Bearing the cost of politics: Consumer prices and welfare in Russia

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Abstract

In August 2014, the Russian Federation implemented an embargo on select food and agricultural imports from Western countries in response to previously imposed economic sanctions. In this paper we quantify the effect of this embargo on consumer prices and welfare in Russia. We provide evidence for the direct effect on monthly consumer prices with a difference-in-differences approach. The embargo caused prices of embargoed goods to rise by up to 7.7% – 14.9% in the short run and by on average 2.6% – 8.1% until at least 2016. The results further suggest the shock was transmitted to non-embargoed sectors through domestic input-output linkages. We then construct a general equilibrium Ricardian model of trade with input-output linkages and goods that are tradable, non-tradable or *embargoed*. The model-based counterfactual analysis predicts the overall price index in Russia to have increased by 0.33% and welfare to have declined by 1.84% due to the embargo.

Keywords: Embargo, Sanctions, Consumer prices, Trade policy, Sectoral linkages
JEL Classification: F13, F14, F17, F51

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1 Introduction

In the spring and summer of 2014, political relations between the Russian Federation and Western countries cooled dramatically, following an escalation of tensions in eastern Ukraine and Crimea. Seeking to influence the decisions taken by the Russian government, Western countries gradually implemented financial and economic sanctions. In response, in August 2014, Russia introduced an embargo on certain food and agricultural goods.[1] Overall, this trade restriction targeted 48 products from the EU, the US, Australia, Ukraine and some other countries that supported the sanctions. The list of banned products comprises meat, meat products, milk and dairy products, fruits, vegetables, and nuts — everyday products for Russian consumers.[2] While the declared objective of the policy was to harm foreign food producers, it also had an impact on the Russian economy.

This paper quantifies the effects of the self-imposed food embargo on consumer prices and welfare *in Russia*. We first provide empirical evidence for a surge in prices of embargoed and linked products, caused by the embargo. We document the immediate and medium-term price hikes in a difference-in-differences framework, disentangling product-specific from macroeconomic effects. We do so by employing a comprehensive micro-level dataset of consumer prices for a broad set of products, disaggregated by city and date, allowing us to control for various product-, region- and time-specific effects. The dataset of monthly consumer prices is sourced from the Russian Federal State Statistics Service and includes a variety of embargoed and non-embargoed food items and various other types of goods and services. The analysis shows that the embargo led to an average increase in the prices of embargoed products of at least 2.6%, relative to non-embargoed products. The short-run effect after about 6 months is estimated at 7.7% – 14.9% and the average effect over the whole time period at 2.6% – 8.1%. We then explore whether trade diversion and product substitution can explain this smoothing of the effect, using customs- and domestic production data, respectively. Importantly, we observe that consumer prices for *non-embargoed* food products also increased, hinting at a propagation of the impact via input-output linkages.

Recognizing that non-embargoed sectors may have been indirectly affected by the policy, we then construct a theoretical trade model in the spirit of Caliendo and Parro (2015). The model assumes sectoral linkages, trade in intermediate goods and sectoral heterogeneity in production. Goods may be either tradable, non-tradable, or *embargoed*, which implies non-tradability across *some* country pairs. We then use the model to run a quantification exercise to evaluate and dissect the price and welfare effects in Russia. We calibrate the model with data on the production and usage of intermediate inputs in 42 countries from

[1] For a timeline of the evolution of the sanctions imposed by Western countries and the Russian Federation see here: https://www.rferl.org/a/russia-sanctions-timeline/29477179.html.

[2] See a detailed breakdown of the Russian government's decrees and decisions on the list of banned products here: https://ec.europa.eu/food/safety/international_affairs/eu_russia/russian_import_ban_eu_products_en.

the Global Trade Analysis Project (GTAP) from the pre-sanction period. We take data on bilateral tariffs from the Market Access Map (MacMap). A snapshot of pre-sanctions bilateral trade flows is sourced from the BACI dataset provided by CEPII (Gaulier and Zignago, 2010). To model the embargo state of the world, we construct a counterfactual situation that exhibits prohibitive trade costs on the import of embargoed goods from sanctioning countries to Russia, i.e. making them non-tradable across these country pairs.

Our simulations suggest that Russia experienced a welfare loss of 1.84% due to this self-imposed embargo. Furthermore, overall average prices in Russia are predicted to have increased by 0.33%, those for embargoed sectors by on average 7.9% and 0.27% for non-embargoed goods. The results of these model-based simulations are thus in line with our estimates using actual price data.

Our paper contributes to the growing literature on the effects of sanctions, embargoes and boycotts. Despite sparse evidence for their effectiveness, they continue to be popular instruments of foreign policy (Drezner, 1999). The recent rise in their use has renewed the interest to study their outcomes. Etkes and Zimring (2015), e.g., investigate the effect of the Gaza blockade. Their counterfactual exercise reveals welfare losses of 14% – 24%. The identified causes are the reallocation of resources and a decline in labor productivity. Heilmann (2016) studies the effect of consumer boycotts on trade. In multiple case studies using a synthetic control group methodology, he finds significant reductions in imports following abrupt shifts in consumer preferences. Haidar (2017) studies the recent case of Western-imposed sanctions on Iran. He finds that for Iranian firms, aggregate exports decreased, despite the diversion of trade to non-sanctioning countries. Exporting firms experienced losses due to the fall in prices, with small firms being particularly severely harmed. Lee (2018) examines the spatial distribution of economic activity in North Korea under economic sanctions, concluding that sanctions prompt increased regional inequality. Besedeš et al. (2017) study the consequences of financial sanctions for the balance of payments of German firms during the period 2005 – 2014 and find a direct negative effect for bilateral financial sanctions on cross-border capital flows. The effect is lower in cases in which the EU alone imposes sanctions, hinting at possible sanctions evasion. Our paper contributes to this broader literature on sanctions, boycotts and embargoes by investigating the impact on consumers in the affected economy. Next to an analysis of detailed price microdata, we go beyond the current state of the literature by embedding an embargo setting into a quantitative trade model to simulate economy-wide effects of the measures.

A number of papers have focused specifically on the impact of the sanctions against the Russian Federation and their countermeasures. Strong pre-sanction economic ties between Russia and sanctioning countries make this case particularly instructive. Dreger et al. (2016) evaluate the macroeconomic impact of the sanctions regime using a multivariate VAR model. They find that the sanctions had a limited impact and attribute the downturn

in the Russian economy to the decline of oil prices in early 2015. Crozet and Hinz (2020), estimate the effect of the sanctions regime on trade, i.e. the exports of both sanctioned and *sanctioning* countries. They find significant "friendly fire", where even firms that were not directly impacted by any measure nevertheless exported significantly less towards Russia. They also note that firms directly affected by the Russian embargo on food and agricultural products were able to recoup only a fraction of the lost exports in other markets via trade diversion. The most closely related research to this present paper is Boulanger et al. (2016), where the authors simulate the short-run impact of the Russian food embargo on the Russian and European economies in a computable general equilibrium (CGE) exercise. According to their estimates, Russia lost 3.4 billion EUR of real income, equivalent to a 0.24% reduction in per capita utility. At the same time, the EU-28 lost 128 million EUR, or 0.0025% of per capita utility. They model the Russian import ban as a loss in existing trade preferences, leading to a reduction in consumer utility. Our research advances methodologically upon their study by accounting for the realistic input-output structure of modern economies.

In most cases, one or more sanctioning countries implement restrictive measures against another country. However, in some rare cases, a country decides to prohibit its own population from trading with others.[3] This study contributes to the sanctions literature with the analysis of *self-imposed* sanctions. To the best of our knowledge, only one historical event of this kind has been previously studied. In 1807-1809, the United States introduced a full embargo on international trade with European countries, in an effort to harm Great Britain. Irwin (2005) finds that this decision, also known as Jefferson's blockade, cost the United States approximately 5% of its GNP. During the period of the blockade, domestic prices of exported goods declined, whereas those of imported goods increased. O'Rourke (2007) employs a CGE model to assess the consequences of the blockade for Britain, France, and the United States. He shows that the U.S. experienced the strongest welfare loss, equivalent to 4-5% of GDP per annum. Our paper contributes to this strand of the literature by analyzing the effects of a self-imposed embargo in the modern globalized economy, where trade in intermediate goods has become a defining feature. In fact, one main conclusion of our paper is that a significant part of the overall impact is due to the effects of embargoed imported inputs.

In the theoretical part of our paper we construct a Ricardian model of trade à la Caliendo and Parro (2015), and thus relate to a recently flourishing literature that evaluates trade policy changes in this rich yet highly-tractable class of models. Employing the so-called "exact hat algebra" following Dekle et al. (2008), we solve the model in changes and obtain welfare effects by comparing trade shares that the model predicts to the ones observed. The key advantage over traditional CGE models is that such approach requires a minimum

[3] Arms embargoes are relatively frequently used by Western countries. However, arms exports as such are usually heavily regulated and often most closely linked with a country's foreign policy objectives.

of macroeconomic data and associated assumptions. Costinot and Rodriguez-Clare (2014) provide a comprehensive summary of related research on the outcomes of globalization. In another case of heavily politicized change of bilateral trade policies, Dhingra et al. (2017) estimate the welfare effects of Brexit in the medium to long run with a number of counterfactuals. In a similar vain, Mayer et al. (2019) estimate potential welfare losses for any EU member states from no longer being part of the EU. For the purpose of our study, we extend the model proposed by Caliendo and Parro (2015) by featuring *embargoed* country-pair-sector combinations — sectors that are tradable across some country pairs but non-tradable across others — by rendering bilateral prices conditional on the possibility of trading, i.e. the absence of a embargo.

The remainder of this paper is organized as follows. In section 2 we provide first empirical evidence of the changes to consumer prices due to the embargo. In section 3 we then introduce a model of trade with sectoral linkages, trade in intermediate goods and sectoral heterogeneity in production that distinguishes between tradable, non-tradable and embargoed sectors. The model allows us to easily compute the welfare outcomes for the trade frictions introduced by the embargo. We describe the calibration of the model and discuss the counterfactual simulations in section 4. Finally, section 5 concludes the paper.

2 Consumer prices in Russia

The Russian food embargo is a trade-restricting policy that has the concrete political objective of influencing the policy-making in countries imposing sanctions on Russia. This paper does not discuss the political aspects of this measure but addresses its economic outcomes. The embargo represents an abrupt exogenous trade shock and could be seen as a quasi-natural experiment. It targeted a variety of everyday products, ranging from meat and fish products to vegetables.[4] In this section, we document empirically the effects of the embargo on the final prices paid by Russian consumers. We first look at the direct effect on prices of embargoed products, then highlight its channels, before investigating the indirect impact of the embargo on other products' prices.

The dataset we employ records average monthly prices between January 2011 and May 2016 for consumer goods and services. It is constructed by the Russian Federal State Statistics Service, also known as Rosstat.[5] The list of prices includes those for 125 food products, 322 non-food products and 137 services. Each of them accounts for at least

[4]Table 12 in the appendix shows the list of affected Russian consumer goods, including our mapping to the targeted HS codes. For the original declaration of the list of banned products see: https://ec.europa.eu/food/sites/food/files/safety/docs/ia_eu-russia_ru-eu-import-ban_20140807_decree778-rus.pdf

[5]Previous studies using an early version of this dataset on consumer prices were dedicated to the so-called Big Bang economic reforms, which were implemented by Russia in the early 1990s.

