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Russian Roulette at the Trade Table: A Specific Factors CGE Analysis of an Agri-food Import Ban

Pierre Boulanger, Hasan Dudu, Emanuele Ferrari and George Philippidis[1]

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Abstract

In the summer of 2014 Russia imposed a ban on most agri-food products from countries enforcing Ukraine-related sanctions against Russia. We use a specific factors computable general equilibrium (CGE) model to simulate the short-run impact of this retaliatory policy. The baseline is carefully designed to isolate the impacts of the ban on the European Union (EU), Russia itself and a selection of key trade partners. The modelling of the ban follows a novel approach, where it is treated as a loss of established trade preferences via reductions in consumer utility in the Armington import function. Not surprisingly, the results indicate that Russia bears the highest income loss (about €3.4 billion) while the EU recovers part of its lost trade through expansion of exports to other markets. An ex-post comparison between simulation results and observed trade data reveals the model predictions to be broadly accurate, thereby validating the robustness of the modelling approach.

Keywords: *CGE*; *European Union*; *Russia*; *trade*.

JEL classifications: *C68, F11, Q17*.

[1]Pierre Boulanger, Hasan Dudu and Emanuele Ferrari are with the European Commission, Joint Research Centre (JRC), Institute for Prospective Technological Studies (IPTS), Agriculture and Life Sciences in the Economy Unit, Seville, Spain. George Philippidis is with the Aragonese Agency for Research and Development (ARAID), Centre for Food Research and Technology (CITA), Zaragoza, Spain, the Landbouw-Economisch Institut (LEI) Wageningen University, Netherlands and also the University Loyola Andalusia, Department of Economics, Seville, Spain. E-mail: pierre.boulanger@ec.europa.eu for correspondence. The authors would like to thank two anonymous referees for comments on an earlier draft. The authors are also indebted to Robert Waschik for suggesting the specific factors approach, Arnaldo Caivano and Celso Jesús Gorrín González for data support and to Robert M'barek, Fabien Santini, Mihaly Himics and Koen Dillen for providing helpful feedback. Any errors remain the sole responsibility of the authors. The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

1. Introduction

In the legal vernacular of international trade relations, quantitative restrictions are subsumed within GATT article XI as proscribed by the World Trade Organisation (WTO).[2] Nevertheless, exceptions to this article are recognised by the WTO on economic grounds (safeguarding mechanism, developing countries exemption) and non-economic grounds (protection of human, animal or plant life/health, security interest). Presumably under the auspices of the latter, to *'protect national security of the Russian Federation'*,[3] on 7 August 2014, Russia imposed a 1-year import ban on a list of agri-food products from the European Union (EU), the United States of America (USA), Norway, Canada and Australia. This list covers almost all meat products (beef, pig-meat, poultry and certain sausages), milk and dairy products, fruits and vegetables, as well as fish and crustaceans. This trade ban was introduced in addition to existing Russian trade restrictions on North American cattle meat from February 2013 (no guarantee of ractopamine-free exports), European pig meat from February 2014 (African swine fever) and Polish fruit and vegetables from August 2014 (pest, and residues of pesticides and nitrates).[4] On 25 July 2015, Russia announced a 1 year prolongation of the ban on agri-food products (until August 2016), which has been extended to Iceland, Liechtenstein, Albania and Montenegro.[5]

Of all the targeted countries, the EU as a group was potentially the most affected. With the exceptions of poultry (USA) and fish and crustaceans (Norway), EU exports in the remaining banned product categories accounted for the largest Russian import trade share prior to the ban (FAO, 2014). Furthermore, at the time this measure was enforced, Russia constituted the second most important destination for EU agri-food exports, accounting for approximately 10% (DG AGRI, 2014). Though 43% of EU agri-food exports to Russia were hit by the ban (i.e. 4.2% of total EU agri-food exports), further decomposition revealed that specific EU sectors and Member States would be more heavily affected.[6]

In response, the European Commission introduced emergency measures, especially for fruits and vegetable (perishable) products through market withdrawals (free distribution) and compensation for non-harvesting and green harvesting; for milk and dairy products through private storage aid in addition to public intervention for butter and skimmed-milk powder. Exceptional aid to milk producers in Estonia, Latvia, Lithuania and Finland was approved. Lastly additional funds were granted to promotion

[2]Note this paper does not address import restrictions such as quotas (e.g. tariff rate quotas, seasonal quotas, etc.) which remain frequently used in international trade relations.

[3]Presidential Decree No. 560 of 6 August 2014 'on the application of certain special economic measures in order to protect national security of the Russian Federation', and Government Decree No. 778 of 7 August 2014 (amended by Government Decree No. 830 of 20 August 2014).

[4]The EU filed a complaint at the WTO against Russia (member since August 2012) for the measures on imports of live pigs, pork and other pig products from the EU (Dispute DS4750).

[5]Presidential Decree No. 320 of 24 June 2015 320 'on the extension of certain special economic measures in order to protect the national security of the Russian Federation', and Government Decree No. 625 of 25 June 2015.

[6]For a comprehensive picture of relative exposure to the Russian market of countries affected by the ban, based on existing trade flows before the trade prohibition, see DG AGRI (2014), FAO (2014) and European Parliament (2014).

schemes for both EU and foreign markets. With no budgetary impacts, bilateral trade negotiations were intensified in order to facilitate exports to other markets.

Examining the mechanics of a trade ban, the ensuing economic shock gives rise to changes in resource allocation between economic activities. Furthermore, Czaga (2004) notes that an import prohibition worsens the terms of trade for exporting countries,[7] and impacts on both consumers and downstream industries within the country imposing the ban. As a recognised economy-wide market modelling tool, there are several computable general equilibrium (CGE) quantitative assessments of import bans in the agricultural economics literature. These include the ban on Genetically Modified Organisms (GMOs) imports (Anderson and Jackson, 2005; Philippidis, 2010; Henseler *et al.*, 2013); the avian influenza outbreak (Rodriguez *et al.*, 2007) and the Bovine Spongiform Encephalopathy (BSE) outbreak (McDonald and Roberts, 1998; Philippidis and Hubbard, 2001; Chatterjee *et al.*, 2010), whilst a more recent study directly examines the Russian ban (Antimiani *et al.*, 2014). Here, we examine the economic consequences of the Russian ban introduced in August 2014 for both Russia and exporting countries, with a particular focus on the EU exporting countries. We focus attention on the short run, with factor mobility between sectors restricted, in contrast to Antimiani *et al*. (2014).

We use a multi-region CGE methodology, although we characterise the ban employing a different and more intuitive approach (Philippidis, 2010). Moreover, to accommodate the short-run nature of the ban, a specific factors approach that better accommodates the short-run nature of the ban is proposed that restricts the mobility of a share of the production factors within the economy. It should be made clear that the modelling strategy focuses on the consequences of the Russian ban *per se*, and does not take into account any policy responses to the ban by the EU, Russia or any affected country.[8]

The paper is structured as follows. Section 2 presents the methodology which includes the modelling approach, database preparation and scenarios. A carefully designed baseline is used to account for the specific macroeconomic and agri-food trade situation at the time the ban entered into force. In addition, precise import shocks are implemented using detailed tariff line trade data. Results are discussed in section 3. A comparison between simulation results and observed data is presented in section 4 to test the robustness of the model findings. Section 5 concludes.

