3	-0.3	0.1
Luxembourg	73	0.0	0.0	0.0	0.1	0.9	0.9	-0.1	0.8
Cyprus	23	0.0	0.0	0.0	0.0	0.3	0.2	0.0	0.3
Malta	18	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.2

Appendix D Effects on non-targeted countries

The present analysis consists in identifying whether third countries (no targeted by the ban) benefited from the Russian import ban and in quantifying these effects. We focus only Russian imports from non-targeted countries. Ban dummies are constant and equal to zero within this sub-sample. The only controls that vary in this case are the dummies capturing the change in the evolution of Russian imports of banned products. Hence, we can estimate only three of the five specifications displayed in Table 4: those corresponding to columns (1), (4) and (5). Results, reported in Table A4, point to a significant increase in Russian imports of products under the food embargo, but not for banned pork and swine products. The trade specification in column (2) produces the most accurate results and yields the highest fit. We use this specification to compute the change in Russian imports from non-banned countries:

$$\ln y_{it}^{k} = \tilde{\gamma}\left(I_{k\in K_B} \cdot I_{t\in T_B}\right) + \lambda_t + \omega_{ik} + \upsilon_{it}^{k}. \tag{22}$$

In (22) we collapse the controls for the two groups of banned products into a single dummy $(I_{k\in K_B} \cdot I_{t\in T_B})$. Results are displayed in Table A5. Estimated changes in monthly trade for the entire group of non-banned countries are slightly larger than estimates obtained on the full sample (Table 4). By eliminating imports from countries targeted by the Russian ban, we exclude some of Russia's main trade partners, and, therefore, can no longer correctly control for the drop in Russia's overall import demand during the ban period.

Table A4: Pork ban and food embargo effects on Russian imports

	Explained var.: ln imports		
	(1)	(2)	(3)
Imports of pork & swine during the pork ban	-0.83	-0.25	-0.97
	(0.57)	(0.72)	(0.61)
Imports of banned food products during the food ban	0.44***	0.29***	0.43***
	(0.07)	(0.05)	(0.07)
Fixed effects	i, k, t	ik, t	it, k
R^2	0.34	0.82	0.37
Number of observations		54,146	

Notes: Clustered (by country) standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Changes in Russian imports: Non-banned countries sub-sample (€ m)

Source country	average monthly agri-food imports*	change in imports of banned products	non-banned products	all products
Not banned countries	**1,325**	**182.5**	**21.0**	**203.5**
Belarus	189.9	50.9	0.1	51.0
Brazil	162.8	30.3	11.6	41.9
Turkey	105.5	11.9	0.3	12.2
China	103.3	15.1	0.5	15.6
Ecuador	80.9	19.0	0.2	19.2
Paraguay	70,1	9,1	4,8	14,0
Argentina	55,2	3,8	0,4	4,2
Indonesia	50,9	0,5	0,5	1,0

Notes: * Data for 2013, the year before the ban. Estimations on the sub-sample of non-banned countries.

Appendix E Did Russia turn to cheaper imports?

Countries targeted by the Russian pork ban and food embargo included some of Russia's closest and main suppliers of banned products. Switching to new import sources, Russian buyers inevitably incurred higher trade costs. Shortly after the introduction of the Russian embargo, the sharp drop in oil prices has significantly reduced the country's hard currency revenues, and consequently the amount it could spend on foreign-produced goods. The coincidence of these factors may have determined Russian consumers to switch to cheaper products. Figure A3 illustrates below the price evolution of Russian imports. The overall evolution of the Russian import price index (the thick solid black line) is given by month dummies λ_t in:

