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

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# ABSTRACT

# BEARING THE COST OF POLITICS: CONSUMER PRICES AND WELFARE IN RUSSIA*

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In August 2014, the Russian Federation implemented an embargo on select food and agricultural imports from Western countries in response to the economic sanctions. The measure was designed to harm producers in United States, European Union, Norway, Ukraine, along other Western countries. In this study we quantify the effect of the embargo for welfare and consumer prices in Russia. We first provide evidence for the direct effect on consumer prices with a difference-in-differences approach with a highly detailed monthly dataset of consumer prices in Russia between 2011-2016. The results suggest that the embargo caused consumer prices of embargoed goods to rise in the short run by 8.9% - 12.6%. Regions of Russia with previously above-average levels of food imports from sanctioned countries experienced a stronger impact. In the medium run the effect reduces to 1.2% - 6.3%. The results also indicate that the policy shock has been transmitted to non-embargoed sectors by means of domestic inputoutput production linkages. We then use a Ricardian model of trade with domestic sectoral linkages, trade in intermediate goods and sectoral heterogeneity in production to perform counterfactual simulations, isolate the direct and indirect price effects, and compute welfare measures for a situation without embargo. Our simulations suggest that the self-imposed embargo caused a decline in Russian welfare by 1.88% and an increase in the overall price index by 0.19%.

**Keywords:** Trade policy, Embargo, Consumer prices, Sectoral linkages

**JEL classification:** F10, F13, F14, F51

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# 1 Introduction

In the spring and summer of 2014, political tensions between the Russian Federation and Western countries cooled dramatically, following an escalation of the crises in eastern Ukraine and Crimea. Seeking to influence the political stance of 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, with the declared objective of harming foreign food producers. This trade restriction includes 48 food and agricultural 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.

This paper quantifies the effects of the self-imposed food embargo on consumer prices and welfare in Russia. We first provide empirical evidence for price hikes caused by the embargo. We then build on a trade model with sectoral linkages and intermediate goods to account for indirect effects on other, directly unaffected sectors. The quantification exercise shows significant adverse price and welfare effects for Russian consumers.

Despite sparse evidence for their effectiveness, embargoes and sanctions have been popular instruments of political pressure (Drezner, 1999). In most cases, one or more countries implement such measures against another country. However, in rare cases, a country may also decide to forbid its own people from trading with others: 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 computable general equilibrium (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.

This study contributes to the literature on sanctions and embargoes, which has seen renewed interest in light of recent political events. Etkes and Zimring (2015) investigate the welfare outcomes of the 2007-2010 Gaza blockade. Their counterfactual exercise reveals welfare loses 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 no link between financial sanctions and cross-border capital flows.

Recent contributions in one strand of this literature have focused on the sanctions against Russia. Dreger et al. (2015) 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 (2016), on the other hand, estimate the effect of sanctions on the exports of the *sanctioning* countries. They find significant "friendly fire" for affected firms, particularly those affected by the Russian embargo on food and agricultural products, as the firms were able to recoup only a fraction of the lost exports in other markets via trade diversion. Finally, closely related to this study, Boulanger et al. (2016), simulate the short-run impact of the Russian food embargo on the Russian and European economies. 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.

This paper is also related to a flourishing strand of the literature that quantifies the welfare consequences of trade policy.[1] In the a recent contribution, Dhingra et al. (2017) estimate the welfare effects of Brexit in the medium to long run with a number of counterfactuals. Mayer et al. (2018) estimate potential welfare losses for EU member states from no longer being part of the EU. All of these papers employ input-output data to calibrate general equilibrium models.

The focus of this study is to investigate the effects of sanctions and embargoes on consumers in the affected economy. We estimate the outcomes of an embargo by Russia in terms of changes in consumer prices and the aggregate effect on consumer welfare. We first 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

[1] See, e.g., Costinot and Rodriguez-Clare (2014) summarizing recent research on the outcomes of globalization.

analysis shows that the self-imposed embargo lead to an average increase in the prices of embargoed products of at least 2.7%, relative to non-embargoed products. We further examine the channels of trade divergence and product substitution using customs and domestic production data, respectively. Furthermore, 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.[2] Goods may be either tradable, non-tradable, or *embargoed*, which implies non-tradability across *some* country-pairs.

We calibrate the model with data on the production and usage of intermediate inputs in 42 countries from 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 bilateral trade flows is sourced from the BACI dataset provided by CEPII. 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 embargoed countries to Russia, i.e. making them *non-tradable* across these country pairs. We compute the welfare effects by following the so-called "exact hat algebra" approach of Dekle et al. (2008). Our simulations suggest that Russia experienced a welfare loss of 1.88% due to this self-imposed embargo. Furthermore, overall average prices in Russia are estimated to have increased by 0.19%, and those for embargoed goods by up to 9.1 %.

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 self-imposed embargo. In section 3 we then build on a standard trade model with sectoral linkages, trade in intermediate goods and sectoral heterogeneity in production that distinguished 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] In this regard, the present study represents a methodological advance relative to the closely related paper by Boulanger et al. (2016). They model the Russian import ban within a CGE framework as a loss in existing trade preferences, leading to a reduction in consumer utility. In our research, we allow for the realistic input-output structure of modern economies.

## 2 Consumer prices in Russia

The Russian food embargo is a trade-restricting policy that has the concrete political objective of influencing the countries imposing sanctions on Russia. This paper does not discuss the political aspects of this measure but addresses the economic outcomes. The embargo represents an abrupt exogenous trade shock and could be seen as a quasi-natural experiment. The embargo targeted a variety of everyday products, ranging from meat and fish products to vegetables. Table A1 in 5 shows the list of goods, including our mapping to the targeted HS codes. In this section, we first document the direct effects of the self-imposed embargo on the final prices paid by Russian consumers.

The dataset we employ records average monthly prices between January 2011 and May 2016 for consumer goods and services. It is constructed by Russian Federal State Statistics Service, also known as Rosstat.[3] The list of prices includes 128 food products, 332 non-food products and 127 services. Each of them accounts for at least 0.1% of aggregate consumer expenditures in Russia.[4] 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.[5] In total, there are 3,547,171 observations at the city level. At the intermediate (regional) level of aggregation, 87 subjects of the federation, prices are calculated as the population-weighted averages of the prices of the corresponding products at the city level. There are 1,510,280 product-month-subject observations. At the highest level of aggregation, 9 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.[6] In total, there are 143,682 observations at the level of federal districts.

Our first aim is to visualize the patterns of the prices of embargoed and non-embargoed goods. To do so, in Fig. 1, we plot a simple average of the prices of embargoed and non-embargoed (both food and non-food) products over time. The prices of both types

[3]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.

[4]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.

[5]The cities are selected according to the following criteria: (1) in each region, 2–4 cities are chosen to account for spatial variations; (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 selected cities.

[6]The dataset has average prices for 8 districts until 2015, when it also started recording the data for a Crimean Federal District. We restrict our analysis to the 8 previous federal districts.