2. Methodology

2.1. Modelling approach

Multi-region neoclassical CGE models have become the *de facto* tool of choice for assessing the implications of a trade shock and the resulting feedbacks on resource

[7]It is worth mentioning that the ban applied by Russia is partial since it affects selected trade partners. A total import ban would lead to trade volume of zero, thus inhibiting terms of trade as there would be no substitute imports.

[8]Wegren (2014) discusses increasing public support from Russian authorities to develop domestic agricultural and food industries, including financial assistance of 87 billion roubles (approximately €1.2 billion) for Russian agricultural producers to cope with the effects of the ban, and 239 billion roubles (approximately €3.3 billion) transferred to banks in late 2014, for ensuring capital reserves and lending for Russian food producers.

reallocation between competing activities, output, prices and trade flows. This study employs the well-known GTAP model (Hertel, 1997). As a demand driven model, GTAP is based on standard neoclassical assumptions of constrained optimisation to derive intermediate-input, factor and final demand functions. Market clearing equations determine equilibrium prices, whilst a series of accounting conventions ensure that the circular flow of income, expenditure and output are equal. As is typical in such models, imports are treated using a parsimonious CES Armington specification, which encompasses an exogenous treatment of region of origin (substitution elasticity) allowing for two way gross bilateral trade flows. Assuming that all domestic markets clear, neoclassical model closure ensures that withdrawals (savings and imports) equal injections (investment and exports) resulting in a net balance of payments of zero.

The modelling of the ban departs from the traditional 'closure swap approach', where an (endogenous) tariff reaches prohibitively high levels to target exogenous reductions in imports (Anderson and Jackson, 2005; Henseler *et al.*, 2013; Antimiani *et al.*, 2014). The underlying hypothesis is that tariff driven import price increases cause the fall in imports – which is not an accurate depiction of the Russian ban. Instead, this study depicts Russia's self-imposed ban and subsequent loss of access to preferred import trade routes, as a reduction in import demand by Russian consumers (Philippidis, 2010).[9] More specifically, in log linear terms, equation (1) represents cost minimising bilateral (Armington) import demands for '*i*', from export region '*r*' to import region '*s*' ($q_{i,r,s}$), as a function of aggregate utility in region '*s*' ($u_{i,s}$), the bilateral import price ($p_{i,r,s}$), the composite price per unit of utility ($p_{i,s}$), the elasticity of substitution (σ_i) and bilateral consumer utility ($z_{i,r,s}$):

$$q_{i,r,s} = u_{i,s} - \sigma_i[p_{i,r,s} - p_{i,s}] + \sigma_i z_{i,r,s} \tag{1}$$

The composite price (equation (2)) is a trade weighted share ($S_{i,r,s}$) of bilateral import prices and utility, as well as the elasticity parameter, ρ_i:

$$p_{i,s} = \sum_r S_{i,r,s}\left[p_{i,r,s} + \left[\frac{1}{\rho_i}\right] z_{i,r,s}\right] \tag{2}$$

Targeted (exogenous) reductions in Russian imports (i.e. '*s*' = Russia) associated with the ban, are enforced by associated (endogenous) falls in Russian bilateral import demand, which also implies that the per unit cost of utility on banned good '*i*', rises.

2.2. Database

The study employs version 9 of the GTAP database (Narayanan *et al.*, 2015). Benchmarked to the year 2011, it includes gross bilateral trade flows, trade protection and transport margins between 140 regions. The trade data are reconciled with input-output data disaggregated to 57 tradeable sectors, supplemented by macro accounts data. As the most recent dataset of its type, it includes features like Ukrainian accession to the WTO. As a point of departure, further data updates are still required to correctly isolate the impacts of the ban (see discussion below).

[9] In Philippidis (2010), falling utility was associated with reduced confidence in the quality of the imported product. In this paper, falls in consumer utility are rationalised by the fact that Russian consumers are being denied access to their preferred bundle of imported goods.

Table 1
Regional and commodity aggregation

Regional Aggregation (37 regions):
Russia (1)
EU Members (banned) (15): Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Netherlands, Poland, Spain, Rest of the EU.
Other exporters (banned) (4): Canada, USA, Norway, Australia
Key Russian trading partners in commodities which are banned (16): Ukraine, Belarus, Kazakhstan, Other CIS*, Turkey, Israel, Iran, Ecuador, Argentina, Brazil, Paraguay, Uruguay, China, North Africa, Republic of South Africa, New Zealand.
Rest of the World (1)
Commodity Aggregation (12 commodities):
Banned commodities (5): Fruits and vegetables, Fish, Cattle meat, pork and poultry meat, dairy
Other commodities (7): Cereals and oilseeds, other agriculture, live cattle, live pigs and poultry, raw milk, other food, other commodities.

*Other CIS (Commonwealth of Independent States) includes Azerbaijan, Tajikistan, Turkmenistan and Uzbekistan.

The choice of 37 regions (Table 1) is based on those countries most affected by the ban (i.e. EU, Canada, USA, Norway and Australia) and Russia's key trade partners across the selection of banned products. Remaining EU Member States largely unaffected by the ban (i.e. Cyprus, Malta) are aggregated within the Rest of the EU region. All remaining countries enter a residual rest of the world (ROW) region.

The 12-sector aggregation focuses on those banned commodities (Table 1) plus relevant adjacent industries (upstream livestock and raw milk sectors). Remaining sectors are grouped into four aggregates (cereals and oilseeds, other agriculture, other food, and the rest of the economy).

To isolate the impacts of the ban, a careful database update is performed prior to running the simulation experiments. A first step takes into account the changes in the main macro drivers between the benchmark year 2011 and 2014 (i.e. GDP, population, factor endowments, land productivity and Croatian accession into the EU). In a second step, changes in Russia's trade trends with its main partners for those commodities of interest to the ban are implemented exogenously employing additional data (United Nations Statistical Division, 2014). Importantly, the resulting updated data include the aforementioned Russian bans on Canadian and US cattle meat (early 2014) and on EU pig meat due to African swine fever (February 2014) (Table S1 in the online appendix).

To adequately accommodate the short-run supply response from a sudden ban, a 'specific factors' variant of the GTAP database is developed. More specifically, the three existing mobile factors of capital, skilled labour and unskilled labour in GTAP, are each split into a 'sector specific' component and a 'mobile' component, creating six production factors (plus land and natural resources). We assume that 75% are tied to the sector, whilst the remaining 25% continue to be treated as fully mobile between sectors.[10] In addition, we assume that there is zero mobility of land between different

[10]Other combinations (50%, 25% and 0%) of specific factors were also implemented. The results from these data variants are available upon request from the authors.

agricultural activities. The choice of a 'very short run' configuration is coherent with the availability of only 3 months of post-ban trade data (see section 4) with which to compare the veracity of our estimates to actual post-ban market trends.