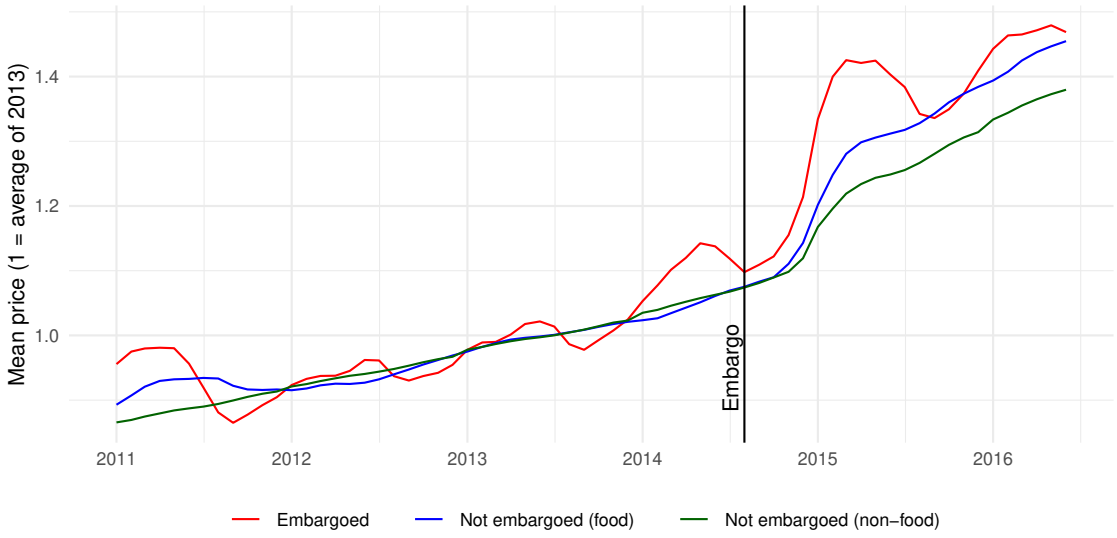


Figure 1: Evolution of average prices of embargoed and non-embargoed products.

0.1% of aggregate consumer expenditures in Russia.[6] Regional offices of the Federal State Statistics Service monitor prices between the 21st and 25th day of each month. They examine large, medium and small-sized retailers in both organized and non-organized markets.

The dataset is divided into three levels of aggregation based on the administrative organization of the Russian Federation. The monitoring is done at the least aggregated level in 279 selected cities.[7] In total, there are 4,314,991 observations at the city level. At the intermediate level of aggregation, the 83 subjects of the Russian Federation, prices are calculated as the population-weighted averages of the prices of the corresponding products at the city level. Here there are 2,838,466 product-month-subject observations. At the highest level of aggregation, the 8 federal districts, average prices are computed using the shares of the corresponding products' consumption in each region out of the total consumption of the federal district as weights.[8] In total, there are 275,372 observations at the level of federal districts.

[6]See `http://www.gks.ru/bgd/free/meta_2010/IssWWW.exe/Stg/2015/met-734.docx` for a detailed documentation of the survey methodology in Russian.

[7]The cities are selected according to the following criteria: (1) in each region, 2–4 cities are chosen to account for spatial heterogeneity; (2) communities close to one another are included only if they have "fundamental differences" in the levels and dynamics of prices; (3) consumers in selected cities must be consistently supplied with monitored goods; and (4) the total population of monitored communities is at least 35% of the total urban population of the Russian Federation. The price of each product is then computed as the mean of 5–10 prices registered in different parts of a selected cities.

[8]The dataset has average prices for 83 subjects and 8 districts until 2015, before it also started recording the data for the subjects Sevastopol and Republic of Crimea, and a Crimean Federal District. We exclude Crimea from our analysis.

Direct impact of the embargo

We first visualize the patterns of the prices of embargoed and non-embargoed goods in figure 1. We plot a simple average of the prices of embargoed and non-embargoed products, both food and non-food, over time. The prices of all types of products increase throughout the period of interest, with a clearly visible seasonality in food prices. An abrupt shock affecting the prices of embargoed goods, and to a lesser degree non-embargoed goods, can be observed following the introduction of the embargo in August 2014. Furthermore, prices of non-embargoed food products are increasing more than non-food products. This may hint at a propagation of the effect of the embargo to linked sectors.

To underline the difference in the shock for embargoed and non-embargoed goods in figure 1, we perform a simple difference-in-differences analysis inspired by these initial visual explorations of the data.[9] The treatment and control groups are well defined: products in the price data can be directly mapped to HS codes that have been banned from being imported from certain countries. We first estimate the following specification:

$$\begin{aligned}\log(\text{price}_{irtm}) = \alpha_0 + \alpha_1 \text{Product}_i + \alpha_2 \text{Period}_t + \beta\, \text{Product}_i \times \text{Period}_t \\ + \text{FE}_{rt} + \text{FE}_{irm} + \varepsilon_{irtm} \end{aligned} \tag{1}$$

where price_{irtm} is the price of a product i in region r at time t (in calendar month m), Product_i a dummy variable that indicates a treated product and Period_t a dummy variable that takes the value of 1 during the time of the embargo and 0 otherwise. The interaction of the two is therefore the variable of interest, with β being the coefficient. We control for structural regional variations as well as seasonality, as indicated in figure 1, by including region $\times$ date, FE_{rt}, and region $\times$ product $\times$ calendar month fixed effects, FE_{irm}, where region is a federal district, subject of the federation, or a city. Note that the inclusion of region $\times$ date fixed effects allows us to account for fluctuations in the Ruble exchange rate. The sensitivity of consumer prices to changes of the exchange rate can be expected to vary across regions, with respect to the share of imported goods in a region's consumption. Further note that the two sets of fixed effects absorb coefficients α_0, α_1, and α_2, leaving only variation in the dimension of the variable of interest.

Table 1 displays the results for our benchmark regression. Across all specifications, the estimated effect of the embargo on the prices of embargoed food and agricultural products is economically and statistically significant and similar in magnitude, depending on the control group. Columns (1) and (2) report the coefficient for the estimation at the district level. Columns (3) and (4) report those for the estimation at the subject level, and (5) and

[9] Interestingly, the Kremlin maintains the official talking point that Russian consumer prices did not react to the self-imposed import ban on food and agricultural products (see the speech by Dmitry Medvedev to the meeting of the Russian government, 26 August 2014). The difference-in-differences analysis can be seen as an empirical test of this statement.

Table 1: Benchmark regression: Diff-in-diff of impact of embargo on prices by spatial aggregation and control group.

	Dependent variable: log(prices)					
	(1)	(2)	(3)	(4)	(5)	(6)
Sanction period	0.026***	0.070***	0.030***	0.073***	0.027***	0.081***
× Embargoed product	(0.002)	(0.008)	(0.002)	(0.004)	(0.001)	(0.002)
Spatial agg.	district	district	subject	subject	city	city
Control group	F	NF	F	NF	F	NF
Observations	63,408	904,669	665,943	2,296,975	1,106,498	3,084,890
Adjusted R^2	0.990	0.990	0.987	0.996	0.987	0.995

Notes: F stands for (non-embargoed) food products and NF stands for non-food items. All regression include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

(6) at the least aggregated city level. For each, we alternate between control groups: either non-embargoed food products, denoted by (F), in columns (1), (3) and (5), or non-food products, denoted (NF), in columns (2), (4) and (6).

The results of these diff-in-diff estimations with non-embargoed food items as the control group are the first principal result of our empirical analysis. The group of food products is generally more homogeneous than that comprised of non-food items. Following the embargo, prices of embargoed food products grew on average by between 2.6% and 3% vis-à-vis those of non-embargoed food products. Note also, though, that these numbers are systematically lower than those from the diff-in-diff estimates with a control group of non-food products, which range between 7% and 8.1%. Thus, it appears as if other non-embargoed food prices also increased relative to non-food prices, providing further hints at indirect effects of the embargo in linked sectors.

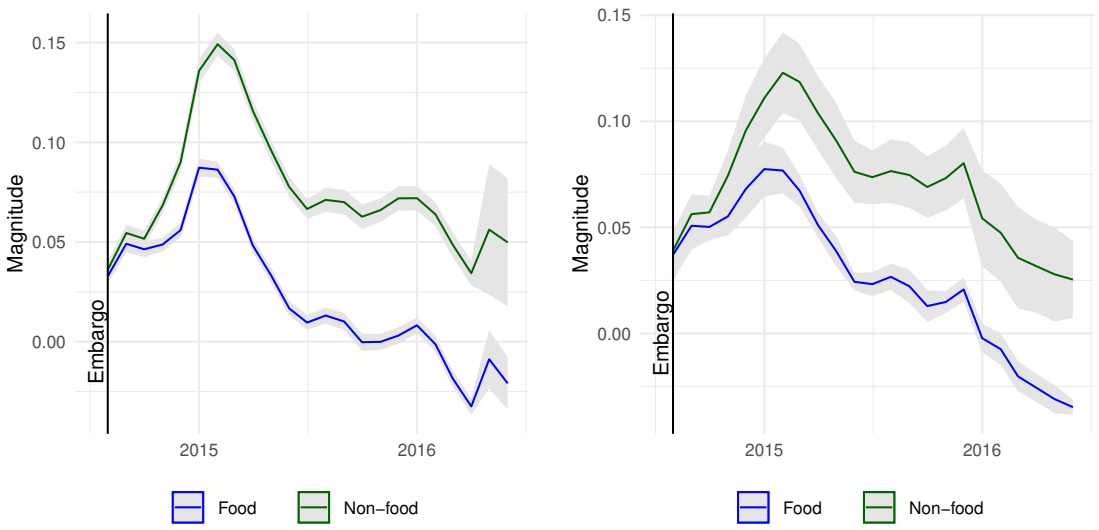
The magnitude of the direct effect of the embargo on food prices appears reasonable. Imported food products make up about 30% of the representative Russian consumption basket.[10] On top of that, 51% of these products had been imported from sanctioning countries before the start of the sanctions.[11]

We also explore how the impact of the shock to consumer prices varies over time. To do so, we let the previous variable of interest and its coefficient vary by post-embargo date. Specifically, we estimate:

$$\log(\text{price}_{irtm}) = \alpha_0 + \alpha_1 \text{Product}_i + \boldsymbol{\alpha}_2' \mathbf{Date}_t + \boldsymbol{\beta}' \text{ Product}_i \times \mathbf{Date}_t + \text{FE}_{rt} + \text{FE}_{irm} + \varepsilon_{irtm} \quad (2)$$

where the only difference to equation 1 is the inclusion of the *vector* of dummy variables $\mathbf{Date}_t$ that indicate an exact date post-embargo and $\boldsymbol{\beta}$ being the vector of coefficients

[10] Source: https://www.ft.com/content/398cbdce-1e4a-11e4-9513-00144feabdc0.
[11] Own calculation using UN COMTRADE data.



(a) City level

(b) Federal district level

Figure 2: Monthly coefficients for diff-in-diff estimates. 95% confidence intervals are shaded in grey.

of interest. Again, the included fixed effects absorb all coefficients other than β. The estimated monthly coefficients are plotted at city-level in figure 2(a) and at district-level in 2(b).[12]

In both plots, the effect is steadily increasing until January/February 2015 up to 7.7% and 14.9%, depending on the control group, and then decreasing in intensity, irrespective of the level of spatial aggregation. The difference with respect to the control group considered is also clear: The coefficient drops essentially entirely back to zero for the food products control group one year after the beginning of the embargo (and even slightly beyond in mid-2016). Embargoed food prices remain significantly higher, though, for a control group composed of non-food products. This underlines earlier results where we suspected a propagation of the price shock to other non-embargoed food and agricultural products.