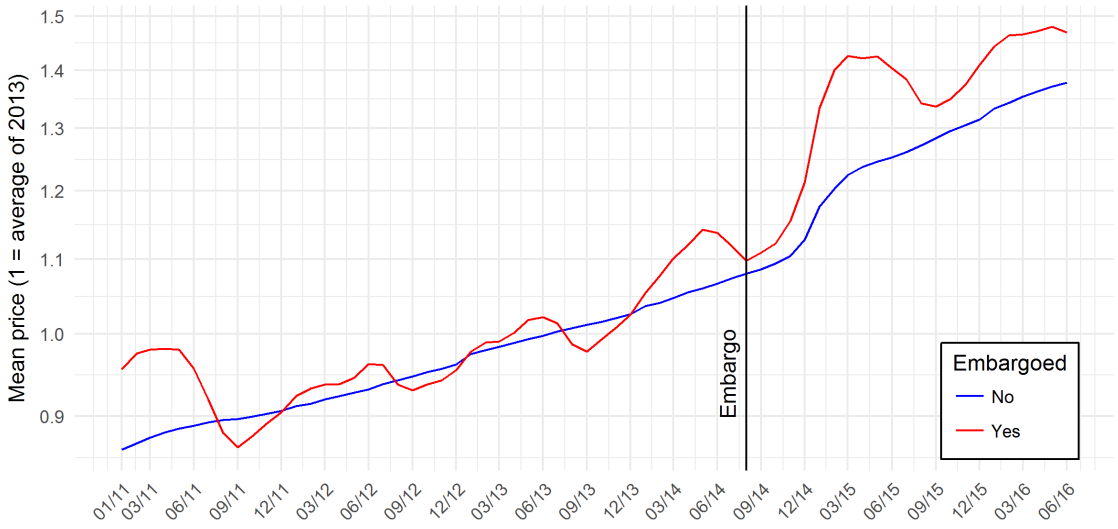



**Figure 1:** Evolution of average prices of embargoed and non-embargoed products.

of products increase throughout the period of interest, and there is also clear seasonality in food prices. An abrupt shock affecting the prices of embargoed goods can be observed following the introduction of the embargo in August 2014.

To underline the difference in the shock for embargoed and non-embargoed goods in figure 1, we perform a simple difference-in-difference analysis inspired by these initial visual explorations of the data.[7] The control and treatment groups are well defined: specific products, as described above, can be directly mapped to HS codes that have been banned from being imported from certain countries. We first estimate the following specification:

$$\begin{aligned}\log(\text{price}_{irt}) = \alpha_0 + \alpha_1 \text{Product}_i + \alpha_2 \text{Period}_t + \alpha_3 \text{Product}_i \times \text{Period}_t \\ + FE_{rt} + FE_{irm} + \varepsilon_{irt}\end{aligned} \tag{1}$$

where $\text{price}_{it}$ is the price of a product $i$ at time $t$, $\text{Product}_i$ a dummy variable that indicates a treated product and $\text{Period}_t$ that indicates the treatment period. The interaction of the two therefore captures the coefficient of interest. We control for structural regional variations as well as seasonality, as indicated in figure 1 by including region $\times$ date and region $\times$ product $\times$ month fixed effects, where region is district, subject of the federation or a city. Note that the inclusion of region $\times$ product $\times$ month fixed effects allows us to account for fluctuations in the ruble exchange rate. The sensitivity of consumer prices to the shock to the exchange rate is expected to vary across regions, with respect to the share

[7] 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 prices by spatial aggregation and control group.

| | *Dependent variable:* | | | | | |
|---|---|---|---|---|---|---|
| | log(prices) | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Sanction period | 0.027*** | 0.065*** | 0.030*** | 0.067*** | 0.028*** | 0.069*** |
| × Embargoed product | (0.004) | (0.007) | (0.002) | (0.003) | (0.002) | (0.002) |
| Spatial agg. | district | district | subject | subject | city | city |
| Control group | F | F+NF | F | F+NF | F | F+NF |
| Number treated | 16572 | 16572 | 174611 | 174611 | 456446 | 456446 |
| Observations | 42,884 | 140,670 | 453,164 | 1,477,892 | 1,117,395 | 3,460,386 |
| Adjusted $R^2$ | 0.991 | 0.998 | 0.988 | 0.997 | 0.987 | 0.995 |

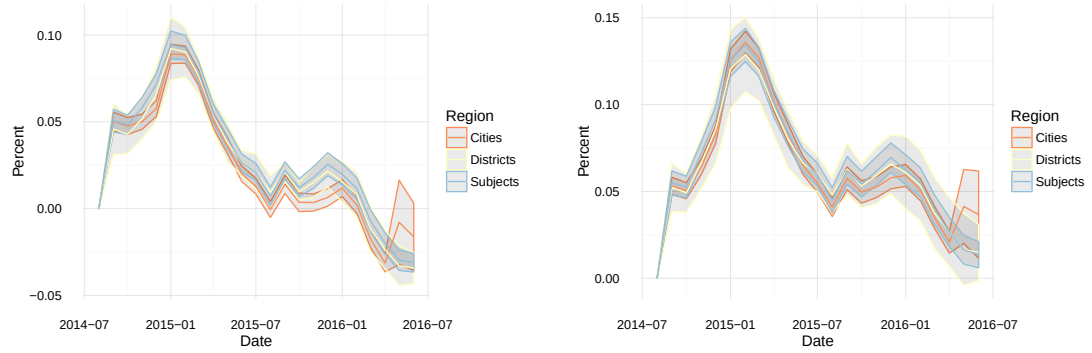
Notes: F stands for non-targeted food products and NF stands for non-food items. All regression include region × date and region × product × month fixed effects. Robust standard errors in parentheses are clustered by region. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

of imported goods in a region's consumption.

Table 1 displays the results for our benchmark regression. Across all different 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. Columns (1) and (2) report the coefficient for the diff-in-diff estimation at the the district level (there are 8 districts in total). Columns (3) and (4) report those for the estimation at the subject level (87 subjects of the federation) and (5) and (6) at the least aggregated city level (279 cities). For each, we alternate between control groups: either only other non-embargoed food products, denoted by (F), in columns (1), (3) and (5), or we additionally include non-food products, denoted (NF), in columns (2), (4) and (6).

The results of the diff-in-diff estimation with non-embargoed food items as the control group are the principal results of our empirical analysis. In fact, the group of food products is generally more homogeneous than all non-food items taken together. We conclude that the prices of embargoed food products grew on average by about 3% following the onset of the embargo. We note that this result is systematically lower than that from the diff-in-diff estimate that includes non-food products in the control group (about 7%). Thus, one could hypothesize that other non-embargoed food prices also increased relative to non-food prices.

We further explore how the impact of the shock to consumer prices varies over time. We plot monthly post-embargo coefficients in figure 2a (food control group) and 2b (food and non-food control group). For both plots, the effect is clearly steadily increasing until January 2015 and then decreasing in intensity, irrespective of the level of spatial aggregation. The difference with respect to the control group considered is also clear: While the coefficient drops almost entirely back to zero for the food control group one year after the beginning of the embargo, i.e., August 2015, embargoed food prices remain




(a) Food products as control group

(b) Food and non-food products as control group

**Figure 2:** Monthly coefficients for diff-in-diff estimates with other food items as the control group (a) and food and non-food items as the control group (b). 95% confidence intervals are shaded in grey.