The updated 2014 benchmark reveals that the EU is a relevant exporter to Russia in all banned products except fish; providing 29% of Russia's fruits and vegetables, 24% of its cattle meat, 58% of its pork and poultry meat and 81% of its dairy imports (Table 2).

Table 2 also shows that Russia is import-dependent on pork and poultry meats from the EU, Canada and the USA, which represent more than a quarter of domestic production. At the other extreme, cattle meat imports from the EU represent only 2% of Russia's domestic market. In terms of Russia's market share of EU Member State exports, Lithuania bears the highest burden from the ban (over 37% of produced fruits and vegetables, almost 15% of cattle meat, 7% of pork and poultry, 8.6 of dairy), together with Poland (over 18% of produced fruits and vegetables) and Denmark (13.3% of cattle meat and 8.8% of pork and poultry meat).

Table 2

Estimated share of trading partners in Russian imports of affected commodities and ratio of import over Russia's domestic production by origin (pre-ban) (%)

	Fruits and vegetables		Fish		Cattle meat		Pork and poultry meat		Dairy	
	Imp.	Prod.	Imp.	Prod.	Imp.	Prod.	Imp.	Prod.	Imp.	Prod.
EU-28	29.0	5.4	4.3	1.4	24.4	1.6	57.8	19.3	81.1	7.1
Australia	0.1	0.0	0.1	0.0	6.6	0.4	0.1	0.0	2.1	0.2
Canada	0.0	0.0	0.1	0.0	0.4	0.0	8.3	2.8	0.0	0.0
Norway			94.8	30.3			0.0	0.0	0.3	0.0
USA	2.8	0.5	0.4	0.1	0.1	0.0	13.4	4.5	0.2	0.0
BANNED COUNTRIES	**32.0**	**5.9**	**99.6**	**31.8**	**31.5**	**2.1**	**79.5**	**26.5**	**83.6**	**7.4**
New Zealand	0.1	0.0			1.5	0.1	0.0	0.0	4.8	0.4
China	7.1	1.3	0.1	0.0	0.0	0.0	0.2	0.1	0.2	0.0
Argentina	3.3	0.6			7.0	0.5	0.3	0.1	2.7	0.2
Brazil	0.1	0.0			33.8	2.2	17.3	5.8	0.0	0.0
Paraguay	0.0	0.0			7.3	0.5	0.0	0.0		0.0
Uruguay	0.1	0.0			11.4	0.8	0.0	0.0	1.0	0.1
Ecuador	6.5	1.2								
Belarus	0.0	0.0	0.0	0.0					6.1	0.5
Kazakhstan	0.0	0.0			0.0	0.0			0.0	0.0
Ukraine					1.7	0.1	1.7	0.6		
Other CIS	7.8	1.4							0.0	0.0
Israel	4.4	0.8	0.0	0.0			0.0	0.0	0.0	0.0
Iran	3.3	0.6	0.0	0.0	0.0	0.0			0.1	0.0
Turkey	15.4	2.8	0.1	0.0	0.2	0.0	0.2	0.1	0.2	0.0
North Africa	7.9	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
R. South Africa	2.1	0.4			0.0	0.0	0.0	0.0	0.0	0.0
RoW	9.9	1.8	0.2	0.0	5.5	0.4	0.9	0.3	1.4	0.1

Source: Authors' own calculations from GTAP database.

Table 3
Import ban shocks (% change from 2014)

	Fruits and vegetables	Cattle meat	Pig and poultry meat	Dairy
Australia	−100	−54.3	0.0	−100
Canada	−100	−0.6	−100	−100
USA	−100	−6.5	−100	−2.3
Austria	−100	−5.0	−5.6	−100
Belgium	−100	−0.7	−89.4	−88.8
Denmark	−99.6	−4.8	−11.7	−100
Finland	−100	0.0	−98.9	−100
France	−99.5	−1.1	−58.6	−89.5
Germany	−100	−2.0	−18.9	−96.5
Greece	−100	−100	−100.0	−86.8
Hungary	−100	−0.9	−50.2	−68.3
Ireland	0.0	−11.7	−85.9	−55.1
Italy	−100	−7.3	−4.8	−88.2
Lithuania	−100	−86.9	−87.7	−89.7
Netherlands	−100	−1.6	−95.5	−98.0
Poland	−100	−32.4	−51.8	−98.8
Spain	−100	−9.8	−4.6	−28.9
Rest of EU	−100	−1.2	−49.1	−94.3
Norway	−100	−100	0.0	−83.0

***Source*:** Authors' own calculations.

2.3. Scenario design

Employing trade data from the United Nations Statistical Division (2014), Russian import reductions on banned products from affected exporting countries are exogenously targeted subject to endogenous consumer utility (demand) reductions. Note that the exogenous import reductions in Table 3 are not necessarily 100%. Firstly, given the broad sector definitions in the GTAP database, banned products may only account for a small share of the trade of that sector. Secondly, given the varied pattern of trade specialisation, the list of banned commodities affects some exporters more than others. In fruits and vegetables, there is almost blanket coverage of the ban, whilst in remaining sectors, the depth of the ban varies significantly by exporter. Interestingly, in the cattle meat sector, the EU's most important exports for the Russian market are trimmings, offal and fats (not covered by the ban), whilst horse, sheep and goat meat, as well as raw animal fat are also not covered by the ban.[11] An important component of pig exports to the Russian market is lard, fats and offal, although under the previous African swine fever ban, these are already removed prior to this analysis (see section 2.2).

[11]'Cattle meat' in the GTAP database includes fresh or chilled meat and edible offal of cattle (bovine), sheep, goats, horses, asses, mules and hinnies; raw fats or grease from any animal or bird. The GTAP sector 'other meat' includes swine and poultry meat, offal, preserves and preparations of swine and poultry meat, swine and poultry meat offal or blood, flours, meals and pellets of meat or inedible meat offal; greaves.

3. Results

The complexity of the CGE model framework renders a full discussion of all the results unwieldy. Instead, the discussion focuses on the main outcomes by sector and region. All model results presented are changes with respect to the updated 2014 database.

3.1. Domestic effects

Price and production effects resulting from the ban are presented in Table 4. The magnitude of the domestic price and output drop in the exporting countries is related to (*ceteris paribus*) the share of their domestic production which is exported to Russia. In fact, in the short term, (low factor mobility) output responses are limited, provoking (in some cases, significant) price falls.