Channels of the direct impact

We now try to decompose the direct impact of the food embargo on prices into several plausible channels. We do so by estimating different variations of the benchmark specification described in equation 1, in some case by interacting the shock with an additional variable, such that:

$$\log(\text{value}_{irtm}) = \alpha_0 + \alpha_1 \text{Product}_i + \alpha_2 \text{Period}_t + \beta\, \text{Product}_i \times \text{Period}_t \times \text{Variable} + FE_{rt} + FE_{irm} + \varepsilon_{irtm} \quad (3)$$

[12] For completeness we report the estimated coefficients for the subject level in figure 6 in Appendix D.

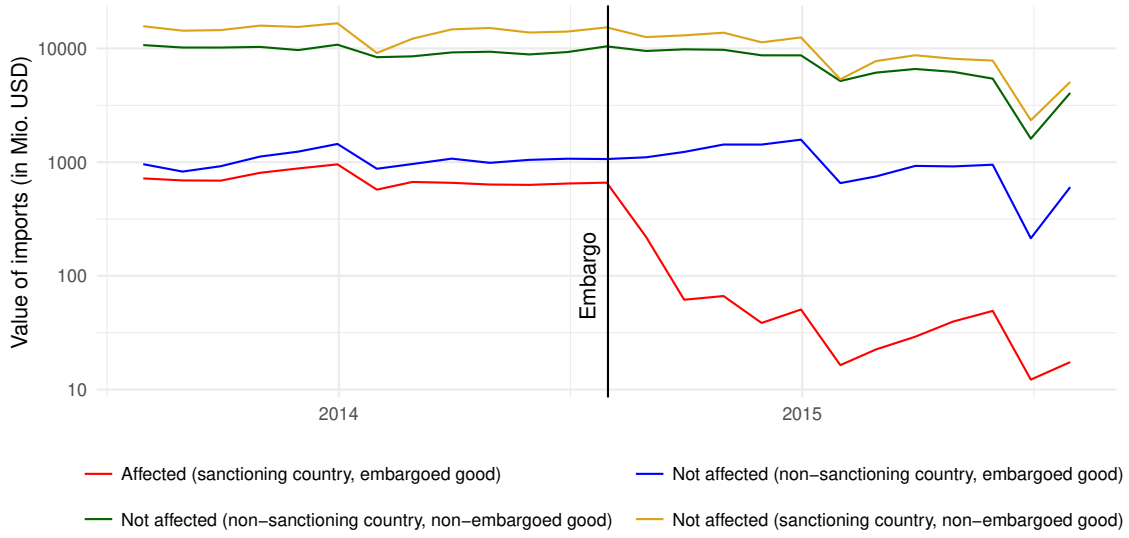


Figure 3: Imports of embargoed and non-embargoed products to Russia.

where the dependent variable value_{irtm} is a relevant economic variable, like prices as above. The additional interaction allows us to detect heterogeneous effects along the dimensions of the included *Variable*.

A first channel we explore is whether trade diversion may have taken place, driving up prices. Russian firms may have simply adjusted their import strategy and shifted away from imports of embargoed products from sanctioning countries to those from non-sanctioning countries.[13] Finding new trading partners may not be easy instantaneously, leading to a sharp initial increase in prices, but over time substitutes may have been found, explaining the dampening of the effect. We briefly explore whether this form of trade diversion took place using monthly product-level trade data from the Regional Russian Customs Offices.

Figure 3 shows the evolution of imports of embargoed and non-embargoed products from sanctioning and non-sanctioning countries. The red line shows the drastic drop in imports of embargoed products from sanctioning countries. This drop comes at no surprise, as the policy effectively bans imports of these products.[14] It also suggests a slight relative increase in the imports of embargoed products from other source countries (blue line) following the embargo, vis-à-vis non-embargoed imports from these countries (green line). Thus, trade diversion may have compensated somewhat for the initial supply shock.

We test for trade diversion more carefully by employing again a very similar difference-in-differences estimation as above. We report the results in table 2. Columns (1) and (2)

[13]Note that for clarity throughout the paper we refer to (non-)embargoed *products* and (non-)sanctioning *countries*.

[14]Note that the value of imports of apparently banned products does not drop to zero, as there were some minor exemptions, e.g. for baby milk powder. See e.g. `http://publication.pravo.gov.ru/Document/View/0001201606010004?index=0&rangeSize=1`.

Table 2: Decomposition: Impact on imports

	Dependent variable:			
	log(value) (1)	log(weight) (2)	log(value) (3)	log(weight) (4)
Sanction period × Sanctioning country	-0.622^{***} (0.112)	-0.710^{***} (0.139)	-	-
Sanction period × Embargo product	-	-	0.422^{***} (0.076)	0.452^{***} (0.068)
Spatial aggregation	subject	subject	subject	subject
Sample	E	E	NS	NS
Control group	NS	NS	NE	NE
Observations	62,894	62,894	987,113	987,113
Adjusted R^2	0.470	0.458	0.479	0.564

Notes: E stands for embargoed food products and NE stands for non-embargoed products. NS stands for non-sanctioning countries. Columns (1) and (2) include region × date and region × partner × month fixed effects. Columns (3) and (4) include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

document empirically the first observation: Focusing on a sample of embargoed products, we compare imports from sanctioning and non-sanctioning countries, i.e. essentially comparing the red and blue lines in Figure 3. As expected, the embargo is effective, in the sense that imports from sanctioning countries indeed drop dramatically. The estimated coefficients are similar in magnitude for value and weight of imported products.[15]

Importantly though, these imports from non-sanctioning countries may have compensated for the drop from embargoed sources through trade diversion, thus inflating the estimated effect. In columns (3) and (4) we therefore estimate whether there may have been trade diversion of these affected products. Here we focus on a sample of non-sanctioning countries and compare imports of embargoed and non-embargoed products, i.e. essentially comparing the blue and green lines in Figure 3. The estimated coefficient is positive and significant, suggesting that relative to non-embargoed products, imports of embargoed products from non-sanctioning countries increased. Overall these results indicate that imports of embargoed products from sanctioning countries, as expected, decreased significantly, whereas imports from other origins increased. This confirms that at least some trade divergence took place.

Two additional channels come to mind. Russian consumers may have adjusted their consumption basket in the aftermath of the import ban. Intuitively, an increase in consumer prices is likely to result in reduced domestic consumption. Furthermore, increased domestic production may have absorbed part of the effect. Using wholesales and production data provided by Rosstat — similar to the price data used above — we can test these hypotheses.

[15] We include an estimation for weight as below we report estimates of changes in wholesales and production that are also recorded as weight in tons.

Table 3: Decomposition: Impact on wholesales and domestic production

	Dependent variable:			
	log(wholesales)		log(production)	
	(1)	(2)	(3)	(4)
Sanction period	-0.224^{*}	-0.303	0.029	0.091^{**}
$\times$ Embargoed product	(0.104)	(0.249)	(0.030)	(0.026)
Spatial agg.	district	district	district	district
Control group	F	NF	F	NF
Observations	7,476	5,354	108,586	162,333
Adjusted R^2	0.908	0.948	0.950	0.949

Notes: F stands for (non-embargoed) food products and NF stands for non-food items. All regression include region $\times$ date and region $\times$ product $\times$ month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

The wholesales data records figures for large and medium-sized companies for a range of products, albeit far fewer than for prices and only at the federal district level.[16] The unit of observation here is given in weight in tons. These figures may not translate perfectly into domestic consumption, as e.g. small shops and local farmers markets are not included. However, the results likely give an indication for the overall situation. We again employ a difference-in-differences framework to isolate the impact of the embargo on the consumption of embargoed products. The results presented in table 3 suggest that the food embargo had a non-negligible impact on demand. Domestic consumption of embargoed products decreased by around 22%, when comparing to non-embargoed food products. While the coefficient in the estimation with a control group made up of non-food items is statistically insignificant, the results could provide an indication for some shift of consumption from embargoed towards similar non-embargoed products, and, accordingly, explain some of the increase in prices of non-embargoed goods. We investigate this possible indirect effect below. Overall, the decrease in wholesales might explain a part of the reversion of the price shock from its peak in early 2015 back towards lower prices.

The price changes may also be affected by changes in domestic production following the embargo. An increase in production of embargoed products might have contributed to the reversion of the prices in the medium run. In addition to the embargo policy, the Russian government announced that it would strengthen agricultural import substitution. New support programs for national agricultural producers entered into force in late 2014 and 2015. Figure 4 suggests that the production of embargoed products grew steadily between early 2011 and mid-2016, with no visible spike after the import embargo was imposed.[17] The related diff-in-diff estimation results, presented in table 3, largely confirm

[16] In total the wholesales dataset has 31,979 observations.

[17] Note the marked seasonality in the production of non-embargoed food products, with peaks in the fall of each year.

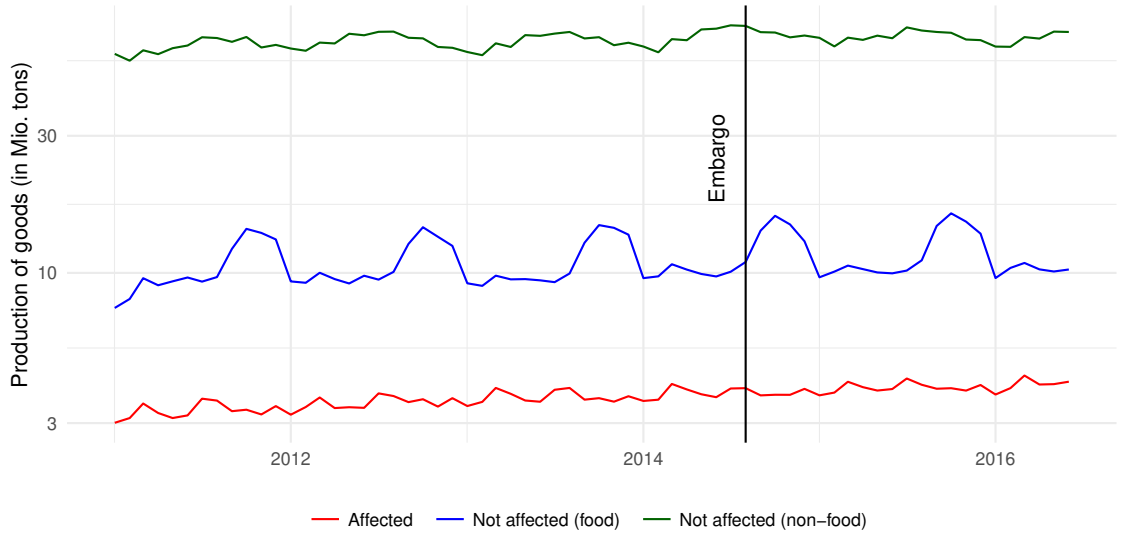


Figure 4: Evolution of aggregate production of embargoed and non-embargoed products in Russia.

this picture, with no significant increase in production of embargoed food products relative to non-embargoed food products, and only a moderate increase of about 9.1% relative to non-food products.

To further pin down the price changes of embargoed products as a result of the embargo, we now combine the price data with the product-level import data to test whether a previous reliance on food imports from sanctioning countries in the respective region lead to systematically higher food prices after the embargo. As we suspect that imports (or rather the ban thereof) resulted in increased consumer prices, we expect that those parts of the country that imported relatively more of the embargoed products from sanctioning origin countries to have experienced a relatively higher increase in prices.