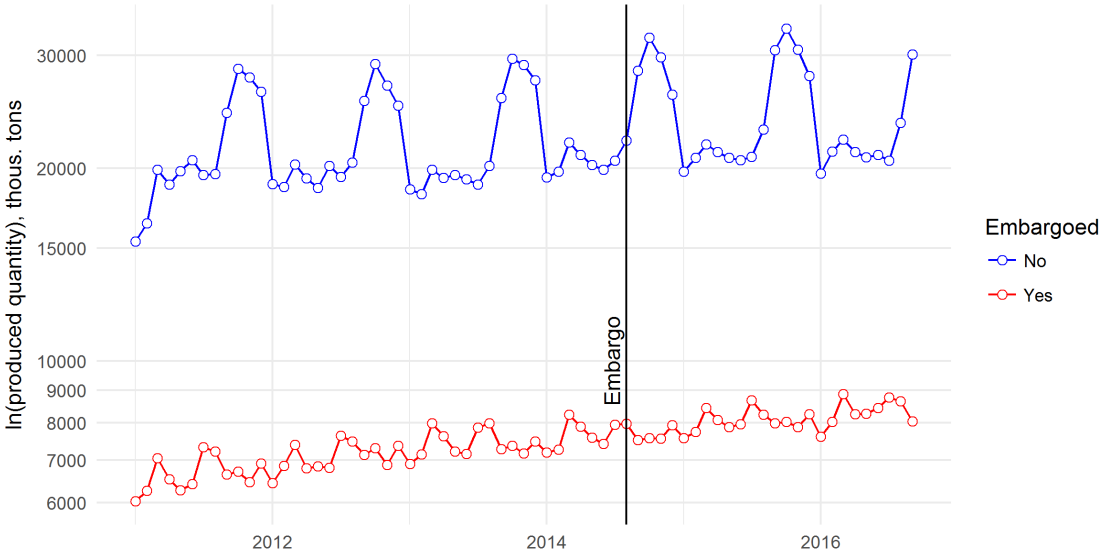



**Figure 3:** Evolution of aggregate production of embargoed and non-embargoed products in Russia.

significantly higher (by approximately 5%) than a control group that includes non-food products and services. This underlines earlier results based on which we suspect a propagation of the price shock to other non-embargoed food and agricultural products.

We next turn to interpret the reversion of the price shock from its peak in January 2015 back towards lower prices. A possible explanation relates to the increased domestic production of embargoed products. 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 2014 and 2015.

Based on monthly production data from the Federal State Statistics, we compare the production of embargoed and non-embargoed food items. The overall picture for all

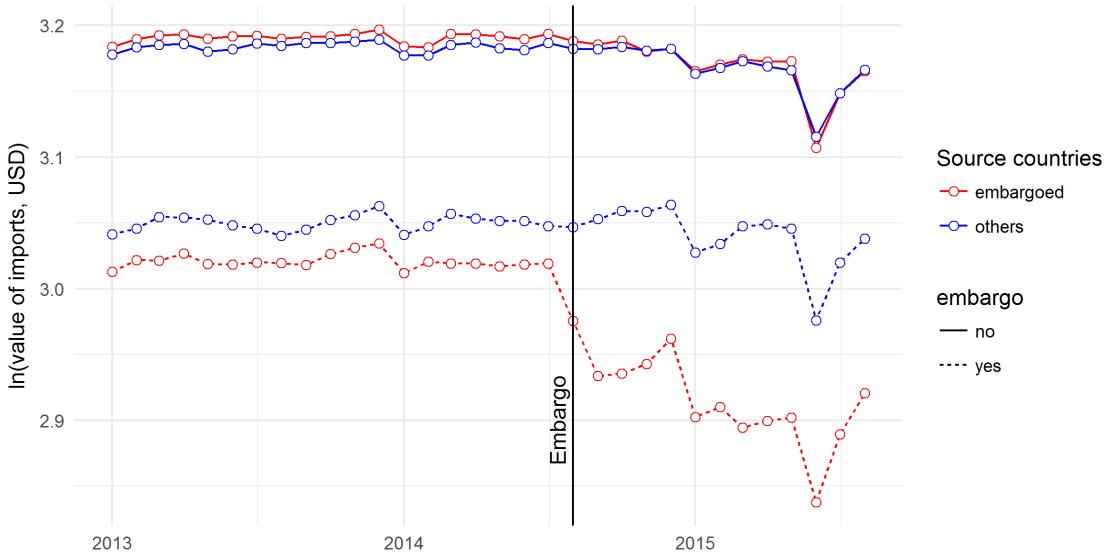



**Figure 4:** Aggregate imports of embargoed and non-embargoed products to Russia.

embargoed and non-embargoed products is obtained by aggregating produced quantities. Such aggregation is possible because most agricultural production data are reported in the same statistical unit (thousands of tons). Figure 3 suggests that the production of embargoed products grew steadily between January 2011 and July 2016, i.e., also during the period well before the import embargo was imposed.[8] Thus, the aggregate picture does not support the hypothesis of rapid growth in domestic production following the introduction of the embargo.

The increase in consumer prices is expected to result in reduced domestic consumption. Using the data on wholesale sales provided by Rosstat, we test this prediction. We hypothesize that total retail consumption equals total wholesale sales. We again employ a difference-in-differences analysis to isolate the impact of the embargo on the consumption of embargoed products. The results are reported in table D1 in the Appendix. The results suggest that domestic consumption decreased by at least 8.7%, depending on the specification. Thus, we conclude that the self-imposed food embargo had non-negligible consequences for Russian consumers.

Another important factor that could mitigate the increase in consumer prices over time is trade diversion. Russian firms could have begun to import embargoed agricultural products from non-embargoed countries. Figure 4 suggests a slight increase in the imports of embargoed products from non-embargoed sources following the embargo. Thus, trade diversion may have compensated somewhat for the initial price shock.

We test for trade diversion by again employing a difference-in-difference estimation.

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

**Table 2:** Change in imports of embargoed vs. non-embargoed goods by sanctioning/non-sanctioning country

| | *Dependent variable:* | |
|---|---|---|
| | log(value) | log(weight) |
| | (1) | (2) |
| Sanction period × Embargoed product | $0.932^{***}$ | $0.878^{***}$ |
| | (0.215) | (0.224) |
| Sanction period × Embargoed product × Embargoed country | $-1.114^{*}$ | $-1.032^{*}$ |
| | (0.569) | (0.612) |
| Observations | 592,885 | 592,885 |
| Adjusted $R^2$ | 0.380 | 0.478 |

*Note:* All regressions include date, partner country and product fixed effects. Standard errors clustered on date, partner country and product. $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01

We report the results in table 2. The key variable of interest is the interaction with a dummy for an embargoed origin. Our results suggest that imports of embargoed products from embargoed countries decreased significantly, whereas imports from other origins increased. This evidence confirms that at least some trade divergence took place.

As we suspect that imports (or rather the ban thereof) result in increased consumer prices, we further expect that those parts of the country that imported relatively more of the embargoed products from targeted origin countries to have experienced a relatively higher increase in prices. Figure 5 indicates significant geographical heterogeneity in price increases, potentially due to the heterogeneous exposure to the embargo. The western regions of Russia experienced higher price growth.