In the fruit and vegetable sector (Table 4), Lithuania and Poland are the most affected countries with price falls of over 10% (13.3% and 11.2%, respectively), and corresponding falls in production of 1.8% and 2.9%. However, Poland is a

Table 4
Change in market prices (P) and quantities (Q) (%)

	Fruits and vegetables		Cattle meat		Pork and poultry meat		Dairy	
	P	Q	P	Q	P	Q	P	Q
Austria	−0.8	−0.1	−0.1	−0.0	0.0	0.0	−0.6	−0.3
Belgium	−2.9	−0.4	−0.1	−0.0	0.0	0.1	−0.5	−0.3
Denmark	−0.7	−0.1	−0.1	−0.1	−0.0	0.1	−0.9	−0.3
Finland	−1.6	−0.2	−0.1	0.0	−0.1	−0.4	−5.7	−2.2
France	−0.6	−0.1	−0.0	−0.0	−0.0	0.0	−0.5	−0.3
Germany	−1.1	−0.1	−0.1	−0.0	0.0	0.0	−0.6	−0.2
Greece	−3.7	−0.3	−0.1	−0.0	−0.0	0.0	−0.4	−0.2
Hungary	−1.3	−0.5	−0.1	−0.0	−0.2	−0.1	−0.4	−0.2
Ireland	−0.5	−0.1	−0.1	−0.0	0.0	0.1	−0.5	−0.1
Italy	−0.9	−0.1	−0.1	−0.0	0.0	0.0	−0.4	−0.2
Lithuania	−13.3	−1.8	−5.5	−2.2	−0.6	−0.2	−3.2	−3.3
Netherlands	−1.6	−0.2	−0.1	−0.0	0.0	0.0	−0.8	−0.2
Poland	−11.2	−2.9	−0.3	−0.2	−0.0	0.0	−0.8	−0.5
Spain	−1.4	−0.1	−0.1	−0.1	0.0	0.0	−0.3	−0.2
Rest of EU	−0.7	−0.1	−0.1	−0.0	0.0	0.0	−0.5	−0.4
EU-28*	−1.9	−0.3	−0.1	−0.0	−0.0	0.0	−0.7	−0.3
Russia	9.5	0.7	0.4	−0.1	5.8	3.2	6.1	4.8
Australia	0.4	0.0	−0.2	−0.1	−0.1	−0.0	−0.2	−0.1
Canada	0.5	0.1	−0.1	0.0	−1.1	−1.0	−0.1	−0.0
Norway	−0.7	−0.1	−0.1	0.1	−0.0	0.1	−0.2	0.1
USA	0.0	0.0	−0.1	−0.0	−0.3	−0.3	−0.1	0.0
ROW	0.9	0.1	0.0	−0.0	0.1	0.1	0.2	0.1

Notes: *EU-28 prices are production weighted average.
Source: Authors' own calculations from model results.

large exporter, (over €150 million per year since 2010 of mainly apples), while Lithuania's exports of fruits and vegetables to Russia are smaller (less than €10 million per year, principally carrots and mushrooms). In addition, Greece (which exports mainly peaches, kiwifruit and strawberries), Belgium (pears, tomatoes and apples), the Netherlands (pears, onions, tomatoes and peppers) and Spain (peaches, citrus fruit, tomatoes and cucumbers) face notable market price falls. At the EU-28 level, fruit and vegetable prices and production decrease by 1.9% and 0.3%, respectively.

Assuming perfect factor mobility for labour and capital, and focusing on the case of Italy, Antimiani *et al.* (2014) report significantly greater production response in their affected sectors. For example, they estimate Italian production falls in fruits and vegetables of 1.1%, compared with 0.1% in our study.[12] As a result, it is expected (although not shown) that price effects in their study are much more modest compared to the current research. Likewise, their reported changes in Italian cattle meat production are modest (0.4%), due to the limited shocks imposed by the ban at this level of aggregation. Comparing with meat estimates in our study, Lithuania, which is the main fresh bovine meat exporter to Russia, is the only Member State exhibiting price and production changes of more than 0.3% (Table 4).

Variations are small in the pork and poultry meat sector. Historically, most EU exports are pig meat, but since most of this trade has been removed in our update procedure owing to food safety concerns in 2014, there is little margin for further impact in this sector. Historically, EU poultry exports to Russia are only moderate (principally from France and Germany) and consequently do not represent a large share of the exports.

Table 4 also shows that dairy and (upstream) raw milk sectors face notable drops in price in Finland (principally cheese, butter and milk) and Lithuania (principally cheese). Although both EU members are relatively modest producers, they featured within the top four dairy exporters to Russia. Due to the ban on dairy, the upstream milk sector in most EU countries experiences a drop in price of over 1% (raw milk results not shown) whilst short run production adjustments are minimal. At the EU level, raw milk price and production decrease by approximately 1.5% and 0.2%, respectively.

Examining the Russian market, prices in the fruit and vegetable and dairy sectors rise by about 9.5% and 6.1%, respectively. Production increases but with lower magnitude. In cattle meat where the ban has a lower coverage, and raw milk which is not directly banned, increases in prices are rather small and changes in production are even negative. This result is related to improved allocative efficiency of the Russian production structure and changes in trade patterns.

As expected, those countries unaffected by the Russian ban witness a rise in market prices and production, such as Belarus which increases its dairy production by 3.3% with a price increase of 4.4% (not shown). On the other hand, the domestic price of fruit and vegetables in Ecuador, CIS countries, Israel, North Africa and Turkey rises between 3% and 7% without significant increases in production (not shown).

[12] In Antimiani *et al.* (2014), complete bans are assumed across all sectors. In the case of fruits and vegetables, this closely approximates the reality, such that the comparison presented is largely explained by the sector specificity modelling assumption.

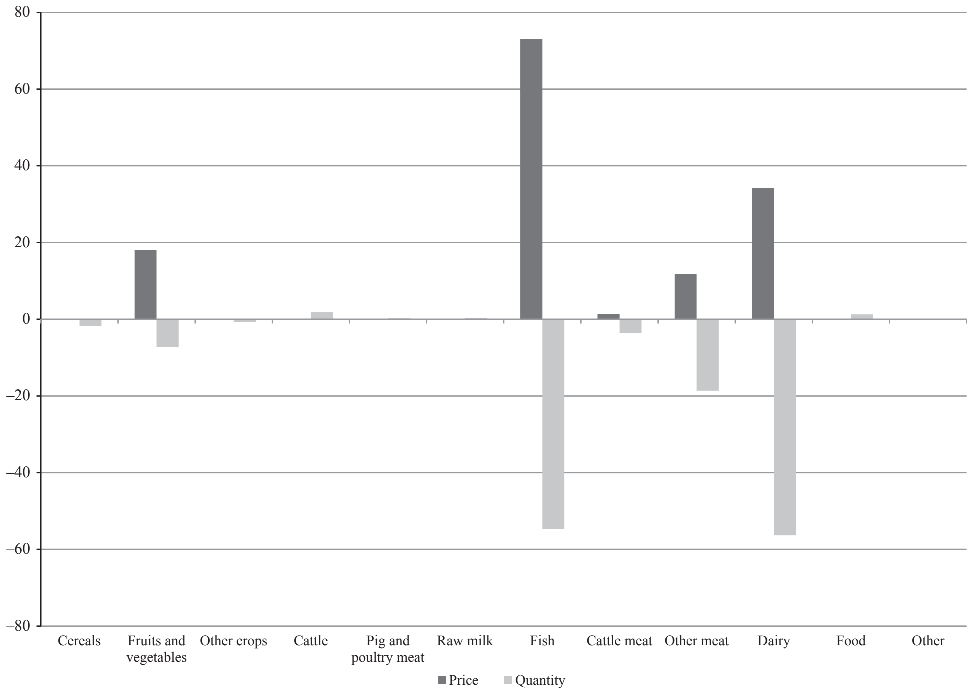

Figure 1. Change in Russian import quantities and prices (%)
***Source*:** Authors' own calculations from model results.