Figure 5 visualizes the noticeable spatial heterogeneity of price increases. The western regions of Russia experienced higher price increases, likely due to the heterogeneous exposure to the embargo. We test this more formally by again turning to the diff-in-diff framework from above, and now interacting the variable of interest — the interaction of sanction period with embargoed product — with the share of imports of sanctioning countries in the respective region prior to the embargo.

Table 4 reports the findings. Columns (1) and (2) display the coefficients at the district level, and columns (3) and (4) do so at the federal subject level.[18] While the point estimate for the triple interaction is positive in all specifications, it is only statistically significant for the control group that includes non-food products. This suggests, on the one hand,

[18]Note that we rely on import data from the Russian Customs Administration, which provides data at the federal subject level. We therefore restrict our analysis to district- and subject-level aggregations of the price data.

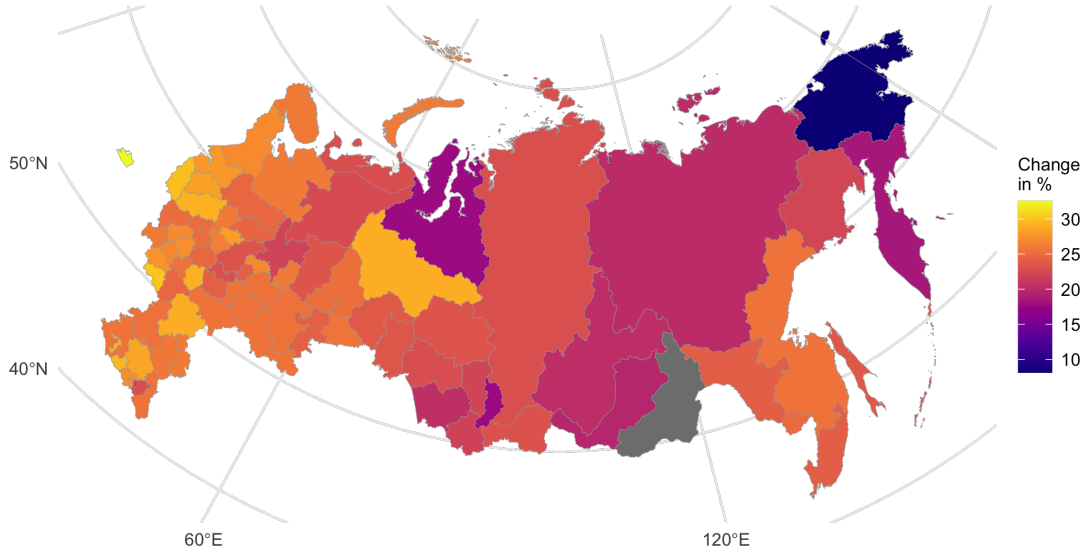


Figure 5: Average prices change of embargoed products by region, June '14 to June '15.

Table 4: Decomposition: Interaction with share of sanctioning countries in imports

	Dependent variable: log(prices)			
	(1)	(2)	(3)	(4)
Sanction period × Embargo product	0.008	0.012	0.024***	0.068***
	(0.012)	(0.012)	(0.003)	(0.003)
— × Share sanctioning country in imports	0.030	0.123***	0.012	0.034***
	(0.025)	(0.025)	(0.009)	(0.009)
Spatial agg.	district	district	subject	subject
Control group	F	NF	F	NF
Observations	35,130	241,440	376,850	1,009,188
Adjusted R^2	0.991	0.994	0.988	0.997

Notes: F stands for (non-embargoed) food products and NF stands for non-food items. Columns (1) and (2) include region × date and region × partner × month fixed effects. Columns (3) and (4) include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

that regions that previously relied on now banned food imports indeed experienced higher prices post-embargo and, on the other hand, that other food prices in these regions were also affected indirectly. This provides further evidence that the embargo likely propagated to other linked sectors.

It could also be the case, however, that some specific products, e.g. fresh produce, exhibit a differential effect in terms of the location of their consumers. To capture this type of heterogeneity across geographical locations of the regions,[19] we compute the distance between the capital of each region and the capital of Ukraine, Kyiv. We take this distance

[19]Previous studies, e.g., Gardner and Brooks (1994) and De Masi and Koen (1995), exploiting weekly retail food prices in 132 cities in the Russian Federation, reveal significant and persistent differences for these products in prices across regions.

Table 5: Indirect effects: Demand shock

	Dependent variable:			
	log(prices)		log(wholesales)	
	(1)	(2)	(3)	(4)
Sanction period	0.070***	-	−0.303	-
× Embargoed product	(0.008)		(0.249)	
Sanction period	-	0.050***	-	−0.075
× Non-embargoed product		(0.006)		(0.235)
Spatial agg.	district	district	district	district
Observations	904,669	1,038,604	5,354	7,348
Adjusted R^2	0.990	0.994	0.948	0.940

Notes: The treatment group consists of embargoed food products in columns (1) and (3) and non-embargoed food products in columns (2) and (4). The control group consists of non-food items only. All regression include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

as a proxy for the proximity to European markets, which are a major origin of embargoed products. We repeat the difference-in-differences estimation of prices from above, now interacting with distance to Europe. The results are reported in table 13 in Appendix B. Price increases were indeed higher for regions closer to European markets for embargoed products relative to other food products.

Indirect impact of the embargo

Overall, the data reveals that the embargo had a significant *direct* effect on consumer prices of banned goods. Additionally, the analysis above provides ample evidence that other food and agricultural products that were not embargoed appear to have been *indirectly* affected. In fact, visually this is already hinted at in the evolution of average prices after the implementation of the embargo in figure 1: The blue line, non-embargoed food products, shifted up much more than the green line, prices unaffected non-food products.

One explanation for the rise in prices of non-embargoed food and agricultural products could be a short-run demand shock induced by consumers substituting embargoed goods with similar non-embargoed ones. The results of the difference-in-differences analyses of wholesales and production data above (table 3) suggest that sales of embargoed products have declined as compared to non-embargoed food products, or vice versa, that the demand for non-embargoed goods has increased relative to embargoed products.

We can test whether domestic demand indeed shifted from embargoed to non-embargoed food products by comparing price and quantity reactions to the policy shock. Specifically, we look at whether non-embargoed food products exhibited a different behavior than embargoed goods vis-à-vis *non-food* products. Whereas for embargoed products we observe an increase in prices and decrease in wholesales, an increase in consumer prices and a

Table 6: Indirect effects: Prices in sectors that are vertically linked to embargoed sectors.

	Dependent variable: log(prices)		
	(1)	(2)	(3)
Sanction period × Embargo product	0.063***	0.065***	0.069***
	(0.006)	(0.003)	(0.002)
Sanction period × Linked product	0.016*	0.014***	0.019***
	(0.007)	(0.004)	(0.003)
Spatial agg.	district	subject	city
Observations	130,748	1,378,441	3,414,161
Adjusted R^2	0.998	0.997	0.995

Notes: The control group consists of sectors that are not embargoed nor downstream linked to embargoed sectors. All regression include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

simultaneous *increase* in wholesales for non-embargoed products would be consistent with a demand shock.

Table 5, however, shows this likely was not the case. Columns (1) and (3) reproduce the results from table 1 and table 3, i.e. the price and wholesales impact for embargoed products, and columns (2) and (4) report the analogous coefficients for non-embargoed food products. Both pairs of coefficients paint a very similar picture, albeit with smaller magnitudes of the impact for non-embargoed food products. This lets us conclude that a demand shock induced by consumers switching from embargoed to similar non-embargoed food items was not the dominant force behind the latter's increase in prices.[20] Rather, these results are consistent with a *cost* shock for non-embargoed food products, where — as for embargoed products — prices increased and quantities fell.

A plausible explanation for such a cost shock could be that the embargo impact was transmitted to non-embargoed sectors via input-output linkages. First, in general, agricultural and food products are often used as inputs in other sectors, as shown in table 14 using GTAP data for the European Union.[21] Second, in the case of Russia, there are strong intersectoral connections with embargoed sectors, as revealed in table 15 by computing the use of banned products in Russian production. E.g., foreign same-sector inputs are intensively employed in the production of "Bovine Meat Products" and "Other Meat Products". Foreign "Vegetables and Fruits" account for more than 40% of the inputs in six GTAP sectors: "Bovine Cattle", "Other Animal Products", "Raw Milk", "Wool", "Other Meat Products" and "Sugar".

[20] As pointed out above, caution regarding the wholesales data is required, as the sample is dramatically smaller compared to the price data.

[21] Antràs et al. (2012) suggest a comprehensive measure of the upstreamness of sectors across countries. In table 14, we reproduce their results for the European Union. The food products sector has a non-negligible value of 1.73. Note that the further this measure is from unity, the more the output of the corresponding sector is used as an input in the production of other sectors.

To provide empirical evidence for the propagation of the embargo through linked products and sectors, we can test whether consumer prices in these sectors also increased following the embargo. To do so, we again replicate the difference-in-differences analysis from above, now adding a variable indicating linked products during the time of sanctions, i.e. Sanction period $\times$ Linked product. The results are reported in table 6, strongly supporting the previous indication of an indirect embargo effect on linked sectors. The coefficients are, as expected, smaller, but statistically and economically highly significant. They are clear evidence for the notion that the effect of the embargo was indeed transmitted to other sectors, leading to indirect increases in consumer prices in sectors that are downstream from embargoed sectors.

3 Theory

To account for these indirect effects revealed in the data, we now construct a structural model of international trade that exhibits domestic input-output linkages that transmit sectoral *international* shocks across the affected *domestic* economy. In the current context, this allows us — under plausible assumptions common in the related literature — to compute a counterfactual scenario in which the embargo by the Russian Federation on certain food and agricultural products had not taken place. We compute prices and welfare effects for this scenario and contrast it to the observed situation, allowing us to evaluate the direct and indirect effects of the use of this foreign policy instrument on Russian consumers.

We set up a model in the spirit of Caliendo and Parro (2015) that displays the mechanisms at play. There are N countries, indexed i and n, and J sectors, indexed j and k. Production uses labor as the sole factor, which is mobile across sectors but not across countries. All markets are perfectly competitive. Sectors are either wholly tradable, non-tradable, or *embargoed*, which implies non-tradability across some country pairs.