We explore this spatial variation by estimating

$$\begin{aligned}\log(\text{price}_{irt}) = \beta_0 + \beta_1 \text{Product}_i + \beta_2 \text{Period}_t + \beta_3 \text{Region}_r + \\ \beta_4 \text{Product}_i \times \text{Period}_t + \beta_5 \text{Product}_i \times \text{Region}_r + \\ \beta_6 \text{Period}_t \times \text{Region}_r + \beta_7 \text{Product}_i \times \text{Region}_r \times \text{Period}_t \end{aligned} \quad (2)$$

where in addition to the previously mentioned dummies, we now include and interact an additional variable, $\text{Region}_r$, that incorporates regional characteristics, specifically, the share of imports from sanctioned countries in the region prior to the embargo.

To associate the increase in the prices of embargoed products with the embargo itself, we test whether a previous reliance on food imports from currently sanctioning countries in the respective region leads to systematically higher food prices after the embargo. Table 3 reports the findings. Columns (1) and (2) display the coefficients at the district level,

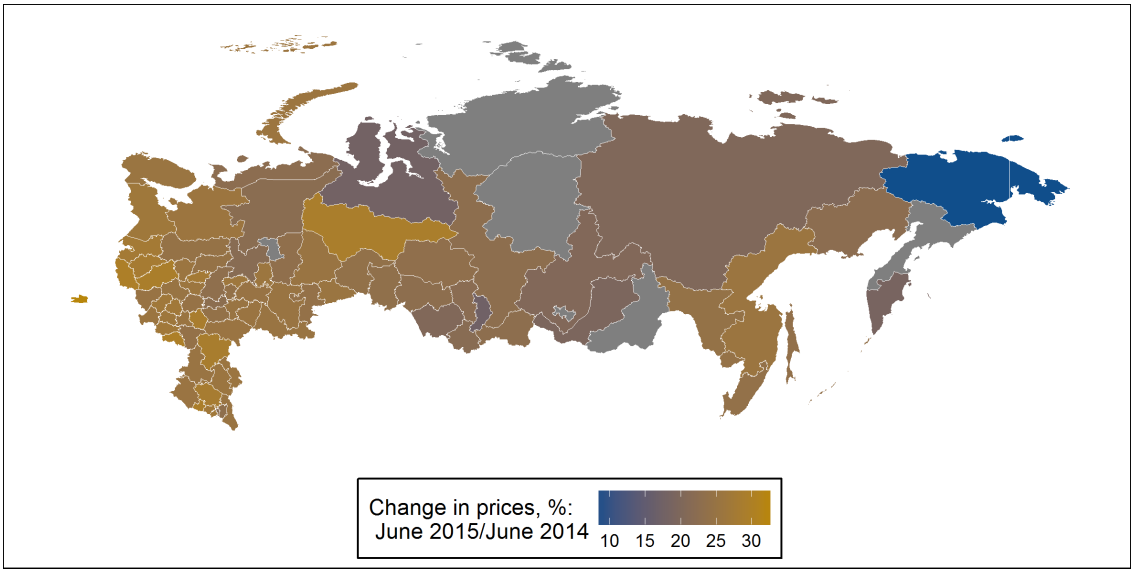



**Figure 5:** Change in average prices of embargoed products by region, June 2014 to June 2015.

**Table 3:** Diff-in-diff of prices interacted with share of sanctioning countries in imports.

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | log(prices) | | | |
| | (1) | (2) | (3) | (4) |
| Sanction period × Embargoed product | 0.014 | 0.015 | 0.024*** | 0.058*** |
| | (0.014) | (0.026) | (0.006) | (0.007) |
| Sanction period × Embargoed product × Share of sanctioning country in imports | 0.024 | 0.100** | 0.011 | 0.020* |
| | (0.023) | (0.044) | (0.010) | (0.012) |
| Spatial agg. | district | district | subject | subject |
| Control group | F | F+NF | F | F+NF |
| Number treated | 14520 | 14520 | 155159 | 155159 |
| Observations | 37,582 | 123,395 | 402,540 | 1,313,613 |
| Adjusted $R^2$ | 0.991 | 0.998 | 0.988 | 0.997 |

Notes: F stands for non-targeted 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.

and columns (3) and (4) do so at the federal subject level.[9] 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, 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. The impact is not statistically different across these products.

[9]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.

**Table 4:** Diff-in-diff of prices in the sectors that are vertically linked to embargoed sectors.

| | *Dependent variable:* | | |
|---|---|---|---|
| | log(prices) | | |
| | (1) | (2) | (3) |
| Sanction period × Linked product | 0.017** | 0.016*** | 0.017*** |
| | (0.008) | (0.004) | (0.004) |
| Sanction period × Embargoed product | 0.064*** | 0.068*** | 0.071*** |
| | (0.008) | (0.003) | (0.002) |
| Spatial agg. | district | subject | city |
| Observations | 138,856 | 1,462,299 | 3,453,794 |
| Adjusted $R^2$ | 0.998 | 0.996 | 0.995 |

Notes: The comparison 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.

It could, however, be the case 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,[10] we compute the distance between the capital of each region and the capital of Ukraine (Kiev). We assume that this distance is 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, now interacting with distance to Europe. The results are reported in table D2. We conclude that the remoteness of regions from embargoed countries might partially mitigate the impact on prices.

Overall, the data suggest that the embargo affected consumer prices of banned goods directly. However, other food and agricultural products not directly embargoed, i.e. not banned from being imported from targeted countries, appear to have been indirectly affected. This is underlined in the graph of average prices in figure 1: The blue line, non-embargoed goods, has also shifted up. Thus, it could be that the shock was transmitted to non-embargoed sectors via input-output linkages. We next search for evidence supporting this hypothesis.

First, we note that the aggregated food sector has upstream connections to other sectors.[11] Second, we proceed to reveal the intersectoral connections with embargoed sectors by computing the use of banned products in Russian production in table F1. Foreign same-sector inputs are intensively employed in the production of bovine meat products

[10] 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 in prices across regions.

[11] Antràs et al. (2012) suggest a comprehensive measure of the upstreamness of sectors across countries. In table F2, 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.

and other meat products. Foreign fruits and vegetables account for more than 40% of the inputs in the following sectors: Bovine cattle, Other animal products, Raw milk, Wool, Other meat products and Sugar. We then test whether the consumer prices in these sectors also increased following the embargo. To do so, we replicate the difference-in-differences analysis from above, now isolating the $Period \times Linked\ product$ interaction term. The results are reported in table 4. The results are 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-linked to 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 wholy 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 $\omega^j$. $\gamma_n^{k,j}$ and $\gamma_n^j$ 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 $\omega^j$ 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 $\omega^j$ 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 $\omega^j$ across all locations. Composite intermediate goods are used in the production of intermediate goods $\omega^j$ and as the final good in consumption as $C_n^j$, so that the market clearing condition is written as

$$Q_j^n = C_n^j + \sum_{k=1}^{J} \int m_n^{j,k}(\omega^j) d\omega^j \tag{3}$$

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 $\omega^j$ from $i$ in $n$ is given by

$$p_{ni}^j\left(\omega^j | \varepsilon_{ni}^j = 1\right) = \tau_{ni}^j d_{ni}^j \cdot \frac{c_i^j}{z_i^j(\omega^j)} \tag{4}$$

where $\tau_{ni}^j$ represent sector-specific ad-valorem tariffs, and $d_{ni}^j$ iceberg trade costs. $\tau_{ni}^j$ are collected by the importing country and transferred lump-sum to its households. In contrast

to Caliendo and Parro (2015), we append a term $\varepsilon_{ni}^j$, 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, $\varepsilon_{ni}^j$ 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 price of $\omega^j$ in country $n$ is given by

$$p_n^j = \min_i \left\{ p_{ni}^j \left( \omega^j | \varepsilon_{ni}^j = 1 \right) \right\}. \tag{5}$$