3.2. Trade effects

The highest quantity and price impacts on Russian imports occur in fish (−54%) and dairy (−56%) (Figure 1). Impacts on fruits and vegetables, cattle meat, cattle, and pork and poultry are lower but still significant. Russia can find new sources of imports for banned products, although this is more difficult for fish and dairy for which Russia's dependency on imports from the banned countries is significantly higher.

Table 5 shows that the regions that benefit most from the Russian import ban are Turkey and other CIS countries (fruit and vegetable exports rise by €433 and €165 million, respectively); Brazil, Argentina, Paraguay and Uruguay (summing over these four countries, cattle meat exports rise by approximately €77 million); and Belarus and New Zealand (dairy exports in each country increase by €202 million). The trade pattern is broadly consistent with that reported in Antimiani *et al*. (2014). Nevertheless, the meat sector in our analysis is barely affected (due to the aggregation issue discussed in section 2.3). Thus Antimiani *et al*. (2014) potentially overestimate the extent to which Russia's cattle meat imports are redirected from banned to non-banned countries.

For remaining sectors, our study reports greater domestic price changes due to factor immobility, resulting in larger substitution effects in the Armington function and consequently larger trade increases between Russia and non-banned countries and between banned countries and third countries, compared to Antimiani *et al*. (2014). These trade trends are confirmed when examining real trade data (see section 4).

Table 5

Change in value of Russian imports at constant base year prices by source

	Fruits and vegetables		Cattle meat		Pork and poultry meat		Dairy	
	Million €	%	Million €	%	Million €	%	Million €	%
EU-28	−1,429.3	−100.0	−67.4	−12.2	−112.9	−47.9	−1,493.7	−95.1
Australia	−5.7	−100.0	−76.7	−54.3	0.0	0.0	−32.5	−100.0
N. Zealand	3.4	68.7	2.3	7.1	0.4	116.3	201.5	263.5
China	241.5	68.2	0.0	7.0	10.0	115.0	8.2	271.4
Canada	−1.6	−100.0	−0.1	−0.6	−322.6	−100.0	−0.2	−100.0
USA	−180.4	−100.0	−0.1	−6.5	−496.7	−100.0	−0.1	−2.3
Argentina	102.6	57.5	9.7	6.1	11.6	111.1	108.6	245.7
Brazil	4.0	68.6	44.7	5.8	708.9	97.9	1.4	268.7
Paraguay	0.0	66.8	8.7	5.3	0.7	112.2	0.0	267.1
Uruguay	3.3	66.1	14.2	5.5	0.4	113.5	38.1	243.2
Ecuador	188.4	51.4	0.0	4.8	0.1	109.6	0.1	265.0
Norway	−0.1	−100.0	−0.1	−100.0	0.0	0.0	−3.5	−83.0
Belarus	1.1	79.7	0.0	−8.0	0.1	107.3	202.0	179.9
Kazakhstan	0.2	64.5	0.0	6.1	0.1	110.0	0.9	267.7
Ukraine	0.0	70.2	2.5	5.6	56.4	59.2	0.0	268.6
Other CIS	165.8	38.3	0.0	6.7	0.1	109.1	0.6	262.1
Israel	108.6	52.7	0.0	6.4	0.4	114.2	0.4	272.6
Iran	116.5	59.7	0.0	6.6	0.3	113.9	2.9	270.9
Turkey	433.0	56.5	0.4	5.5	8.4	110.3	9.5	268.1
North Africa	256.8	61.3	0.1	6.4	0.8	110.8	1.9	272.2
R. South Africa	80.7	65	0.0	6.9	0.8	113.5	1	272.1
ROW	382.5	68.2	8.9	7.0	44.4	114.2	65.1	271.6

***Source*:** Authors' own calculations from model results.

EU exports to other regions expand, although not sufficiently to compensate for the loss of the Russian market. Indeed, in the absence of any market intervention, the expansion in EU exports of banned commodities to third countries recovers about one-fifth of the lost trade volume with Russia.[13] However, when exports of non-banned (agricultural and non-agricultural) commodities are also accounted for, the EU recovers 81% of the banned exports to Russia by expanding trade with other regions.[14] Since the domestic prices of banned commodities decline significantly, local producers in affected regions gain trade competitiveness through purchases of cheaper intermediate inputs.[15]

Bearing in mind that the model does not capture re-exportation effects, the EU re-orientates exports toward other regions, including those not affected by the ban which divert their production away from their own domestic markets. Table 6 shows that

[13]This statistic is calculated by dividing the row sum 'Total' in Table 6, with the row sum 'EU-28' in Table 5.

[14]A full set of results for all regions and sectors is available from the authors upon request.

[15]The assumption of perfect competition is a key factor in this conclusion. In non-perfect markets, price changes may well be merely translated into margin changes along the food chain.

Table 6

Change in value of EU exports to non-EU countries at constant base year prices

	Fruits and vegetables		Cattle meat		Pork and poultry meat		Dairy	
	Million €	%	Million €	%	Million €	%	Million €	%
Australia	1.5	7.3	0.0	−0.4	−2.3	−1.6	5.7	4.4
N. Zealand	0.2	9.5	0.0	−0.2	−0.4	−1.3	1.7	4.6
China	2.2	5.3	0.7	0.2	2.7	0.6	29.4	6.9
Canada	3.0	4.8	0.0	−0.1	−1.6	−4.7	4.2	3.0
USA	12.9	5.6	−0.1	−0.2	−10.4	−3.2	31.3	4.0
Argentina	0.7	12.3	0.0	1.4	0.4	4.6	0.6	9.5
Brazil	7.5	7.0	0.0	1.3	0.5	4.2	2.9	7.5
Paraguay	0.0	10.0	0.0	1.6	0.0	4.1	0.0	8.4
Uruguay	0.1	6.9	0.0	1.4	0.1	4.7	0.1	11.1
Ecuador	0.1	11.7	0.0	1.6	0.0	2.0	0.1	6.4
Norway	11.0	3.2	0.1	0.3	−0.2	−0.2	1.9	1.6
Belarus	17.1	15.3	1.3	9.7	2.8	1.7	1.6	40.5
Kazakhstan	7.6	39.7	0.4	2.9	0.7	5.3	4.1	17.6
Ukraine	26.2	20.5	0.6	1.6	10.9	10.2	6.1	13.2
Other CIS	2.1	31.2	0.3	1.4	0.8	5.3	7.2	13.0
Israel	2.0	12.9	0.8	1.8	0.1	0.4	1.7	3.3
Iran	1.6	8.8	0.3	1.0	0.1	3.9	3.3	4.8
Turkey	8.7	14.5	1.4	0.4	0.3	2.6	1.6	4.4
North Africa	32.1	7.3	0.3	0.6	0.6	4.7	43.1	3.8
R. South Africa	0.8	6.4	0.0	0.1	2.1	2.0	2.6	3.5
ROW	97.3	6.1	0.4	0.1	16.1	0.5	210.5	4.6
Total	234.9	7.3	6.6	0.4	23.4	0.5	359.6	4.6

Source: Authors' own calculations from model results.