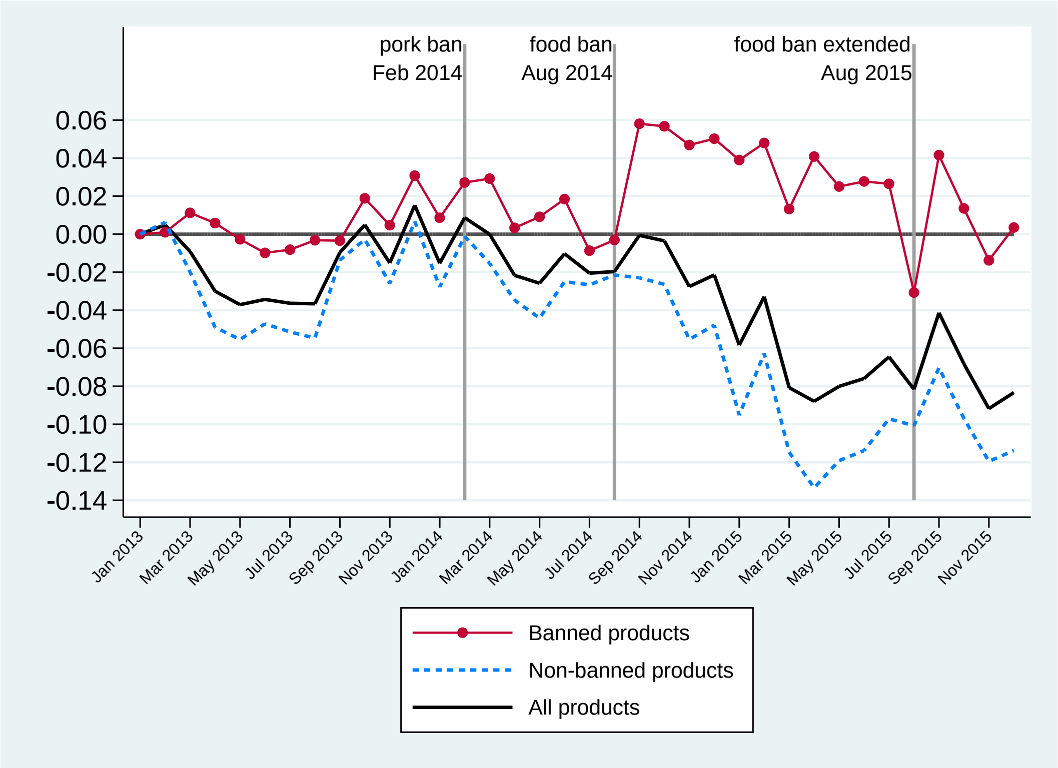
$$\ln UV_{ikt} = \alpha_i + \phi_k + \lambda_t + \psi_0 \cdot BAN_{i\in I_B, k\in K_B, t\in T_B} + \psi_1 \left(I_{i\in I_B} \cdot I_{k\in K_B}\right) + \upsilon_{ikt} \tag{23}$$

To separate the price evolution of for banned and non-banned products, we estimate

$$\ln UV_{ikt} = \alpha_i + \phi_k + \tilde{\lambda}_t \cdot I_{k\in K_B} + \underset{\sim}{\lambda}_t \cdot (1 - I_{k\in K_B}) + \psi_0 \cdot BAN_{i\in I_B, k\in K_B, t\in T_B} + \upsilon_{ikt} \tag{24}$$

Parameters $\tilde{\lambda}_t$ capture the price evolution for import of banned products (the thin solid red line), and $\underset{\sim}{\lambda}_t$ for the imports of ban-free products (the dashed blue line). All evolutions are computed with respect to January 2013. The evolution of average unit values of Russian agri-food imports signals a profound structural change in the Russian imports of agri-food products. Average unit values have decreased steadily after August 2014, a trend driven mainly by the imports of products not subject to the ban. During the first two months of the embargo, the price of imported banned products increased, reflecting an initial reorientation of Russian imports towards more distant and less competitive alternative markets. This evolution was reversed in the last months of 2014, as the purchasing power of Russia consumers deteriorated. The drop in the average import price of banned products continued throughout the entire year 2015.

Figure A3: Evolution of unit values of Russian imports



Appendix F Country-level changes in Russian imports

We compute the change in Russian imports from each country m as the difference between the average predicted value of imports from m in a month prior to the ban and in a month during the ban period, separately for the groups of banned and non-banned products. To obtain the predicted value of imports in months with the ban, we estimate an equation similar to (13). For countries targeted by the ban ($m \in I_B$), we let the effect of the ban on imports from m to differ from its effect on imports from other targeted countries:

$$\ln y_{it}^k = \alpha_{it} + \phi_{kt} + \omega_{ik} + \gamma \cdot BAN_{i \in I_B, k \in K_B, t \in T_B} + \gamma_m \cdot BAN_{i=m, k \in K_B, t \in T_B} + \upsilon_{ikt}. \quad (25)$$

This permits to compute the embargo-induced changes in Russian imports from each targeted country $i \in I_B$ as $[1 - \exp(-\hat{\gamma} - \hat{\gamma}_m)]\, \hat{y}_{it}^k$. We sum these effects across products covered by the Russian ban ($k \in K_B$), and take the average across months under the ban $t \in T_B$). For non-targeted countries, estimating (25) resumes to estimating:

$$\ln y_{it}^k = \alpha_{it} + \phi_{kt} + \omega_{ik} + \gamma \cdot BAN_{i \in I_B, k \in K_B, t \in T_B} + \upsilon_{ikt}. \quad (26)$$

Both (25) and (26) are estimated on the full panel of Russian agri-food imports. Note that the direct effect of the ban can be computed only for banned products imported from countries targeted by the embargo. For imports of non-banned products from these countries, as well as for imports from non-targeted countries (of either group of products), the computed change in imports is the result of other factors than the embargo. In Table A6, we report results for Russia's main trade partners.