There are L_n representative households in each country that maximize their utility by consuming final goods C_n^j in the familiar Cobb-Douglas fashion.

$$u(C_n) = \prod_{j=1}^{J} C_n^{\alpha_n^j} \quad \text{with} \quad \sum_{j=1}^{J} \alpha_n^j = 1.$$

Household income I_n is derived from the supply of labor L_n at wage w_n and a lump-sum transfers of tariff revenues. Intermediate goods $\omega^j \in [0, 1]$ are produced in each sector j using labor and *composite* intermediate goods from all sectors, such that

$$q_n^j(\omega^j) = z_n^j(\omega^j) \left[l_n^j(\omega^j)\right]^{\gamma_n^j} \prod_{k=1}^{J} \left[m_n^{k,j}(\omega^j)\right]^{\gamma_n^{k,j}}$$

where $z_n^j(\omega^j)$ is the overall efficiency of a producer, $l_n^j(\omega^j)$ is labor input, and $m_n^{k,j}(\omega^j)$ represent the composite intermediate goods from sector k used to produce ω^j. $\gamma_n^{k,j}$ and γ_n^j are the shares of materials used in production and value added, that are allowed to vary across countries and sectors. With constant returns to scale and perfectly competitive markets, unit cost are

$$c_n^j = \frac{\Upsilon_n^j w_n^{\gamma_n^j}}{z_n^j(\omega^j)} \prod_{k=1}^{J} P_n^{k\gamma_n^{k,j}}$$

where P_n^k is the price of a composite intermediate good from sector k, and the constant $\Upsilon_n^j = \prod_{k=1}^{J} (\gamma_n^{k,j})^{-\gamma_n^{k,j}} (\gamma_n^j)^{-\gamma_n^j}$. Hence, the cost of the input bundle depends on wages and the prices of *all* composite intermediate goods in the economy. Producers of composite intermediate goods supply Q_n^j at minimum costs by purchasing intermediate goods ω^j from the lowest cost supplier across countries, so that

$$Q_n^j = \left[\int r_n^j(\omega^j)^{1-1/\sigma^j} d\omega^j \right]^{\sigma^j/(\sigma^j-1)}.$$

$\sigma^j > 0$ is the elasticity of substitution across intermediate goods within sector j, and $r_n^j(\omega^j)$ the demand for intermediate goods ω^j from the lowest cost supplier

$$r_n^j(\omega^j) = \left(\frac{p_n^j(\omega^j)}{P_n^j} \right)^{-\sigma^j} Q_n^j$$

where P_n^j is the unit price of the composite intermediate good

$$P_n^j = \left[\int p_n^j(\omega^j)^{1-\sigma^j} d\omega^j \right]^{1/(1-\sigma^j)}$$

and $p_n^j(\omega^j)$ denotes the lowest price of intermediate good ω^j across all locations. Composite intermediate goods are used in the production of intermediate goods ω^j and as the final good in consumption as C_n^j, so that the market clearing condition is written as

$$Q_n^j = C_n^j + \sum_{k=1}^{J} \int m_n^{j,k}(\omega^j) d\omega^j$$

Thus far, the model is identical to Caliendo and Parro (2015). It differs slightly in the following. Trade in goods is costly, such that the offered price of ω^j from i in n is given by

$$p_{ni}^j \left(\omega^j | \varepsilon_{ni}^j = 1 \right) = \tau_{ni}^j d_{ni}^j \cdot \frac{c_i^j}{z_i^j(\omega^j)}$$

where τ_{ni}^j represent sector-specific ad-valorem tariffs, and d_{ni}^j iceberg trade costs. τ_{ni}^j are

collected by the importing country and transferred lump-sum to its households. In contrast to Caliendo and Parro (2015), we append a term ε_{ni}^j, which is an indicator variable that takes $\varepsilon_{ni}^j = 0$ in the case of an embargo on sector j by n towards i and $\varepsilon_{ni}^j = 1$ otherwise. This effectively renders goods produced in sector j *non-tradable* between *some* country pairs, while being tradable across others. Furthermore, ε_{ni}^j is unlike a tariff, as no revenue is generated for the imposing importing country. Ricardian comparative advantage is induced à la Eaton and Kortum (2002) through a country-specific idiosyncratic productivity draw z^j from a Fréchet distribution. The price of ω^j in country n is given by

$$p_n^j = \min_i \left\{ p_{ni}^j \left(\omega^j | \varepsilon_{ni}^j = 1 \right) \right\}.$$

The price of the composite good is then given as

$$P_n^j = A^j \left[\sum_{i=1}^{N} \varepsilon_{ni}^j \lambda_i^j (c_i^j \tau_{ni}^j d_{ni}^j)^{-\theta^j} \right]^{-1/\theta^j}$$

which, for the non-tradable sector or embargoed sector towards *all* non-domestic sources collapses to

$$P_n^j = A^j (\lambda_n^j)^{-1/\theta^j} c_n^j$$

where $A^j = \Gamma(\xi^j)^{1/(1-\sigma^j)}$ with $\Gamma(\xi^j)$ being a Gamma function evaluated at $\xi^j = 1 + (1 - \sigma^j)/\theta^j$. Total expenditures on goods from sector j in country n are given by $X_n^j = P_n^j Q_n^j$. The expenditure on those goods originating from country i is called X_{ni}^j, such that the share of j from i in n is $\pi_{ni}^j = X_{ni}^j / X_n^j$. This share can also be expressed as

$$\pi_{ni}^j = \frac{\varepsilon_{ni}^j \lambda_i^j (c_i^j \tau_{ni}^j d_{ni}^j)^{-\theta^j}}{\sum_{h=1}^{N} \varepsilon_{nh}^j \lambda_h^j (c_h^j \tau_{nh}^j d_{nh}^j)^{-\theta^j}}$$

which displays the direct effect of an embargo clearly: a ε_{ni}^j, i.e. an embargo by n towards i on goods j reduces i's share of this good in n's total imports to zero. The indirect effect, as in Caliendo and Parro (2015) in the case of tariff changes, goes through c_n^j due to cross-sector linkages.

Total expenditures on goods from sector j are the sum of the firms' and households' expenditures on the composite intermediate good, either as input to production or for final consumption

$$X_n^j = \sum_{k=1}^{J} \gamma_n^{j,k} \sum_{i=1}^{N} \frac{\pi_{in}^k}{1 + \tau_{in}^k} X_i^j + \alpha_n^j I_n$$

with $I_n = w_n L_n + R_n + D_n$, i.e., labor income, tariff revenue and the aggregate trade

deficit, which is exogenously set. Finally, global deficits sum to 0, i.e. $\sum_n D_n = 0$, and

$$\sum_{j=1}^{J}\sum_{i=1}^{N}\frac{\pi_{ni}^{j}}{1+\tau_{ni}^{j}}X_n^j - D_n = \sum_{j=1}^{J}\sum_{i=1}^{N}\frac{\pi_{in}^{j}}{1+\tau_{in}^{j}}X_i^j.$$

As in Dekle et al. (2008) and following Caliendo and Parro (2015) the equilibrium is solved for in changes. For any variable x, let the relative change from x' be denoted as $\hat{x} = x'/x$. The equilibrium conditions are defined as follows. The change in the cost of input bundles is expressed as

$$\hat{c}_n^j = \hat{w}_n^{\gamma_n^j}\prod_{k=1}^{J}\hat{P}_n^{k\ \gamma_n^{k,j}}$$

whereas the change in the price index is given by

$$\hat{P}_n^j = \left[\sum_{i=1}^{N}\varepsilon_{ni}^{j\prime}\pi_{ni}^{j}(\hat{c}_i^j)^{-\theta^j}\right]^{-1/\theta^j}.$$

Bilateral trade shares adjust according to

$$\hat{\pi}_{ni}^{j} = \varepsilon_{ni}^{j\prime}\left[\frac{\hat{c}_i^j}{\hat{P}_n^j}\right]^{\theta^j}$$

and total expenditures on sector j in country n as

$$X_n^{j\prime} = \sum_{k=1}^{J}\gamma_n^{j,k}\sum_{i=1}^{N}\varepsilon_{in}^{k\prime}\frac{\pi_{in}^{k\prime}}{1+\tau_{in}^{k}}X_i^{k\prime} + \alpha_n^j I_n'.$$

The trade balance is assured by

$$\sum_{j=1}^{J}\sum_{i=1}^{N}\varepsilon_{ni}^{j\prime}\frac{\pi_{ni}^{j\prime}}{1+\tau_{ni}^{j}}X_n^{j\prime} - D_n = \sum_{j=1}^{J}\sum_{i=1}^{N}\varepsilon_{in}^{j\prime}\frac{\pi_{in}^{j\prime}}{1+\tau_{in}^{j}}X_i^{j\prime}$$

where $I_n' = \hat{w}_n w_n L_n + D_n + \sum_{j=1}^{J}\sum_{i=1}^{N}\varepsilon_{ni}^{j\prime}\tau_{ni}^{j}\frac{\pi_{ni}^{j\prime}}{1+\tau_{ni}^{j}}X_n^{j\prime}$. As in Caliendo and Parro (2015) relative changes in welfare are given by

$$\ln\hat{W}_n = \ln\frac{\hat{w}_n}{\hat{P}_n} = -\sum_{j=1}^{J}\frac{\alpha_n^j}{\theta^j}\ln\hat{\pi}_{nn}^{j} - \sum_{j=1}^{J}\frac{\alpha_n^j}{\theta^j}\frac{1-\gamma_n^j}{\gamma_n^j}\ln\hat{\pi}_{nn}^{j} - \sum_{j=1}^{J}\frac{\alpha_n^j}{\gamma_n^j}\ln\prod_{k=1}^{J}\frac{\hat{P}_n^{k\ \gamma_n^{k,j}}}{\hat{P}_n^j}.$$

Table 7: Employed GTAP variables

Employed variable	Definition
Gross output	Total sales of domestic products at market prices
Share of value added in gross output	Value added divided by gross output
Input-output coefficients	Sum of domestic purchases by firms and import purchases by firms divided by gross output by sector

Notes: Table reports definitions of variables that are employed in the calibration of the model and are sourced from GTAP dataset.

4 Counterfactuals

We now describe how the model is employed to simulate the outcomes of the embargo. An important feature of the model is that its calibration and application to simulations does not require the use of sophisticated or extensive datasets.

The first set of data we employ is on production and the use of intermediary inputs. It is sourced from the 8th version of the GTAP database.[22] Table 7 summarizes the definitions of the variables we employ. The second ingredient is the trade data. We source the bilateral flows from BACI.[23] We take trade elasticities for 33 GTAP sectors from Ossa (2014) and complement the selection of sectors by the sectors of fishing, extraction of crude petroleum and natural gas,[24] petroleum and coke, coal and other mining. We source the elasticities for the six aforementioned sectors from Imbs and Mejean (2015), from the section where they follow the estimation technique of Feenstra (1994).[25] The non-tradable GTAP sectors are the following: "Electricity", "Gas Distribution", "Water", "Construction", "Trade", "Other Transport", "Water Transport", "Air Transport", "Communications", "Other Financial Intermediation", "Insurance", "Other Business Services", "Recreation and Other Services", "Other Services (Government)", and "Dwellings". We source the bilateral tariff rates for 2007 from MacMap.

Finally, data on the Russian food embargo are needed. The following countries were subject to the import ban: Albania, Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Montenegro, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Ukraine, the United Kingdom, and the United States.

The exhaustive list of all embargoed products was published by the Russian government

[22] See a recent application of GTAP in, e.g., Johnson and Noguera (2012).

[23] BACI is a harmonized dataset on global trade developed by CEPII. It contains highly disaggregated yearly trade flows.

[24] The oil and gas sectors are major pillars of the Russian economy.

[25] The complete list of tradable sectors with corresponding elasticities is reported in table 16 in Appendix D.

Table 8: Identification of embargoed sectors

Sector	Number of embargoed products	Share of embargoed trade in imports, %	Embargoed in model
Vegetables and Fruits	22	100	Yes
Fishing	4	99.11	Yes
Dairy	6	98.06	Yes
Other Meat Products	4	91.78	Yes
Bovine Meat Products	2	77.02	Yes
Other Food Products	12	34.41	No
Other Animal Products	1	0.002	No

Notes: Table reports GTAP sectors that correspond to embargoed HS4 products.

in August 2014.[26] To match them with GTAP sectors, we employ World Integrated Trade Solution (WITS) product concordance tables. The mapping of embargoed sectors to the GTAP classification is reported in Appendix A in table 12. It is crucial to properly identify GTAP sectors that were the most exposed to the studied bilateral shock. We make this decision with respect to one key criterion: The share of embargoed trade in total imports of each sector. In table 8 we report those seven GTAP sectors which include at least one embargoed product.