Ukraine, North Africa, Norway, USA, Rest of the World (aggregate that includes a vast set of countries such as China or Gulf countries), Belarus, Kazakhstan and other CIS countries are key markets for EU export reorientation.

There are significant increases in intra-EU fruit and vegetable trade, especially with origin from EU members (i.e. Poland, Spain, Belgium, Netherlands and Greece) that re-direct part of their ban affected fruit and vegetable exports towards the single market (Table 7). This increase in intra-EU fruit and vegetable trade represents 2% of EU exports after the ban and corresponds to 41% of the loss in EU exports to Russia. However, this does not imply significant changes in EU consumption since the share of fruits and vegetables trade in consumption is rather small (Table S2, in the online appendix). Nevertheless, fruits and vegetables is the sector which exhibits the greatest increase in internal market trade (–€626.7 million, Table 7) and exhibits the largest drops in market price (Table 4). Interestingly the increase in intra-EU trade operates at the expense of extra-EU trade. In other words, for all banned commodities the EU substitutes former imports with EU production. Table 7 quantifies this trade diversion effect.

For most Member States, the percentage of banned items in cattle meat exports to Russia is <10%. Furthermore, the decrease of exports to Russia is rather diverse for non-EU countries facing the ban (below 1% for the USA, up to 50% for Australia).

Table 7

Change in value of intra-EU trade at constant base year prices by source

	Fruits and vegetables		Cattle meat		Pork and poultry meat		Dairy	
	Million €	%	Million €	%	Million €	%	Million €	%
Austria	−0.6	−0.3	0.5	0.2	0.6	0.1	−1.9	−0.2
Belgium	117.6	7.1	−0.3	−0.1	8.4	0.4	−7.9	−0.4
Germany	0.7	0.1	−0.8	−0.1	0.4	0.0	20.6	0.3
Denmark	−0.4	−0.3	2.2	0.6	7.9	0.3	15.1	1.2
Spain	166.3	2.2	0.4	0.1	2.1	0.1	−13.2	−1.8
Finland	0.2	3.4	−0.1	−0.5	0.7	1.2	70.1	44.8
France	5.5	0.3	−0.7	−0.1	9.7	0.5	−38.0	−0.8
Greece	52.8	9.8	0.0	−0.1	0.2	0.4	−3.5	−1.2
Hungary	2.3	1.2	0.0	−0.0	11.6	1.6	−4.6	−1.5
Ireland	−0.4	−0.3	1.0	0.1	1.6	0.2	−12.8	−0.9
Italy	−10.0	−0.3	0.2	0.1	3.3	0.3	−18.5	−1.2
Lithuania	31.6	48.3	14.2	48.3	4.1	5.1	61.2	19.5
Netherlands	86.7	2.9	−0.3	−0.0	6.6	0.2	46.5	1.6
Poland	180.4	46.4	8.9	1.4	7.7	0.5	13.4	1.3
Rest of EU	−5.9	−0.4	−1.4	−0.1	3.6	0.2	−32.1	−1.0
Total intra-EU	626.7	2.9	24.0	0.2	68.5	0.3	94.3	0.3
Extra-EU*	−828.1	−6.0	−15.8	−0.5	−92.5	−2.9	−86.8	−6.2

Notes: *The row 'extra-EU' quantifies change in value of trade between the EU and all trade partners outside the EU market.
Source: Authors' own calculations from model results.

There are slight increases in EU exports of cattle meat to (*inter alia*) Belarus, Israel and Turkey, but these are marginal (Table 6).

The impacts on the pork and poultry meat are modest (Table 6), since the pig sector has already been facing export restrictions in the Russian market. However, the EU pork and poultry meat sector is facing an indirect channel of impact. The countries covered by the ban are significant trade partners for the EU (13% of the EU exports go to Australia, the USA and Ukraine). Resulting excess domestic supply and falling market prices in those countries, has the indirect effect of strengthening import trade links between banned countries and third countries unaffected by the ban (e.g. CIS countries and South Africa).

European Union exports of dairy products to all regions increase. The most prominent percentage increase is observed in exports to CIS countries which face supply deficiencies following the increase in demand from Russia. However, the increase in value of EU exports at constant prices[16] is higher for the USA, China and North Africa where the EU already has a significant volume of trade. The ban also increases the trade of banned commodities between Member States. However, such an increase in the trade of dairy products is modest (0.3%, Table 7) compared to the increase in exports outside the EU (4.6%, Table 6).

[16]All prices in the model are relative and are assumed to equal unity. Hence the quantities in the model are at the same time value of that economic variable at the constant base year prices. The term 'value at the constant base year prices' is used to avoid any confusion for the readers.

Table 8

Change in value of EU exports at constant base year prices by source

	Fruits and vegetables		Cattle meat		Pork and poultry meat		Dairy	
	Million €	%	Million €	%	Million €	%	Million €	%
Austria	−1.0	−0.4	−0.7	−0.2	1.0	0.1	−13.8	−1.4
Belgium	−10.1	−0.5	−0.5	−0.1	1.2	0.1	−17.8	−0.7
Germany	−21.1	−1.3	−3.3	−0.2	4.0	0.1	−126.9	−1.6
Denmark	1.0	0.6	−1.1	−0.2	3.3	0.1	−32.9	−1.6
Spain	−57.6	−0.7	−3.1	−0.5	2.7	0.1	−12.5	−1.4
Finland	−3.2	−29.5	−0.1	−0.4	−4.9	−4.7	−182.1	−33.4
France	−20.3	−0.7	−1.6	−0.1	−4.9	−0.2	−104.6	−1.6
Greece	−47.3	−6.0	−0.3	−1.3	0.2	0.3	−3.9	−1.2
Hungary	−4.5	−2.2	−0.1	−0.1	−7.8	−0.8	−4.5	−1.3
Ireland	−0.2	−0.1	−0.8	0.0	0.4	0.1	−6.0	−0.3
Italy	−52.7	−1.5	−4.0	−0.7	1.5	0.1	−55.8	−2.5
Lithuania	−22.8	−14.8	−14.7	−21.2	−6.0	−6.3	−90.6	−16.6
Netherlands	−22.1	−0.6	−1.0	0.0	−8.7	−0.2	−71.6	−1.6
Poland	−287.3	−27.2	−4.3	−0.4	1.6	0.1	−156.7	−10.1
Rest of EU	−18.6	−1.1	−1.2	−0.1	−4.5	−0.2	−160.2	−4.0
Total	−567.8	−2.1	−36.9	−0.3	−21.0	−0.1	−1,039.8	−2.8

Source: Authors' own calculations from model results.