The price of the composite good is then given as

$$P_n^j = A^j \left[ \sum_{i=1}^{N} \varepsilon_{ni}^j \lambda_i^j (c_i^j \tau_{ni}^j d_{ni}^j)^{-\theta^j} \right]^{-1/\theta^j} \tag{6}$$

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

$$P_n^j = A^j (\lambda_n^j)^{-1/\theta^j} c_n^j \tag{7}$$

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

$$\pi_{ni}^j = \frac{\varepsilon_{ni}^j \lambda_i^j (c_i^j \tau_{ni}^j d_{ni}^j)^{-\theta^j}}{\sum_{h=1}^{N} \varepsilon_{nh}^j \lambda_h^j (c_h^j \tau_{nh}^j d_{nh}^j)^{-\theta^j}} \tag{8}$$

which displays the direct effect of an embargo clearly: a $\varepsilon_{ni}^j$, 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

$$X_n^j = \sum_{k=1}^{J} \gamma_n^{j,k} \sum_{i=1}^{N} X_i^j \frac{\pi_{in}^k}{\tau_{in}^k d_{in}^k} + \alpha_n^j I_n \tag{9}$$

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

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

$$\hat{c}_n^j = \hat{w}_n^{\gamma_n^j} \prod_{k=1}^{J} \hat{P}_n^{k\ \gamma_n^{k,j}} \tag{10}$$

whereas the change in the price index is given by

$$\hat{P}_n^j = \left[ \sum_{i=1}^{N} \varepsilon_{ni}^{j\prime} \pi_{ni}^{j} (\hat{c}_i^j)^{-\theta^j} \right]^{-1/\theta^j}. \tag{11}$$

Bilateral trade shares adjust according to

$$\hat{\pi}_{ni}^j = \varepsilon_{in}^{j\prime} \left[ \frac{\hat{c}_i^j}{\hat{P}_n^j} \right]^{\theta^j} \tag{12}$$

and total expenditures on sector $j$ in country $n$ as

$$X_n^{j\prime} = \sum_{k=1}^{J} \gamma_n^{j,k} \sum_{i=1}^{N} \varepsilon_{ni}^{j\prime} \pi_{in}^{j\prime} X_i^{k\prime} + \alpha_n^j I_n'. \tag{13}$$

The trade balance is assured by

$$\sum_{j=1}^{J} \sum_{i=1}^{N} \varepsilon_{ni}^{j\prime} \pi_{ni}^{j\prime} X_n^{j\prime} - D_n = \sum_{j=1}^{J} \sum_{i=1}^{N} \varepsilon_{in}^{j\prime} X_i^{j\prime} \pi_{in}^{j\prime} \tag{14}$$

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

$$\ln \hat{W}_n = \ln \frac{\hat{w}_n}{\hat{P}_n} = -\sum_{j=1}^{J} \frac{\alpha_n^j}{\theta^j} \ln \hat{\pi}_{nn}^j \qquad \textit{(final goods)} \tag{15}$$

$$-\sum_{j=1}^{J} \frac{\alpha_n^j}{\theta^j} \frac{1-\gamma_n^j}{\gamma_n^j} \ln \hat{\pi}_{nn}^j \qquad \textit{(intermediate goods)} \tag{16}$$

$$-\sum_{j=1}^{J} \frac{\alpha_n^j}{\gamma_n^j} \ln \prod_{k=1}^{J} \frac{\hat{P}_n^{k\ \gamma_n^{k,j}}}{\hat{P}_n^j} \qquad \textit{(sectoral linkages)} \tag{17}$$

# 4 Counterfactuals

In this section, we describe how the model is employed to simulate the outcomes of 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.[12] Table 5 summarizes the definitions of the variables we employ.

**Table 5:** 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.

The second ingredient is the trade data. We source the bilateral flows from BACI.[13] 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,[14] 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). The complete list of tradable sectors with corresponding elasticities is reported in Table 6. 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.[15]

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.

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

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

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

[15] Data for more recent years were unavailable.

**Table 6:** Tradable sectors

| Sector | Elasticity | Embargoed | Sector | Elasticity | Embargoed |
|---|---|---|---|---|---|
| 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 | Yes | 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 | Yes | Wood products | 2.29 | |
| Motor vehicles, etc. | 3.13 | | Vegetables and fruits | 2.19 | Yes |
| 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.

The exhaustive list of all embargoed products was published by the Russian government in August 2014. 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 Table A1. It is important to properly choose GTAP sectors that were the most exposed to the studied bilateral shock. We make this decision with respect to the share of embargoed products in the total number of products constituting each of the GTAP sectors. Thus, our selection includes the following sectors: "Vegetables and fruits", "Bovine meat products" and "Other meat products". Note that the sectors "Dairy", "Fishing" and "Other food products" are not treated as embargoed for the purposes of the simulations. Products belonging to the official prohibited list constitute minor shares of all products in these GTAP sectors. Furthermore, the sector "Raw milk" is excluded because the BACI dataset does not report any data on its trade flows.

The simulations predict that the welfare of the Russian Federation decreased by approximately 1.88%. This effect is, perhaps unsurprisingly, the most severe compared to those on all embargoed countries that are included in our analysis. Moreover, the simulations indicate that the price index in Russia increased by 0.16%. Thus, we conclude that the self-imposed import embargo has been harmful to the country's economy and led to higher average prices across for Russiann 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.

We further disaggregate the simulated change in the price index into price effects for

the individual sectors (see Table 7). Our counterfactual analysis indicates that the prices in all three embargoed sectors have risen drastically. The prices on vegetables and fruits increased by 6.14%. The magnitude of the effect for the prices of other meat products is stronger (19.62%). The growth of the prices of bovine meat products was more moderate (2.1%). Overall, these numbers are in line with our difference-in-differences estimations for observed consumer prices.

We further compute the contribution of individual sectors to the total welfare outcomes of the Russian embargo. We plot the results for Russia in figure G1 in appendix 5. The embargoed sectors contribute to the total outcome in the following shares: Vegetables and fruits, 5.13%; other meat products, 4.27%; and bovine meat products, 4.18%. The two sectors that intensively use inputs from these sectors — dairy and other food products — jointly contribute 11.34% 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.