We select those sectors for which more than 50% of Russian imports in 2013 were embargoed, which includes: "Vegetables and Fruits", "Fishing", "Dairy", "Other Meat Products" and "Bovine Meat Products". The sectors "Other Food Products" and "Other Animal Products" are excluded as products belonging to the official prohibited list constitute only minor shares in these sectors' imports.[27] One should note that GTAP sector "Raw Milk" is excluded because the BACI dataset does not report any data on its trade flows.

With all needed data at hand, we solve the model in changes for the embargo. First, we take the year 2013 — the latest complete year without embargo — as the base year. We compute the equilibrium in this year with aggregate trade deficits.

Next, we build the counterfactual year 2013 with embargo by copying the base year 2013. We then introduce the Russian food embargo by setting the $\varepsilon_{ni}^{j} = 0$ for affected products and country pairs.[28] Finally, the model is solved in differences, and the welfare and price effects are computed.

[26] The original list of banned products is published here: https://ec.europa.eu/food/sites/food/files/safety/docs/ia_eu-russia_ru-eu-import-ban_20140807_decree778-rus.pdf.

[27] We also ran the simulation for a counterfactual situation in which all seven sectors are treated as embargoed. The corresponding results for welfare change only marginally, the counterfactual price change is about twice as large. We choose to report the results of the more conservative selection of embargoed sectors below, the other results are available upon request.

[28] Effectively, the implementation of the model takes those country-pair-sector combinations where $\varepsilon_{ni}^{j} = 0$ and sets the respective trade costs to the (arbitrary) prohibitive level of $\tau_{ni}^{j} = 1000$, which equivalently yields zero trade.

Table 9: Changes in prices of Russian sectors

Sector	Δ Prices in %	Contrib. in %	Sector	Δ Prices in %	Contrib. in %
Other Meat Products	19.82	4.37	Beverages, etc.	0.4	1.05
Vegetables and Fruits	6.27	5.24	Other Crops	0.32	1.12
Diary	5.85	6.53	Chemical Products, etc.	0.31	9.42
Fishing	5.42	0.26	Paper Products, etc.	0.28	0.43
Bovine Meat Products	2.22	4.28	Bovine Cattle, etc	0.28	0.04
Wood Products	0.88	1.35	Other Transport Equipm.	0.19	0.51
Other Food Products	0.87	5.02	Other Mining	0.18	0.63
Oil	0.79	8.95	Other Manufactures	0.17	1.78
Textiles	0.75	4.9	Other Mineral Products	0.13	1.82
Other Animal Products	0.63	0.1	Ferrous Metals	0.08	1.52
Leather Products	0.6	2.55	Other Metals	0.06	0.56
Wearing Apparel	0.58	5.64	Vegetable Oils, etc.	0.05	0.37
Wool, etc.	0.57	0	Oil Seeds	-0.04	0.07
Plant-based Fibres	0.56	0	Gas	-0.09	0.3
Electronic Equipment	0.55	2.09	Forestry	-0.1	0.02
Coal	0.51	0.26	Wheat	-0.1	0.07
Petroleum and Coke	0.5	1.58	Other Cereal Grains	-0.14	0.29
Metal Products	0.45	2.49	Sugar	-0.2	2.2
Motor Vehicles, etc.	0.4	11.65	Rice	-0.24	0.15
Other Machinery, etc.	0.4	10.4			

Notes: Simulated changes in prices within Russian sectors and their contribution to the overall welfare change.

The simulations predict that the welfare of the Russian Federation decreased by approximately 1.84%. This effect is, perhaps unsurprisingly, the most severe compared to those of all sanctioning countries that are included in our analysis. Moreover, the simulations indicate that the price index in Russia increased by 0.33%.[29] Thus, we conclude that the import embargo has been harmful to the country's economy and led to higher average prices for Russian consumers. This result is in line with the findings of Irwin (2005) and O'Rourke (2007) regarding the consequences of the Jefferson embargo in the US.

To compare these simulation results to those from the price data regressions from section 2, we further disaggregate the simulated change in the price index into price effects for the individual sectors (see table 9). Our counterfactual analysis indicates that the prices in all embargoed sectors have risen drastically. The magnitude is highest for "Other Meat Products" (19.82%). This is followed by slightly less stark price increases in the three sectors of "Vegetables and Fruits" (6.27%), "Diary" (5.85%), and "Fishing" (5.42%). The impact on prices of "Bovine Meat Products" is more moderate (2.22%), perhaps not surprising, as this GTAP sector included the lowest percentage of pre-embargo imports of embargoed products (77%).

Overall, these numbers are directly in line with the difference-in-differences estimations

[29]The counterfactual simulation with all seven indicated sector that have at least one embargoed product yields a welfare change of -1.75% and an increase of the price index by 0.8%.

Table 10: Effect of embargo for Russia and large exporters.

Countries	Embargoed	Δ Welfare	Δ Prices
Russia		-1.84	0.33
China	no	-0.67	1.27
Germany	yes	-0.43	0.14
Belarus	no	5.56	8.31
United States	no	-0.29	-0.31
Italy	yes	-0.29	0.14
Japan	no	-0.39	-0.08
France	yes	-0.21	0.31
Poland	yes	-0.78	0.71
United Kingdom	yes	-0.29	-0.11
Netherlands	yes	-0.88	0.26
Turkey	no	-0.79	0.41
Finland	yes	-0.56	0.60

Note: This table reports (in %) simulated post-embargo outcomes in terms of changes in welfare and prices. The countries are ranked in decreasing order of their share in Russian imports.

from section 2 for observed consumer prices. Whereas the average price increase for non-embargoed sectors is 0.27%, the average price increase across all five embargoed sectors is 7.9%: The difference between the two, i.e. $7.9\% - 0.27\% = 7.63\%$, is within the range of estimated coefficients in table 1 of 7% – 8.1%.[30] One should keep in mind that our counterfactual exercise is one of comparative statics. When comparing the two equilibria — with and without embargo — we keep all other things constant, except for the embargo. In the medium to long run other macroeconomic parameters are likely to adapt to the new situation.

We further compute the contribution of individual sectors to the total welfare outcomes of the Russian embargo. These results are reported in table 9. The embargoed sectors contribute to the total outcome in the following shares: "Dairy" 6.53%; "Vegetables and Fruits" 5.24%; "Other Meat Products" 4.37%; and "Bovine Meat Products" 4.28%. A sector that intensively uses inputs from these sectors — "Other Food Products" — contributes 5.02% of the total effect. Note that the sectors of motor vehicles, other machinery and oil are important contributors and are important in the structure of Russian exports.

In table 10, we report the outcomes for countries that are the largest exporters to Russia.[31] The countries in this table are ranked in decreasing order of their share in total Russian imports. The results suggest that most of the large embargoed exporters experienced

[30]Note that including the only marginally affected sectors "Other Food Products" and "Other Animal Products" as embargoed ones raises the simulated average price change for embargoed sectors to 9.25%, slightly above the range of the difference-in-differences results.

[31]We classify an exporting country as "large" if its share in total Russian imports is 2% or more. Thus, 12 of them are large, and in 2013, their total share of Russian imports was 65%.

Table 11: Effect of embargo for small exporters.

Countries	Embargoed	Δ Welfare	Δ Prices
Czech Republic	yes	0.06	1.82
Kazakhstan	no	-2.14	0.75
Spain	yes	-0.33	-0.66
Austria	yes	-0.42	-0.02
Sweden	yes	-0.01	1.16
Slovakia	yes	-0.55	1.43
Switzerland	no	-0.70	0.14
Brazil	no	-0.61	0.17
Hungary	yes	-0.39	0.87
India	no	-0.41	0.06
Estonia	yes	-1.08	1.42
Denmark	yes	-0.51	-0.20
Romania	yes	0.18	1.54
Norway	yes	-0.59	-0.28
Indonesia	no	-1.75	-0.23
Canada	yes	-0.38	-0.10
Slovenia	yes	-0.35	0.82
Ireland	yes	-0.23	-0.04
Australia	yes	-0.71	-0.41
Bulgaria	yes	0.71	2.36
Argentina	no	-0.86	-0.46
Greece	yes	-0.39	-0.95
Portugal	yes	-0.16	0.08
Croatia	yes	-0.36	-0.03
Egypt	no	-2.15	-0.13

Note: This table reports (in %) simulated post-embargo outcomes in terms of changes in welfare and prices. The countries are ranked in decreasing order of their share in Russian imports.

minor losses, much smaller than those of Russia.

The large increase in the welfare of Belarus (5.56%) deserves particular discussion. Anecdotal evidence has repeatedly come to light that some embargoed food items that were initially imported to Belarus were then relabeled and re-exported to Russia.[32] Belarus participates in the Eurasian Customs Union, together with Russia, Armenia, Kazakhstan and Kyrgyzstan. The quasi-absence of trade barriers between Belarus and Russia could substantially facilitate trade diversion during the embargo.

In table 11, we report the outcomes for countries that are "small" exporters to Russia. All of the negative welfare effects for small *embargoed* exporters are close to zero, which could

[32] See e.g. https://www.reuters.com/article/ukraine-crisis-russia-traders/belarussian-oysters-anyone-eu-food-trade-looks-to-sidestep-russian-ban-idUSL2N0QI1XL20140817, https://www.dairyreporter.com/Article/2014/10/08/Russia-importing-Belarus-dairy-products-made-with-EU-milk-DairyInfa and https://www.rbth.com/business/2014/10/28/how_does_salmon_from_norway_find_its_way_into_russia_40945.html.

be interpreted as a sign of ineffectiveness of the embargo as a policy tool. Some embargoed Eastern European countries (Bulgaria, the Czech Republic, Romania) are estimated to have experienced *positive* welfare outcomes. These countries most likely profited from the diversion of export flows, which were previously directed to Russia. Two factors favor this explanation. First, the relatively short distance between the Eastern European countries and the Russian border imply trade costs that are similar to those with Russia. Second, the structure of these countries' food imports resembles that of Russia.

One should also note that the reliability of the data in the input-output tables might be heterogeneous across countries. For instance, Timmer et al. (2015) note that the official input-output tables for some countries account for the net value added of processing trade flows, whereas for other countries, gross trade flows are reported. Thus, it is possible that the discrepancies in the results of the simulations, in particular for those "small" exporters, might be attributed to this "noise" in the input-output tables.

On important exercise to validate our findings and conclusions regarding the indirect impact of the embargo through input-output linkages is to demonstrate how the model without input-output linkages predicts the outcomes of the embargo. While maintaining all other assumptions of the model, we replicate the simulations in the same steps as above. The corresponding results are reported in Appendix D in table 17. We observe that relaxing the crucial assumption of the model leads to completely different predicted welfare outcomes for most countries. In this specification, the welfare outcomes for most countries are only marginally different from zero. We conclude that the intersectoral linkages are an important transmission mechanism of embargoes.

5 Conclusion

In August 2014, the Russian government implemented an embargo on certain food and agricultural imports from Western countries. This paper assesses the effect of the embargo on welfare and consumer prices in the Russian Federation. We provide evidence of the direct impact of the embargo on prices of affected food products and an indirect impact on linked sectors. Employing a difference-in-differences framework, we find that the embargo's net effect on the consumer prices of embargoed products was an increase of at least 2.6% relative to other (non-embargoed) food products and up to 8.1% relative to non-food items. The maximum effect of 7.7% – 14.9% relative to non-embargoed food products and non-food products was observed in early 2015 and then decreased in subsequent months.