The trade impacts for banned commodities consist of a reduction of exports for all the Member States (Table 8). EU dairy exports suffer the most (Finland −€182 million, Poland −€157, Germany −€127, France −€105 and Netherlands −€72). The fruit and vegetable sector is also heavily hit, Poland (−€287 million) bears half of the EU export fall, while Spain (−€58), Italy (−€53) and Greece (−€47) face most of the remaining decline.

3.3. Welfare effects

As expected, by imposing a unilateral ban, Russia suffers an equivalent variation (EV) or real income loss of −€3.4 billion, which is equivalent to a 0.24% reduction in *per capita* utility. In comparison, the EU-28 only witnesses an EV loss of −€126 million (0.0025% *per capita* utility). Other countries whose exports are affected by the ban (i.e. Australia, Canada, USA and Norway) also experience welfare losses, although once again, in *per capita* terms, the impacts are negligible.[17] As Russia seeks out alternative trade partners for those affected products, the main beneficiaries in *per capita* utility terms are Belarus, rest of CIS, Israel and Turkey. Belarus records a *per capita* real income gain of 0.20%, whilst in the other three cases the magnitude is closer to 0.02–0.03%.

Russia's EV loss is decomposed into Terms of Trade (ToT), allocative efficiency (ALLOC), capital goods (CGDS) and bilateral utility (BAN) effects (Figure 2). The

[17]In all the affected countries, the *per capita* utility (real income) loss is <0.01%.

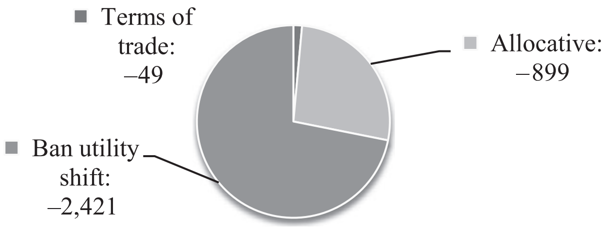

Figure 2. Decomposition of Russian welfare loss (million €)
***Source*:** Authors' own calculations from model results.

ToT is a money metric measure of the rate of exchange between exports and imports (current account) and savings and investment (capital account). Examining the ToT result, the restriction on imports of certain agri-food commodities results in a short-run rise in Russia's import price index, leading to a (small) ToT loss of –€49 million.

The ALLOC measure is the result of changing resource or product usage in the presence of market distortions (taxes, tariffs and subsidies). Since a tax (subsidy) discourages (encourages) resource usage compared with undistorted or Pareto efficient markets, increases in taxed (subsidised) activities yield a positive (negative) marginal social value (Huff and Hertel, 2001). The reported ALLOC loss of –€899 million reflects the net reduction in Russian agri-food imports (which face tariffs).

Finally, the bilateral utility effect, which is specific to Russia, measures the money metric equivalent of lost utility resulting from the prohibition of certain agri-food imports. Thus, the negative EV value of –€2,421 million is the result of inward shifts in the utility function due to restrictions on import quantities.

A further decomposition of the bilateral utility EV result by banned commodities and exporters is presented in Table 9. Approximately 48% of the total (–€1,163 million) is due to the ban on fruits and vegetables, of which –€412 million, or 17%, comes from banned fruits and vegetables from Poland. Similarly, losses of –€468 million (19%) result from banned dairy products, –€460 million (19%) on banned fish (mainly from Norway), –€291 million (12%) on banned pork and poultry meats and –€38 million (1.6%) on banned cattle meat.

4. Comparison of Model Results with Observed Data

As an *ex-ante* tool of empirical international trade impact analysis, multiregional CGE models still offer the most complete framework. Nevertheless, to examine the veracity and increase confidence in the model estimates, where possible, a comparison with actual trade data in the wake of the ban is necessary (Piermartini and Teh, 2005). It should, however, be noted that such a comparison is complicated by the existence of many non-price factors outside the scope of the model which also motivate market trends (e.g. exchange rate changes, local climatic conditions, emergency market intervention measures such as support for perishable fruits and vegetables, and promotion of EU agricultural products, etc.). In light of this, the principal aim is to qualitatively assess the extent to which the model correctly predicts the directional trends of trade flows and prices, whilst additional commentary on the magnitudes of the changes is also made, where data permit.

Table 9
Bilateral utility effects in Russia by origin (country and commodity) (%)

	Fruits and vegetables	Fish	Cattle meat	Pork and poultry meat	Dairy	Total
Australia	0.15	0.01	0.71	0.01	0.47	1.35
Canada	0.04	0.01	0.01	3.90	0.00	3.96
USA	4.04	0.07	0.00	6.19	0.03	10.33
Austria	0.03	0.00	0.02	0.01	0.17	0.24
Belgium	3.94	0.00	0.01	0.10	0.30	4.36
Denmark	0.01	0.11	0.09	0.16	1.07	1.44
Finland	0.09	0.06	0.00	0.07	3.57	3.79
France	1.38	0.24	0.03	0.30	1.69	3.65
Germany	0.81	0.00	0.07	0.06	2.37	3.31
Greece	3.39	0.27	0.00	0.00	0.02	3.68
Hungary	0.22	0.00	0.01	0.37	0.02	0.61
Ireland	0.00	0.00	0.02	0.01	0.18	0.22
Italy	1.91	0.01	0.06	0.12	0.75	2.84
Lithuania	2.06	0.00	0.27	0.11	2.29	4.74
Netherlands	4.20	0.01	0.02	0.19	2.30	6.73
Poland	17.02	0.00	0.18	0.21	2.21	19.62
Spain	8.00	0.01	0.05	0.07	0.07	8.20
Rest of EU	0.76	0.09	0.01	0.15	1.77	2.77
Norway	0.00	18.12	0.00	0.01	0.06	18.18
Total	48.03	19.02	1.57	12.03	19.34	

Source: Authors' own calculations from model results.

4.1. Trade

After 7 months of embargo, EU agri-food exports to third countries increased by 2.4% between August 2014 and February 2015 compared to the previous year. In February 2015, EU agri-food exports to third countries rose by 6.2% compared to February 2014 (DataM, 2015a). This result is due to an increase of exports to the US and China, together with the euro depreciation against other currencies (DG AGRI, 2015).

The model results are compared with HS6 observed trade data from COMEXT (DataM, 2015a), which are aggregated to the GTAP sectoral and regional definitions. To adequately cater for seasonality and the impact of the ban, we compare trade figures between August 2014 (i.e. start of the ban) and November 2014 (i.e. latest available observations). Finally, since model results are mostly reported in real terms, we look at the real change in trade volume. That is, we deflate the 2014 export values to 2013 prices and compare with the reported value of exports in 2013. We mainly use agricultural price data from DG-AGRI (DataM, 2015b) and data from national statistical offices of key affected EU Member States (Central Statistical Office of Poland, 2015; Statistics Finland 2015; Statistics Lithuania, 2015). Our findings suggest that the trends observed are close to actual trade observations.[18]

[18]Table S3 in the online appendix presents actual data observations of intra- and extra-EU trade changes.