**Table 7:** Changes in prices of Russian sectors

| Sector | $\Delta\, Prices$, % | Contribution, % | Sector | $\Delta\, Prices$, % | Contribution, % |
|---|---|---|---|---|---|
| Other meat products | 19.62 | 4.27 | Beverages, etc. | 0.32 | 1.03 |
| Vegetables and fruits | 6.14 | 5.13 | Chemical products, etc. | 0.3 | 9.36 |
| Bovine meat products | 2.1 | 4.18 | Paper products, etc. | 0.23 | 0.44 |
| Diary | 0.9 | 6.37 | Other transport equipment | 0.19 | 0.53 |
| Wood products | 0.82 | 1.33 | Bovine cattle, etc | 0.15 | 0.04 |
| Other food products | 0.77 | 4.97 | Other manufactures | 0.08 | 1.76 |
| Oil | 0.76 | 10.11 | Other mining | 0.08 | 0.65 |
| Textiles | 0.71 | 4.79 | Other mineral products | 0.05 | 1.79 |
| Leather products | 0.57 | 2.5 | Vegetable oils, etc. | 0.02 | 0.38 |
| Wearing apparel | 0.55 | 5.53 | Ferrous metals | 0 | 1.56 |
| Electronic equipment | 0.54 | 2.06 | Other metals | -0.02 | 0.66 |
| Plant-based fibres | 0.53 | 0 | Oil seeds | -0.11 | 0.07 |
| Other animal products | 0.51 | 0.1 | Fishing | -0.15 | 0.27 |
| Coal | 0.49 | 0.31 | Gas | -0.21 | 0.52 |
| Petroleum and coke | 0.44 | 1.57 | Forestry | -0.22 | 0.03 |
| Wool, etc. | 0.43 | 0 | Wheat | -0.23 | 0.07 |
| Metal products | 0.4 | 2.43 | Other cereal grains | -0.28 | 0.28 |
| Motor vehicles, etc. | 0.37 | 11.39 | Sugar | -0.39 | 2.12 |
| Other machinery, etc. | 0.36 | 10.17 | Rice | -0.42 | 0.14 |
| Other crops | 0.33 | 1.1 | | | |

*Notes:* This table reports simulated changes in prices within Russian sectors and their contribution to the overall welfare change.

In table 8, we report the outcomes for countries that are the largest exporters to Russia.[16] 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 minor losses, which are smaller than those of Russia.

The large increase in the welfare of Belarus (5%) 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. Belarus par-

[16]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 8:** Outcomes of Russian embargo for Russia and large exporters.

| Countries | Embargoed | $\Delta\, Welfare$ | $\Delta\, Prices$ |
|---|---|---|---|
| Russia | | -1.88 | 0.16 |
| China | no | -0.67 | 1.26 |
| Germany | yes | -0.43 | 0.15 |
| Belarus | no | 5.00 | 7.65 |
| United States | no | -0.29 | -0.31 |
| Italy | yes | -0.29 | 0.15 |
| Japan | no | -0.39 | -0.08 |
| France | yes | -0.21 | 0.33 |
| Poland | yes | -0.76 | 0.74 |
| United Kingdom | yes | -0.29 | -0.12 |
| Netherlands | yes | -0.86 | 0.29 |
| Turkey | no | -0.80 | 0.38 |
| Finland | yes | -0.53 | 0.75 |

*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.

ticipates in the Eurasian Customs Union, together with Russia, Armenia, Kazakhstan and Kyrgyzstan. The quasi-absence of trade barriers between Belarus and Russia substantially facilitates post-embargo trade divergence.

In table 9, we report the outcomes for countries that are "small" exporters to Russia. All of the negative outcomes for small exporters are close to zero, which might be a sign of the ineffectiveness of the embargo as a policy tool. Embargoed Eastern European countries (Bulgaria, Estonia, the Czech Republic, Romania, Slovakia, Hungary, and Slovenia) are estimated to have experienced *positive* welfare outcomes. These countries most likely profited from the divergence 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 implies 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, we hypothesize that the discrepancies in the results of the simulations for some countries might be attributed to the "noise" in the input-output tables.

We further demonstrate how the version of the model without input-output linkages predicts the outcomes of the embargo. While maintaining all other assumptions of the model,

**Table 9:** Outcomes of Russian embargo for small exporters.

| Countries | Embargoed | $\Delta\, Welfare$ | $\Delta\, Prices$ |
|---|---|---|---|
| Czech Republic | yes | 0.06 | 1.83 |
| Kazakhstan | no | -2.13 | 0.71 |
| Spain | yes | -0.33 | -0.65 |
| Austria | yes | -0.43 | -0.02 |
| Sweden | yes | -0.01 | 1.18 |
| Slovakia | yes | -0.54 | 1.43 |
| Switzerland | no | -0.70 | 0.14 |
| Brazil | no | -0.62 | 0.16 |
| Hungary | yes | -0.38 | 0.87 |
| India | no | -0.42 | 0.05 |
| Estonia | yes | -0.95 | 1.57 |
| Denmark | yes | -0.50 | -0.15 |
| Romania | yes | 0.17 | 1.53 |
| Norway | yes | -0.58 | -0.21 |
| Indonesia | no | -1.76 | -0.26 |
| Canada | yes | -0.38 | -0.10 |
| Slovenia | yes | -0.35 | 0.82 |
| Ireland | yes | -0.23 | -0.03 |
| Australia | yes | -0.71 | -0.42 |
| Bulgaria | yes | 0.73 | 2.36 |
| Argentina | no | -0.87 | -0.50 |
| Greece | yes | -0.38 | -0.90 |
| Portugal | yes | -0.16 | 0.09 |
| Croatia | yes | -0.36 | -0.03 |
| Egypt | no | -2.16 | -0.16 |

*Note:* This table reports 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.

we replicate the simulations in the same steps as above. The corresponding results are reported in the appendix (see table G1). 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 marginally different from zero. We conclude that the inter-sectoral 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 2.7% relative to other (non-embargoed) food products and even more relative to non-food items. The maximum effect of 8.9% (relative to non-sanctioned food products) was observed in January 2015 and then decreased in subsequent months.

To disentangle the observed effects and account for transmission mechanisms throughout the Russian economy, we employ a standard Ricardian trade model that exhibits intersectoral linkages, and allowing for non-tradability of *some* goods across *some* country-pairs. Our simulations suggest that Russia faced a decrease in welfare of 1.88%. The domestic prices are simulated to have risen by on 0.19%, with embargoed sectors seeing price increases of up to 9.14 %. This result is in line 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.

## References


**Antràs, Pol, Davin Chor, Thibault Fally, and Russell Hillberry**, "Measuring the upstreamness of production and trade flows," *American Economic Review*, 2012, *102* (3), 412–416.

**Besedeš, Tibor, Stefan Goldbach, and Volker Nitsch**, "You're banned! The effect of sanctions on German cross-border financial flows," *Economic Policy*, 2017, *32* (90), 263–318.

**Boulanger, Pierre, Hasan Dudu, Emanuele Ferrari, and George Philippidis**, "Russian Roulette at the Trade Table: A Specific Factors CGE Analysis of an Agri-food Import Ban," *Journal of Agricultural Economics*, 2016, *2*, 272–291.

**Caliendo, Lorenzo and Fernando Parro**, "Estimates of the Trade and Welfare Effects of NAFTA," *Review of Economic Studies*, 2015, *82* (1), 1–44.

**Costinot, Arnaud and Andrés Rodriguez-Clare**, "Trade theory with numbers: Quantifying the consequences of globalization," *Handbook of International Economics*, 2014, *4*, 197–261.