To disentangle the observed effects and account for transmission mechanisms throughout the Russian economy, we employ a Ricardian trade model that exhibits intersectoral linkages, and allows for non-tradability of *some* goods across *some* country pairs. Our

simulations suggest that Russia faced a decrease in welfare of 1.84%. Domestic prices are simulated to have risen by on average 0.33%, with non-embargoed sectors seeing price increases by on average 0.27% and embargoed sectors by 7.9%. This result is in line with the empirical results as well as with the related literature, which predicts that the introduction of such bilateral frictions to international trade should entail a surge in domestic prices. The analysis allows us to conclude that the trade embargo imposed by the Russian government has been detrimental to the welfare of Russian consumers.

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A List of products embargoed by Russian Federation

Table 12: Mapping of embargoed HS codes to GTAP classification and Rosstat Price data

HS code	GTAP sector	HS description	Linked consumer products (English translation)
0201	Bovine Meat Products	Meat of bovine animals, fresh or chilled	Meat of bovine animals fresh, cooled down, chilled; Beef (except for boneless meat), kg; Beef boneless, kg; Beef offal other than; Beef, including offal; Beef, except offal
0202	Bovine Meat Products	Meat of bovine animals, frozen	Beef (except for boneless meat), kg; Beef boneless, kg; Beef offal other than; Beef, including offal; Beef, except offal; Meat cattle frostbitten, frozen, deep frozen and defrosted
0203	Other Meat Products	Meat of swine, fresh, chilled or frozen	Pork (except for boneless meat), kg; Boneless Pork kg; Pork steam, cooled down, chilled; Pork frostbitten, frozen, deep-frozen and thawed; pork Offal
0207	Other Meat Products	Meat and edible offal, fresh, chilled or frozen	Poultry; Meat and edible offal of poultry; Meat fresh, cooled down, chilled edible offal and poultry; Meat frostbitten, frozen, deep-frozen and defrosted food and offal of poultry; By-products of poultry food; By-products of poultry food frostbitten, frozen, deep frozen and defrosted; By-products of poultry, fresh or chilled food; Chickens chilled and frozen, kg
0210*	Other Meat Products	Meat and edible offal, salted, in brine, dried or smoked	Products (semi-finished) bulk salted; Products bulk; Products cured bulk; Meat and meat offal of food, salted, in brine, dried or smoked; food meal of meat or meat offal; Pork meat, including offal; Pork other than offal
0301*	Fishing	Live fish	live fish; Live fish, fresh or chilled; Fish and fish products are processed (excluding canned fish), t
0302	Fishing	Fish, fresh or chilled	Live fish, fresh or chilled; Fish and fish products are processed (excluding canned fish), t; Fish, fresh or chilled; Fish chilled and frozen salmon in split, kg
0303	Other Food	Fish, frozen	Fish and fish products are processed (excluding canned fish), t; Fish, fresh or chilled; Fish chilled and frozen salmon in split, kg; Fish, frozen, not cleaned, kg; Fish (except herring), frozen; Fish (except herring), frozen, livers and roes Frozen Fish; Split frozen fish (except salmon), kg; frozen herring
0304	Other Food	Fish fillets and other fish meat, etc	Fish fillets, kg; Minced Fish, fresh or chilled; Fish fillets cream; Fish fillets, fresh or chilled; Fish fillets, other fish meat, livers and roes of fish, fresh or chilled; Fish meat (including beef), fresh or chilled Other; Herring salted, kg; Fish meat (including beef), ice cream etc.

HS code	GTAP sector	HS description	Linked consumer products (English translation)
0305	Other Food	Fish, dried, salted, smoked or in brine	Fish, salted, pickled, smoked, kg; Fish (except herring), smoked; Fish (except herring), smoked; Fish (except herring) pickled; Fish (except herring) salted; Fish (except herring) salt; Fish (except herring) cured; For semi-smoked fish (except herring); Fish salted, salmon; The fish special salted (except herring); Fish, dried; Fish, dried, and dried; Cold smoked fish (except herring); Herring all processes; Herring pickled; Herring salted; Herring cured; Products Cold smoked (without herring) bulk; Products made of herring, bulk; Herring for semi-smoked and hot; Herring cold smoked; Fish, dried; Herring salted, kg
0306	Fishing	Crustaceans, etc.	Crustaceans frozen; Crustaceans, not frozen; Crustaceans, not frozen; oysters; Other aquatic invertebrates, live, fresh or chilled; Molluscs and other aquatic invertebrates, frozen, dried, salted or in brine; Molluscs, crustaceans and aquatic invertebrates, live, fresh or chilled Other
0307	Fishing	Molluscs, etc.	Crustaceans, not frozen; oysters; Other aquatic invertebrates, live, fresh or chilled; Molluscs and other aquatic invertebrates, frozen, dried, salted or in brine; Molluscs, crustaceans and aquatic invertebrates, live, fresh or chilled Other; oysters
0308	Fishing	Other aquatic invertebrates	Crustaceans, not frozen; oysters; Other aquatic invertebrates, live, fresh or chilled; Molluscs, crustaceans and aquatic invertebrates, live, fresh or chilled Other
0401*	Dairy	Milk and cream	Liquid milk processed; Raw milk cattle; Drinking milk, t; Cream; fermented milk products,; Fermented milk products, heat-treated fermented products; Drinking milk, pasteurized 2.5-3.2% fat l; Drinking milk, sterilized 2.5-3.2% fat l
0402*	Dairy	Milk and cream, concentrated or containing sweetening matter	Cream; fermented milk products,; Fermented milk products, heat-treated fermented products; Condensed milk; Condensed milk with sugar, 400 g; Fermented milk products (varieties of sour cream); Dry, granular and other particulate forms than curd; Fermented milk products, other, including fortified; Condensed milk products; Condensed milk products with food and food additives; condensed cream; Milk powder, granular or other solid forms with a fat content of not more than 1.5%; Milk powder, kg; Powdered milk, t; Cream dry granular or other solid forms; Milk powder, granular or other solid forms with a fat content of 2.0% to 18.0%; Milk powder, granular or other solid forms, with a fat content of 20.0%; Canned milk, ths. Conv. cans; Milk powder, granular or other solid forms etc.; Milk and cream in solid forms

HS code	GTAP sector	HS description	Linked consumer products (English translation)
0403*	Dairy	Buttermilk, yogurt and other fermented milk and cream	fermented milk products,; Fermented milk products, heat-treated fermented products; Types of milk or cream, or fermented sour, not included in other categories, other; Sour, including Mechnikovsky curdled milk; Soured cream.; Sour cream with fat content more than 35.0%; Sour cream with a fat content of 10.0% to 14.0%; Sour cream with a fat content of 15.0% to 34.0%; Yogurt; Yogurt without food and food additives; Yogurt and other kinds of milk or cream, fermented or acidified; Yogurt, 125 g; Kefir; Dairy products, kg; Kefir without food and food additives; Sour cream, kg; Ryazhenka
0404*	Dairy	Whey ; products consisting of natural milk constituents	fermented milk products,; Fermented milk products, heat-treated fermented products; Serum
0405*	Dairy	Butter and fats derived from milk; dairy spreads	Butter and oily paste; Butter; Butter, cream and sour cream with fat content from 50% to 79%; Butter, cream and sour cream with fat content from 80% to 85%; Butter, cream cheese; Butter sweet butter with a mass fraction of fat from 50% to 79%; Butter sweet butter with fat content from 80% to 85%; Sterilized with butter fat content from 50% to 79%; Butter sterilized with fat content from 80% to 85%; Butter, kg; heating oil
0406*	Dairy	Cheese and curd	fermented milk products,; Fermented milk products, heat-treated fermented products; Cheese, t; cheese Products; cheese products; Cheese and curd; smoked Cheese; soft cheese; Blue cheese; fresh Cheese; Cheese superhard; Cheese slime; Hard cheese; Cheese and cheese products; Cottage cheese; Grainy cottage cheese; National cheese and feta cheese, kg; Cheese brine; Cottage cheese fat, kg; Low-fat cottage cheese, kg; Curd cheese, glazed with chocolate 50g; Cheeses grated cheeses and powdered; Cheese, kg; cheese; Cheese rennet hard and soft, kg; Cheese semisolid; other Cheeses; mature Cheese
0701*	Vegetables and Fruits	Potatoes, fresh or chilled	Potatoes, kg; Unprocessed vegetables and potatoes
0702	Vegetables and Fruits	Tomatoes, fresh or chilled	Unprocessed vegetables and potatoes; Fresh Tomatoes, kg; Tomatoes (tomatoes); tomatoes (tomatoes) closed ground; tomatoes (tomatoes) of open ground
0703*	Vegetables and Fruits	Onions, leeks and other alliaceous vegetables, fresh or chilled	Unprocessed vegetables and potatoes; Bulb onions; Onions, kg; Garlic
0704	Vegetables and Fruits	Cabbages and similar edible brassicas, fresh or chilled	Unprocessed vegetables and potatoes; Cabbage
0705	Vegetables and Fruits	Lettuce and chicory , fresh or chilled	Unprocessed vegetables and potatoes
0706	Vegetables and Fruits	Carrots and similar edible roots, fresh or chilled	Unprocessed vegetables and potatoes; Carrot dining; Carrots, kg; Beets and carrots Dinner

HS code	GTAP sector	HS description	Linked consumer products (English translation)
0707	Vegetables and Fruits	Cucumbers and gherkins, fresh or chilled	Unprocessed vegetables and potatoes; cucumbers; cucumber greenhouses; cucumbers open ground; Fresh cucumbers, kg
0708	Vegetables and Fruits	Leguminous vegetables, fresh or chilled	Unprocessed vegetables and potatoes
0709	Vegetables and Fruits	Other vegetables, fresh or chilled	Unprocessed vegetables and potatoes; Vegetables, fresh or chilled, not included in other categories
0710	Other Food	Vegetables, frozen	Unprocessed vegetables and potatoes; Frozen vegetables, kg; Vegetables and Mushrooms frozen; Frozen vegetables, not included in other categories
0711	Other Food	Vegetables provisionally preserved	
0712*	Other Food	Dried vegetables, whole, cut, sliced, broken or in powder	Dried Vegetables and Mushrooms
0713*	Vegetables and Fruits	Dried leguminous vegetables, shelled	Dried Vegetables and Mushrooms
0714	Vegetables and Fruits	Manioc, arrowroot and similar roots	
0801	Vegetables and Fruits	Coconuts, Brazil nuts and cashew nuts	Nuts, kg; Unprocessed fruits, except citrus, t
0802	Vegetables and Fruits	Other nuts, fresh or dried	Nuts, kg; Unprocessed fruits, except citrus, t
0803	Vegetables and Fruits	Bananas, including plantains, fresh or dried	Unprocessed fruits, except citrus, t; Bananas, kg
0804	Vegetables and Fruits	Dates, figs, pineapples, avocados, guavas, mangoes	Unprocessed fruits, except citrus, t
0805	Vegetables and Fruits	Citrus fruit, fresh or dried	Oranges, kg; Lemons, kg
0806	Vegetables and Fruits	Grapes, fresh or dried	Unprocessed fruits, except citrus, t; grapes; Grapes, kg
0807	Vegetables and Fruits	Melons (including watermelons) and papaws (papayas), fresh	Unprocessed fruits, except citrus, t; Culture melons food
0808	Vegetables and Fruits	Apples, pears and quinces, fresh	Unprocessed fruits, except citrus, t; The fruits of pome crops; The fruits of pome, stone and berry crops; Apples kg; Pears, kg
0809	Vegetables and Fruits	Apricots, cherries, peaches, plums and sloes, fresh	Unprocessed fruits, except citrus, t; Fruits stone fruits
0810	Vegetables and Fruits	Other fruit, fresh	Unprocessed fruits, except citrus, t; The fruit and berry crops
0811	Other Food	Fruit and nuts, frozen	Fruits and berries (fresh or pre-cooked), frozen
0813	Vegetables and Fruits	Fruit and nuts, provisionally preserved	Fruits, berries and nuts dried; Fruits, berries and nuts, dried, other except bananas

HS code	GTAP sector	HS description	Linked consumer products (English translation)
1601	Other Meat Products	Sausages and similar products, of meat, meat offal or blood	sausage; Smoked sausage, kg; Sausage, t; Cooked sausage I grade, kg; Cooked sausage premium, kg; Cooked sausage, kg; Sausage semi-smoked and cooked-smoked, kg; Sausages, small kg
1901*	Other Food	Malt extract; food preparations of flour, groats, meal, starch or malt extract, etc.	
2106*	Other Food	Food preparations not elsewhere specified or included	

* HS4 code for which sanctions do not apply to some subheadings or for which the rules changed after August 2014.