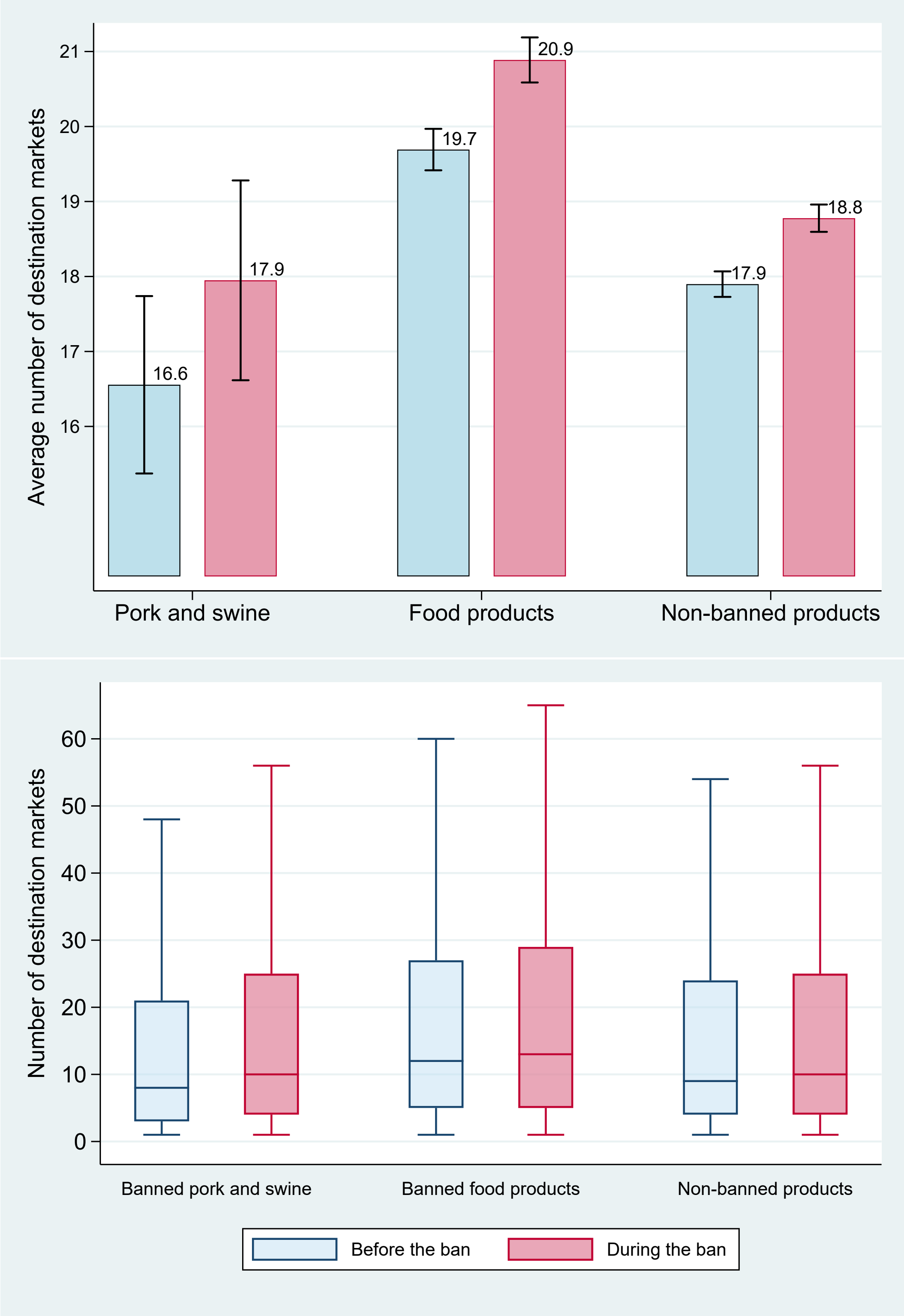
Table A6: Changes in Russian imports during the embargo, by source country (€ m)