**Crozet, Matthieu and Julian Hinz**, "Collateral damage: The impact of the Russia sanctions on sanctioning countries' exports," Working Paper No. 16, CEPII 2016.

**De Masi, Paula and Vincent Koen**, "Relative price convergence in Russia," Working Paper No. 95/54, International Monetary Fund 1995.

**Dekle, Robert, Jonathan Eaton, and Samuel Kortum**, "Global rebalancing with gravity: Measuring the burden of adjustment," *IMF Economic Review*, 2008, *55* (3), 511–540.

**Dhingra, Swati, Hanwei Huang, Gianmarco Ottaviano, João Paulo Pessoa, Thomas Sampson, and John Van Reenen**, "The costs and benefits of leaving the EU: Trade effects," *Economic Policy*, 2017, *32* (92), 651–705.

**Dreger, Christian, Jarko Fidrmuc, Konstantin Kholodilin, and Dirk Ulbricht**, "The ruble between the hammer and the anvil: Oil prices and economic sanctions," BOFIT Discussion Paper No. 25/2015, DIW Berlin, German Institute for Economic Research 2015.

**Drezner, Daniel W**, *The Sanctions Paradox: Economic Statecraft and International Relations*, Cambridge, UK: Cambridge University Press, 1999.

**Eaton, Jonathan and Samuel Kortum**, "Technology, geography, and trade," *Econometrica*, 2002, *70* (5), 1741–1779.

**Etkes, Haggay and Assaf Zimring**, "When trade stops: Lessons from the Gaza blockade 2007–2010," *Journal of International Economics*, 2015, *95* (1), 16–27.

**Feenstra, Robert C**, "New product varieties and the measurement of international prices," *The American Economic Review*, 1994, *84*, 157–177.

**Gardner, Bruce L. and Karen M. Brooks**, "Food prices and market integration in Russia: 1992–93," *American Journal of Agricultural Economics*, 1994, *76* (3), 641–646.

**Haidar, Jamal Ibrahim**, "Sanctions and export deflection: Evidence from Iran," *Economic Policy*, 2017, *32* (90), 319–355.

**Heilmann, Kilian**, "Does political conflict hurt trade? Evidence from consumer boycotts," *Journal of International Economics*, 2016, *99* (C), 179–191.

**Imbs, Jean and Isabelle Mejean**, "Elasticity optimism," *American Economic Journal: Macroeconomics*, 2015, *7* (3), 43–83.

**Irwin, Douglas A.**, "The Welfare Cost of Autarky: Evidence from the Jeffersonian Trade Embargo, 1807-09," *Review of International Economics*, 2005, *13* (4), 631–645.

**Johnson, Robert C and Guillermo Noguera**, "Accounting for intermediates: Production sharing and trade in value added," *Journal of International Economics*, 2012, *86* (2), 224–236.

**Lee, Yong Suk**, "International isolation and regional inequality: Evidence from sanctions on North Korea," *Journal of Urban Economics*, 2018, *103*, 34–51.

**Mayer, Thierry, Vincent Vicard, and Soledad Zignago**, "The cost of non-Europe, revisited," CEPR Discussion Paper 12844 2018.

**Ossa, Ralph**, "Trade Wars and Trade Talks with Data," *American Economic Review*, 2014, *104* (12), 4104–4146.

**O'Rourke, Kevin H**, "War and welfare: Britain, France, and the United States 1807–14," *Oxford Economic Papers*, 2007, *59* (suppl_1), i8–i30.

**Timmer, Marcel P, Erik Dietzenbacher, Bart Los, Robert Stehrer, and Gaaitzen J De Vries**, "An illustrated user guide to the world input–output database: The case of global automotive production," *Review of International Economics*, 2015, *23* (3), 575–605.

# Appendix

# Appendix A. List of products embargoed by the Russian Federation

**Table A1:** 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) balyk salted; Products balyk; Products cured balyk (provesnye); 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) krepkosolenaya; Fish (except herring) salted; Fish (except herring) salt; Fish (except herring) srednesolenaya; For semi-smoked fish (except herring); Fish salting semuzhny; The fish special salting (except herring); Fish, dried; Fish, dried, and dried; Cold smoked fish (except herring); Herring all processes; Herring krepkosolenaya; Herring salted; Herring srednesolenaya; Products Cold smoked (without herring) balyk; Products made of herring, balyk; 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 (kisloslivochnye) 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 mechnikovskaya; 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; Curd zerneny; 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 | Kaptofel; 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; Bow pepchaty; 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 | |

# Appendix D. Additional regression results

**Table D1:** Impact of embargo on wholesales in Russia

| | *Dependent variable:* | | | | | |
|---|---|---|---|---|---|---|
| | log(value of sales) | | | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Sanction period × Embargoed product | −0.501*** | −0.536*** | −0.146* | −0.087** | −0.012 | −0.087*** |
| | (0.114) | (0.040) | (0.088) | (0.038) | (0.017) | (0.032) |
| Spatial agg. | district | subject | district | district | subject | district |
| Control group | F+NF | F+NF | F | F+NF | F+NF | F |
| Fixed effects | R x D | R x D | R x D | R x P x M | R x P x M | R x P x M |
| Observations | 18,441 | 118,028 | 7,338 | 18,441 | 118,028 | 7,338 |
| Adjusted $R^2$ | 0.090 | 0.098 | 0.206 | 0.937 | 0.905 | 0.922 |

*Notes:* F stands for non-targeted food products and NF stands for non-food items. The regressions include either region × date (R x D) or region × product × month (R x P x M) fixed effects. Robust standard errors are reported in parentheses. Significance levels: *: p<0.1, **: p<0.05, ***: p<0.01.

**Table D2:** Diff-in-diff of prices interacted with distance to Europe

| | *Dependent variable:* | | | |
|---|---|---|---|---|
| | log(prices) | | | |
| | (1) | (2) | (3) | (4) |
| Sanction period × Embargoed product | 0.089*** | 0.114** | 0.101*** | 0.140*** |
| | (0.023) | (0.047) | (0.021) | (0.028) |
| Sanction period × Embargoed product × distance to Europe | −0.008*** | −0.006 | −0.009*** | −0.009** |
| | (0.003) | (0.006) | (0.003) | (0.004) |
| Spatial agg. | district | district | subject | subject |
| Control group | F | F+NF | F | F+NF |
| Number treated | 16572 | 16572 | 174611 | 174611 |
| Observations | 42,884 | 140,670 | 453,164 | 1,477,892 |
| Adjusted $R^2$ | 0.991 | 0.998 | 0.988 | 0.997 |

Notes: F stands for non-targeted 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.