Consistent with our findings, actual trade data show that EU-28 fruit and vegetable exports to Belarus and North Africa have increased significantly. Exports to Canada, Turkey, Kazakhstan and other CIS countries also increase although not as much as foreseen by the model. The actual trade data also reveal that the EU-28 recovered 43% of its lost trade with Russia, compared with 35% reported in our model results.

Focusing on commodity aggregates, the actual data also support our finding that intra-EU fruit and vegetable trade increases. For example, Spain, Greece and Poland increase their exports to the EU-28 (intra-EU trade), although contrary to our simulation, exports from the Netherlands, France, Germany and Hungary to the EU-28 decline. On the other hand, model results suggest an overall 2% increase in intra-EU fruit and vegetable exports while actual data show that it declined by 1.9%, mostly due to the fall in exports of Germany, France, Hungary and the Netherlands.

In terms of extra EU-28 cattle meat exports, observed trade data reveal that quantity changes are small. The only significant increase occurred in EU-28 exports to China. There were slight increases in EU-28 exports of cattle meat to Belarus, Turkey, Kazakhstan and Ukraine but these are marginal as suggested by our model results. As simulated, impacts on the pork and poultry meat market arising from the Russian ban were insignificant, leading to 0.3% increase in EU-28 exports.

Observed EU trade data for the dairy sector confirm our model simulations (i.e. that EU-28 exports to all regions of the world increased) except in the cases of China, Ukraine and Brazil. The most prominent increase in percentage terms is observed in EU-28 exports to Belarus, which is consistent with our model results, although increases in EU exports to other CIS countries are not as high as the model simulation suggests.

4.2. Prices

Comparison of observed prices with the model results corroborates the main findings presented in our simulations (Table 4). We compared the model domestic price changes reported in this paper with the actual changes in domestic prices reported in DataM (2015b) and national statistical offices of key affected EU Member States.

According to our simulations, Lithuanian and Polish fruits and vegetables experience the highest domestic price fall. In both countries the actual changes for fruits and vegetables prices is apparent and consistent with the model results (Figure S1 in the online appendix). In Lithuania and Poland, the declines in prices are substantial while the decrease in the EU-28 average price is relatively less. Interestingly, the EU average price starts rising after November, eventually rising above pre-ban levels.

Observed data for the beef price in Poland and Lithuania confirm that the fall is milder compared to the fall in vegetable and fruits prices (Figure S2 in the online appendix). On the other hand, it also verifies that prices in Lithuania have fallen significantly while the price fall in Poland was relatively milder.

In the dairy markets, significant price falls in Lithuania and Finland reported in our results are confirmed by observed price changes. The average EU-28 price also declines as suggested by the model results. However, the magnitude of the fall in dairy prices is greater than those predicted by the model (Figure S3 in the online appendix), no doubt reflecting recent world dairy market conditions, which are not included in our model.

Focusing on the effects in Russia, according to statistics from the Russian government, in 2014 agricultural output increased by 3.7% (USDA, 2015), which is consistent with our results (see Table 4). As noted above, additional non price factors such as the weakening of the rouble against other currencies, local climatic conditions, or state support to agricultural production and rural social development programmes (USDA, 2015) will also have had an impact on Russian agriculture.

5. Concluding Remarks

This study quantitatively evaluates the pure market impacts of the Russian import ban on agri-food trade, although not accounting for reactionary compensation measures undertaken by affected exporters and Russia itself. In the short term, due to factor immobility, production has very little leeway to adjust, provoking notable variations in prices, which reflect most of the import ban shock. As expected, the magnitude of the price decrease is related to the share of national production which is exported to Russia. The strongest price decrease occurs in the fruit and vegetable sector in Poland, Lithuania, Greece and Belgium and in the raw milk and dairy sectors in Finland and Lithuania. In the longer term (if the ban is maintained over the years, full results available on request), where factors of production exhibit greater mobility between sectors, the magnitude of the price (quantity) changes is expected to be lower (higher).

Dairy and fruits and vegetables are the sectors where the EU exports suffer most. Lithuania, Finland and Poland face the largest decreases. In the short term, the EU can recover about one-fifth of the lost trade volume with Russia in banned commodities through expansion of exports in other markets. While Russia is able to substitute imports for some banned products, alternative sources seem limited. Regions whose exports with Russia increase include Turkey and CIS countries (fruit and vegetables, and dairy) and South America (meat).

Results indicate that Russia is the region with the highest welfare loss (approximately –€3.4 billion, equivalent to a 0.24% reduction in *per capita* utility). Banned countries suffer a welfare loss due to the reduction in exports to Russia while in countries which substitute exports from banned countries, particularly Turkey and Brazil, welfare increases. A comparison with observed trade data (post ban) suggests that the model assumptions and scenario design present a plausible picture in highlighting the most important alternative markets for EU exporters and most significant changes in the domestic prices of the EU member countries.

As in any modelling exercise, the usual caveats apply (i.e. assumptions, estimated or calibrated parameters, commodity aggregation bias etc.). A key assumption relates to the assumed split between 'sector specific' and 'mobile' factors to capture the short-run impacts of the ban. As the results comparison in section 4 shows, this assumption generates an improved characterisation of what happened in the wake of the ban, although given a dearth of short-run supply elasticities compatible with the GTAP sector/regional concordance, no attempt is made to fine tune this factor split on an activity-by-activity basis. Other splits between mobile and specific factors were simulated (not shown), which reveal, as expected, that with greater factor mobility (i.e. longer time horizons), the qualitative trends in the results remain unchanged, where price effects are reduced and quantity effects are increased.[19]

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[19]For interested readers, the results of differing factor splits are available from the authors upon request.

Finally, it should be noted that our modelling strategy does not capture some critical trade elements. First, exports to the Russian market face non-tariff barriers (e.g. SPS measures) which might delay the creation of alternative sources to banned imports.[20] Second, those countries unaffected by the ban have to consider that deepening economic relations with Russia could damage their international reputation, which could additionally reduce Russian imports from third countries but cannot be taken into account by an economic model. Finally, the model design impedes imports to be re-exported, especially if entering in the Russian market through its custom union with Belarus and Kazakhstan.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Change in fruit and vegetable price in Poland, Lithuania and EU-28 (% from prices in July 2014).

Figure S2. Change in cattle meat price in Poland, Lithuania and EU-28 (% from prices in July 2014).

Figure S3. Change in dairy prices in Poland, Lithuania and EU-28 (% from price in July 2014).

Table S1. Baseline preparation (% change from 2011).

Table S2. Change in consumption of banned commodities in Russia and EU (%).

Table S3. Change in EU-28 exports by product and destination (%, 2014 compared to 2013).

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[20]As an illustration, New Zealand cheese plants need certification to export to Russia. Those products with certification, already exported to Russia, could cope with an increase in trade if production capacity allows. However, those without certification would not be permitted to enter the Russian market or face delays owing to certification with the associated costs of compliance.

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