B Additional regression results

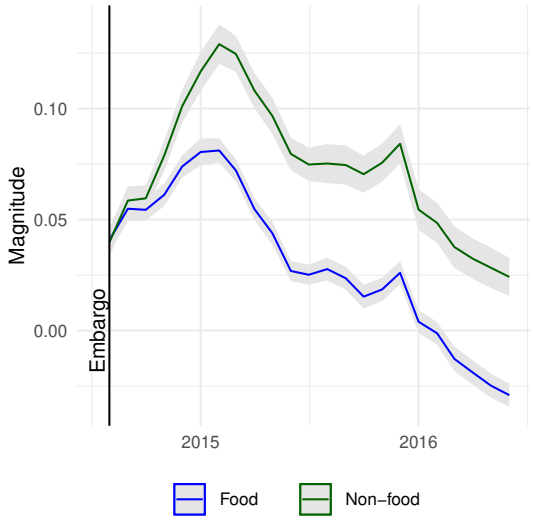

Figure 6: Subject-level monthly coefficient of interest

Table 13: Decomposition: Interaction with distance to Europe

	Dependent variable: log(prices)			
	(1)	(2)	(3)	(4)
Sanction period × Embargoed product	0.066***	0.114***	0.085***	0.144***
	(0.016)	(0.042)	(0.016)	(0.028)
— × Distance to Europe	−0.006**	−0.005	−0.008***	−0.009**
	(0.002)	(0.005)	(0.002)	(0.004)
Spatial agg.	district	district	subject	subject
Control group	F	NF	F	NF
Observations	40,104	274,013	424,604	1,137,206
Adjusted R^2	0.991	0.998	0.989	0.997

Notes: F stands for (non-embargoed) food products and NF stands for non-food items. All regression include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

Table 14: Upstreamness of sectors in European Union

Sector	Upstreamness	Sector	Upstreamness
Private Households with Employed Persons	1.02	Computer & Related Activities	2.54
Public Admin. & Defence; Social Security	1.10	Finance & Insurance	2.54
Health & Social Work	1.11	Land Transport; Transport via Pipelines	2.59
Education	1.22	Electricity	2.59
Hotels & Restaurants	1.38	Research & Development	2.67
Real Estate Activities	1.59	Water Transport	2.74
Construction	1.60	Coke, Refined Petroleum and Nuclear Fuel	2.75
Food Products, Beverages and Tobacco	1.73	Chemicals Excluding Pharmaceuticals	2.79
Textiles, Textile Products, Leather and Footwear	1.77	Other Non-metallic Mineral Products	2.81
Manufacturing and Recycling (include Furniture)	1.85	Pulp, Paper Products and Publishing	2.83
Other Community, Social & Personal Services	1.86	Metal Products, Except Machinery	2.85
Office, Accounting & Computing Machinery	1.87	Renting of Machinery & Equipment	2.96
Motor Vehicles, Trailers & Semi-Trailers	1.89	Rubber & Plastics Products	2.96
Wholesale & Retail Trade; Repairs	1.91	Wood and Products of Wood and Cork	2.97
Machinery & Equipment,	2.06	Auxiliary Transport and Travel Activities	3.0
Building & Repairing of Ships & Boats	2.09	Other Business Activities	3.12
Air Transport	2.29	Mining and Quarrying (Energy)	3.63
Agriculture, Hunting, Forestry and Fishing	2.34	Mining and Quarrying (Non-Energy)	3.63
Electrical Machinery & Apparatus	2.40	Iron & Steel	3.68
Post & Telecommunications	2.53		

Notes: This table reports computed upstreamness of sectors across European countries.

Table 15: Use of foreign inputs from embargoed sectors in Russian production

Sector	Vegetables and Fruits	Other Meat Products	Bovine Meat Products	Dairy	Fishing
Wheat	2.08	0.00	0.00	0.00	0.00
Other Cereal Grains	5.31	0.00	0.00	0.00	0.01
Vegetables and Fruits	6.87	0.00	0.00	0.00	0.00
Oil Seeds	2.41	0.00	0.00	0.00	0.00
Plant-based Fibres	0.00	0.00	0.00	0.00	0.00
Other Crops	0.36	0.00	0.00	0.00	0.00
Bovine Cattle, etc	74.90	0.02	0.23	0.26	0.01
Other Animal Products	74.76	0.02	0.19	0.20	0.06
Raw Milk	48.02	0.01	0.12	0.13	0.00
Wool, etc.	49.13	0.01	0.11	0.13	0.03
Forestry	0.00	0.01	0.06	0.03	0.00
Fishing	0.63	0.06	0.19	0.13	34.33
Coal	0.00	0.01	0.02	0.00	0.01
Oil	0.01	0.00	0.00	0.02	0.00
Gas	0.00	0.00	0.00	0.00	0.00
Other Mining	0.00	0.01	0.01	0.00	0.01
Bovine Meat Products	0.68	0.11	57.72	0.49	0.11
Other Meat Products	40.82	23.30	0.20	0.31	0.53
Vegetable Oils, etc.	0.63	0.01	1.36	0.76	0.01
Diary	10.48	0.01	0.09	39.63	0.00
Rice	36.77	0.00	0.11	0.26	0.00
Sugar	45.08	0.01	0.04	0.06	0.00
Other Food products	13.42	0.00	0.26	0.66	0.26
Beverages, etc.	0.10	0.00	0.14	0.10	0.02
Textiles	0.00	0.00	0.00	0.00	0.00
Wearing Apparel	0.13	0.01	0.00	0.00	0.03
Leather Products	0.74	0.61	0.01	0.00	0.13
Wood Products	0.00	0.01	0.00	0.00	0.00
Paper Products, etc.	0.00	0.01	0.02	0.00	0.00
Petroleum and Coke	0.02	0.00	0.00	0.00	0.00
Chemical Products, etc.	0.10	0.01	0.03	0.03	0.02
Other Mineral Products	0.00	0.00	0.01	0.00	0.00
Ferrous Metals	0.00	0.00	0.00	0.00	0.00
Other Metals	0.00	0.00	0.00	0.00	0.00
Metal Products	0.05	0.01	0.02	0.03	0.00
Motor Vehicles, etc.	0.00	0.00	0.00	0.00	0.00
Other Transport Equipment	0.00	0.01	0.03	0.00	0.00
Electronic Equipment	0.00	0.01	0.00	0.02	0.05

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Table 15 – continued from previous page

Sector	Vegetables and Fruits	Other Meat Products	Bovine Meat Products	Dairy	Fishing
Other Machinery, etc.	0.00	0.00	0.01	0.00	0.03
Other Manufactures	0.00	0.01	0.02	0.00	0.07

Note: This table reports use of inputs from embargoed sectors (in %) in the production of Russian sectors. Columns are the source sectors and rows are the destination sectors. The data is sourced from GTAP input-output tables.

D Counterfactual simulations

Decomposition of welfare change

The welfare of a representative consumer in country d is given as $W_d = I_d/P_d$. Similar to Caliendo and Parro (2015) this can be decomposed into a "terms of trade" and "volume of trade" effect:

$$d\ln W_d = \frac{1}{I_d}\sum_{j=1}^{J}\sum_{o=1}^{N}\varepsilon_{od}^{j}(E_{od}^{j}d\ln c_d^j - M_{od}^{j}d\ln c_o^j) + \frac{1}{I_d}\sum_{j=1}^{J}\sum_{o=1}^{O}\varepsilon_{od}^{j}\tau_{od}^{j}M_{od}^{j}(d\ln M_{od}^{j} - d\ln c_o^j)$$

Further simulation results

Table 16: Tradable sectors

Sector	Elasticity	Sector	Elasticity
Oil	15.37	Beverages, etc.	2.93
Gas	15.37	Textiles	2.90
Wheat	12.37	Wool, etc.	2.89
Fishing	12	Oil Seeds	2.89
Petroleum and Coke	8.5	Metal Products	2.79
Dairy	5.60	Other Food Products	2.78
Wearing Apparel	5.31	Paper Products, etc.	2.73
Vegetable Oils, etc.	4.98	Bovine Cattle, etc.	2.58
Rice	4.87	Other Crops	2.54
Bovine Meat Products	4.39	Sugar	2.52
Other Metals	4.38	Electronic Equipment	2.49
Leather Products	4.11	Other Mineral Products	2.47
Coal	3.77	Chemical Products, etc.	2.37
Other Mining	3.77	Other Machinery, etc.	2.37
Other Manufactures	3.52	Plant-based Fibres	2.33
Other Cereal Grains	3.29	Forestry	2.33
Other Meat Products	3.14	Wood Products	2.29
Motor Vehicles, etc.	3.13	Vegetables and Fruits	2.19
Ferrous Metals	3.01	Other Animal Products	2.12
Other Transport Equipment	2.99		

Notes: Table reports list of all tradable sectors in the data.

Table 17: Simulations of the model without input-output linkages

Sanctioning countries	Δ Welfare	Non-sanctioning countries	Δ Welfare
Romania	0.005	Russia	-0.016
Croatia	0.004	Belarus	0.464
United Kingdom	0.004	Egypt	0.021
Australia	0.002	Brazil	0.014
Sweden	0.001	Argentina	0.013
Austria	0.000	Turkey	0.013
Slovenia	0.000	Indonesia	0.006
United States	-0.001	Switzerland	0.001
Portugal	-0.001	India	0
Canada	-0.002	China	-0.001
France	-0.003	Japan	-0.001
Italy	-0.004	Kazakhstan	-0.012
Germany	-0.004		
Czech Republic	-0.006		
Ireland	-0.007		
Spain	-0.009		
Norway	-0.010		
Greece	-0.017		
Slovakia	-0.021		
Denmark	-0.026		
Hungary	-0.026		
Netherlands	-0.030		
Bulgaria	-0.031		
Finland	-0.035		
Poland	-0.062		
Estonia	-0.131		

Note: This table reports (in %) simulated post-embargo outcomes in terms of changes in welfare and prices. In this version of the model, it is assumed that the input-output linkages don't exist.