Source country	average monthly agri-food imports*	change in monthly imports: banned products total	banned products due to ban	non-banned products	all products
European Union 28	**940**	**-268.6**	**-121.7**	**-82.6**	**-351.1**
Germany	124.0	-31.1	-22.2	-13.4	-44.6
Netherlands	123.5	-36.0	-15.4	-6.2	-42.2
Poland	99.8	-55.4	-11.0	-5.2	-60.7
France	98.4	-21.3	-12.5	-12.0	-33.3
Italy	87.6	-11.0	-2.8	-19.1	-30.1
Spain	79.7	-19.7	-2.2	1.0	-18.7
Denmark	59.0	-25.2	-4.7	-6.7	-31.8
United Kingdom	38.3	-2.1	-1.4	-1.4	-3.5
Banned since Aug 2014†	**221**	**-138.0**	**-37.2**	**-10.2**	**-148.2**
United States	96	-44.8	-20.5	-8.2	-53.0
Norway	75	-62.1	-13.6	0.7	-61.4
Canada	29	-23.5	-4.8	-1.3	-24.8
Banned since Aug 2015‡	**138**	**-14.7**	**-2.2**	**-27.3**	**-42.0**
Ukraine	126	-20.0	-1.4	-27.5	-47.5
Not banned	**1,325**	**172.7**		**38.8**	**211.5**
Belarus	189.9	60.5		7.9	68.4
Brazil	162.8	50.1		20.0	70.1
Turkey	105.5	-0.2		-2.8	-3.0
China	103.3	19.8		1.4	21.2
Ecuador	80.9	-36.7		-4.6	-41.3
Paraguay	70.1	12.0		1.9	13.9
Argentina	55.2	4.3		-1.2	3.2
Indonesia	50.9	0.3		4.0	4.3

Notes: *Data for 2013; † Australia, Canada, Norway, USA; ‡ Albania, Iceland, Liechtenstein, Montenegro, Ukraine.