## Appendix F. Input-output linkages

**Table F1:** Use of inputs from embargoed sectors in Russian production

| Sector | *Vegetables and fruits* | | *Other meat products* | | *Bovine meat products* | |
|---|---|---|---|---|---|---|
| | domestic | foreign | domestic | foreign | domestic | foreign |
| Wheat | 0.01 | 2.08 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other cereal grains | 0.03 | 5.31 | 0.00 | 0.00 | 0.00 | 0.00 |
| Vegetables and fruits | 21.28 | 6.87 | 0.00 | 0.00 | 0.00 | 0.00 |
| Oil seeds | 0.03 | 2.41 | 0.00 | 0.00 | 0.00 | 0.00 |
| Plant-based fibres | 0.09 | 0.00 | 0.29 | 0.00 | 0.00 | 0.00 |
| Other crops | 0.23 | 0.36 | 0.01 | 0.00 | 0.00 | 0.00 |
| Bovine cattle, etc | 4.03 | 74.90 | 0.00 | 0.02 | 0.43 | 0.23 |
| Other animal products | 2.47 | 74.76 | 0.00 | 0.02 | 0.21 | 0.19 |
| Raw milk | 3.76 | 48.02 | 0.00 | 0.01 | 0.33 | 0.12 |
| Wool, etc. | 2.08 | 49.13 | 0.00 | 0.01 | 0.17 | 0.11 |
| Forestry | 0.00 | 0.00 | 0.02 | 0.01 | 0.07 | 0.06 |
| Fishing | 0.25 | 0.63 | 0.08 | 0.06 | 0.28 | 0.19 |
| Coal | 0.00 | 0.00 | 0.02 | 0.01 | 0.03 | 0.02 |
| Oil | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| Gas | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Other mining | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 | 0.01 |
| Bovine meat products | 0.09 | 0.68 | 0.07 | 0.11 | 29.46 | 57.72 |
| Other meat products | 0.03 | 40.82 | 44.32 | 23.30 | 0.01 | 0.20 |
| Vegetable oils, etc. | 0.01 | 0.63 | 0.00 | 0.01 | 2.88 | 1.36 |
| Diary | 3.68 | 10.48 | 0.00 | 0.01 | 0.12 | 0.09 |
| Rice | 0.04 | 36.77 | 0.01 | 0.00 | 0.00 | 0.11 |
| Sugar | 24.55 | 45.08 | 0.01 | 0.01 | 0.11 | 0.04 |
| Other food products | 27.19 | 13.42 | 1.45 | 0.00 | 0.61 | 0.26 |
| Beverages, etc. | 16.90 | 0.10 | 0.00 | 0.00 | 0.32 | 0.14 |
| Textiles | 1.28 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| Wearing apparel | 0.12 | 0.13 | 0.03 | 0.01 | 0.00 | 0.00 |
| Leather products | 0.45 | 0.74 | 0.05 | 0.61 | 0.01 | 0.01 |
| Wood products | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 |
| Paper products, etc. | 0.00 | 0.00 | 0.02 | 0.01 | 0.05 | 0.02 |
| Petroleum and coke | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| Chemical products, etc. | 0.04 | 0.10 | 0.01 | 0.01 | 0.05 | 0.03 |
| Other mineral products | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |

Continued on next page

**Table F1 – continued from previous page**

| Sector | *Vegetables and fruits* | | *Other meat products* | | *Bovine meat products* | |
|---|---|---|---|---|---|---|
| | domestic | foreign | domestic | foreign | domestic | foreign |
| Ferrous metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 |
| Other metals | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Metal products | 0.03 | 0.05 | 0.02 | 0.01 | 0.03 | 0.02 |
| Motor vehicles, etc. | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 |
| Other transport equipment | 0.00 | 0.00 | 0.03 | 0.01 | 0.12 | 0.03 |
| Electronic equipment | 0.00 | 0.00 | 0.03 | 0.01 | 0.00 | 0.00 |
| Other machinery, etc. | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |
| Other manufactures | 0.00 | 0.00 | 0.02 | 0.01 | 0.05 | 0.02 |

*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.

**Table F2:** 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 simulated composition of exports before and after the onset of Russian embargo.

# Appendix G. Additional results of simulations

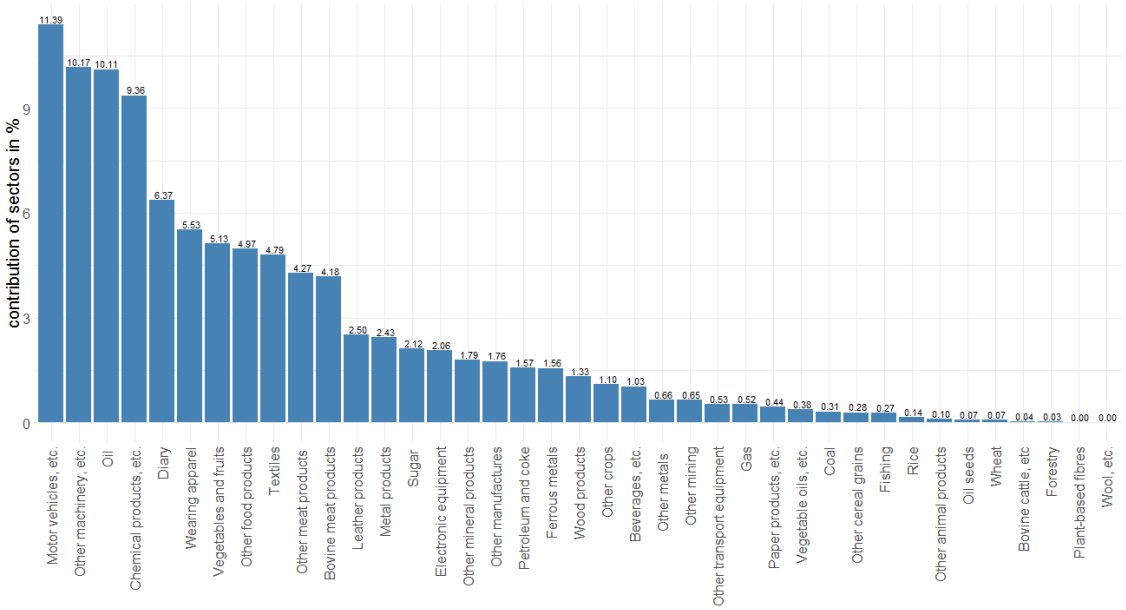



**Figure G1:** Sectoral contribution to welfare outcomes for Russia

**Table G1:** Simulations of the model without input-output linkages

| Embargoed countries | $\Delta Welfare$ | Non-embargoed countries | $\Delta Welfare$ |
|---|---|---|---|
| Australia | 0.001% | Argentina | 0.007% |
| Belgium | -0.01% | Belarus | 0.133% |
| Canada | -0.002% | Brazil | 0.01% |
| Germany | -0.002% | Switzerland | 0.002% |
| Spain | -0.008% | China | 0% |
| France | -0.001% | Egypt | 0.017% |
| United Kingdom | 0.004% | Indonesia | 0.005% |
| Ireland | -0.005% | India | 0% |
| Italy | -0.002% | Japan | -0.001% |
| Lithuania | -0.482% | Kazakhstan | -0.004% |
| Latvia | 0.014% | Republic of Korea | -0.001% |
| Malta | -0.01% | Turkey | 0.01% |
| Netherlands | -0.012% | | |
| Norway | 0.007% | | |
| Poland | -0.042% | | |
| Romania | 0.004% | | |
| Russian Federation | 0.057% | | |
| Slovakia | -0.014% | | |
| Slovenia | 0% | | |
| Sweden | 0% | | |
| Ukraine | -0.054% | | |
| United States of America | -0.001% | | |

*Note:* This table reports 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.