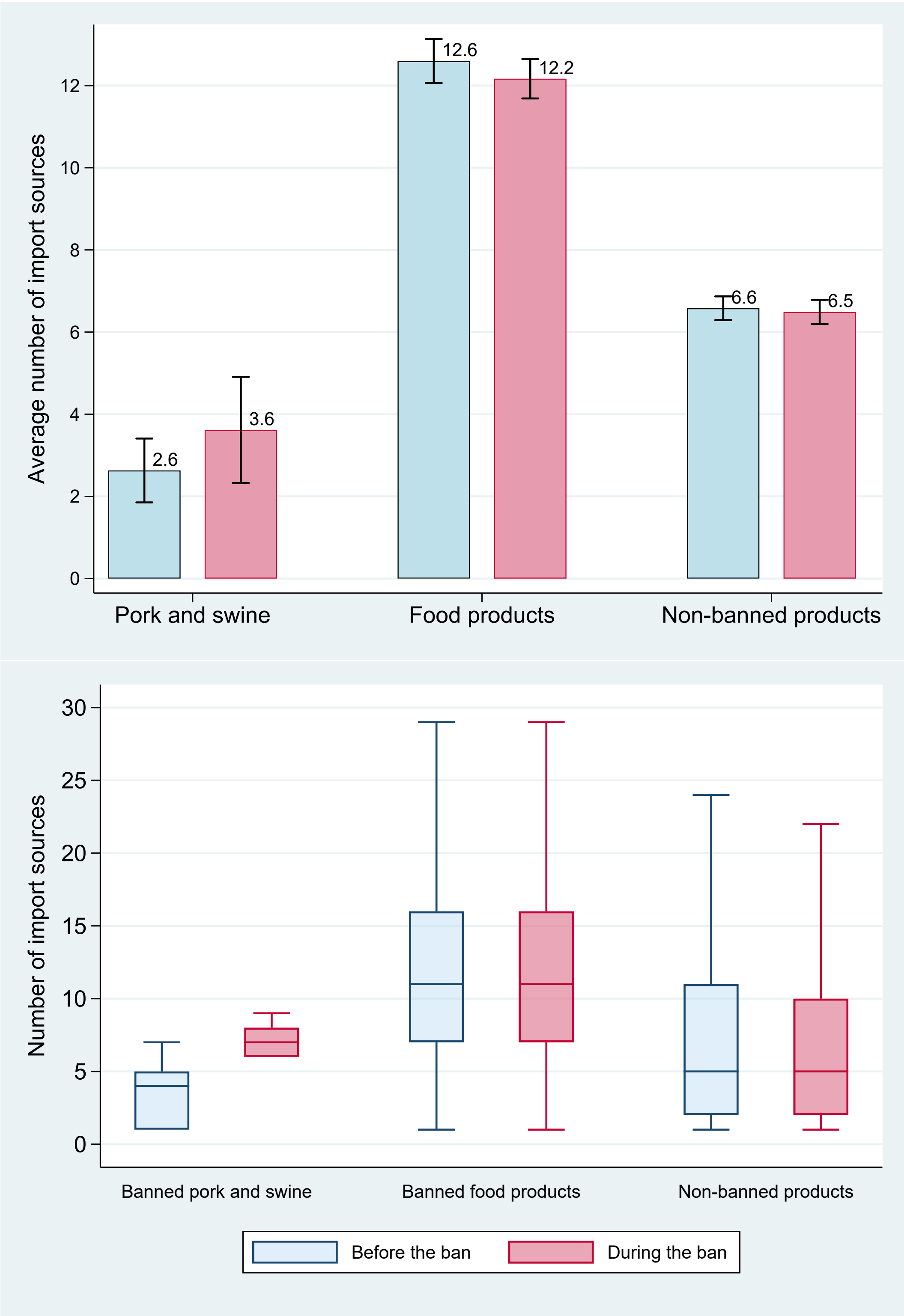
Appendix G Extensive margins

Figure A4: The number of destination markets of EU exports



Notes: The number of export markets, per product and EU country, computed from COMPEXT data and excluding exports to Russia.

Figure A5: The number of sources of Russian imports



Notes: The number of import sources per product, computed from Russian customs data and excluding imports from countries targeted by the ban.

Table A7: EU exports before and during the Russian import ban, monthly averages

Type of products	Number of flows†			Value‡ (€ m)		
	before the ban	during the ban	change	before the ban	during the ban	change
	Exports to Russia					
All banned products⋆	449	166	-63%	434	67	-84%
Products under the pork ban*	20	1.6	-92%	79	0.2	-100%
Products under the food embargo**	435	165	-62%	379	67	-82%
Non-banned products	1,073	1,033	-4%	482	410	-15%
	Exports to other countries					
All banned products⋆	24,971	26,728	+7%	13,312	13,964	+5%
Products under the pork ban*	838	904	+8%	1,483	1,438	-3%
Products under the food embargo**	24,125	25,810	+7%	11,828	12,542	+6%
Non-banned products	60,653	64,281	+6%	20,776	22,166	+7%

Notes: † Average number of flows in a month before and after the introduction of the Russian ban;
‡ Cumulative value of monthly exports before and after the introduction of the Russian ban;
⋆ Before ban refers to Jan 2013 to Jul 2015, during ban refers to Aug 2014 to Dec 2015;
* Figures before the ban are averages across months with no pork ban (Jan 2013 to Jan 2014), and figures during the ban are averages across months with the pork ban (Feb 2014 to Dec 2015);
** Figures before the ban are averages across months with no food embargo (Jan 2013 to Jul 2014), and figures during the ban are averages across months with the food embargo (Aug 2014 to Dec 2015). Computations exclude pork and swine products subject to the pork ban.

Table A8: Russian imports before and during the import ban, monthly averages

Type of products	Number of flows†			Value‡ (USD m)		
	before the ban	during the ban	change	before the ban	during the ban	change
	Imports from countries targeted by the ban					
All banned products⋆	502	157	-69%	628	121	-81%
Products under the pork ban*	19	10	-48%	82	5	-94%
Products under the food embargo**	476	148	-69%	559	96	-83%
Non-banned products	1,163	1,064	-9%	592	471	-20%
	Imports from countries not targeted by the ban					
All banned products⋆	599	583	-3%	843	959	+14%
Products under the pork ban*	5	7	+37%	35	72	+108%
Products under the food embargo**	594	576	-3%	805	883	+10%
Non-banned products	923	914	-1%	485	531	+9%

Notes: † Average number of flows in a month before and after the introduction of the Russian ban;
‡ Cumulative value of monthly imports before and after the introduction of the Russian ban;
⋆ Before ban refers to Jan 2013 to Jul 2015, during ban refers to Aug 2014 to Dec 2015;
* Figures before the ban are averages across months with no pork ban (Jan 2013 to Jan 2014), and figures during the ban are averages across months with the pork ban (Feb 2014 to Dec 2015);
** Figures before the ban are averages across months with no food embargo (Jan 2013 to Jul 2014), and figures during the ban are averages across months with the food embargo (Aug 2014 to Dec 2015). Computations exclude pork and swine products subject to the pork ban.

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