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Diploma Thesis

Agricultural trade between Russia and European Union: Gravity model approach

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Agraricultural trade between Russia and European Union: gravity model approach

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Objectives of thesis

The aim of the research is to compare agricultural trade flow between Russia and European Union for the period of 2000-2017, find some regularity and estimate influence of Russian import ban.
The tasks of the research were set in order to achieve the aim:

- Estimation of current conditions of agricultural trade in Russia and European Union;
- Making regression models for countries and for particular types of agricultural products.
- Making the cluster analysis for the particular group of argicultural products

Methodology

1) Objectives specification

2) Basic literature overview specification

3) Data collection process

4) Quantitative analyses

5) Syntheses of the most relevant results coming from the analytical part of the thesis and their discussion

6) Specification of relevant conclusions related to objectives

The proposed extent of the thesis

60-70 pages

Keywords

Russia, agriculture, trade, gravity model, commodities, territories, value, development, Russian import ban

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Declaration

I declare that I have worked on my diploma thesis titled "Agricultural trade between Russia and European Union: Gravity model approach" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the diploma thesis, I declare that the thesis does not break copyrights of any their person.

In Prague on 24.11.2019 _____

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Agricultural trade between Russia and European Union: Gravity model approach

Abstract

European Union is Russia's largest agricultural trading partner and this cooperation has long history. Imposition of sanctions on certain product groups in 2014 significantly affected trading relations. A gravity model helps to understand and evaluate the characteristics of agricultural trade between countries.

The aim of the research is to compare agricultural trade flow between Russia and European Union for the period of 2000-2017, find some regularity and estimate influence of Russian import ban using regression models for each European country and for particular types of agricultural products. The dataset sample consists of 12,096 observations and 29 countries. The gravity model of dependence of imports and exports from each European country to Russia takes into account such variables as the GDP (US doll), the distance (km) and the dummies (a common boarder, a common language, a common history and seaport availability).

The findings of the research are following: the classical gravity model is feasible for import from Russia to EU countries. Thus, the smaller the distance between countries, the greater the trade flow between them and the larger GDP of both countries and the greater the trade flow between them. Also, the gravity model is feasible not only for countries, but also for the particular group of products. The results of the cluster analysis showed the impact of sanctions on each of 24 groups of products imported into Russia (not just those products that have been under Russian ban). It is possible to say that the impact of sanctions is deeper than previously thought.

Keywords: Russia, agriculture, trade, gravity model, commodities, territories, value, development, Russian import ban

Obchod se zemědělskými produkty mezi Ruskem a Evropskou unií: přístup založený na gravitačním modelu

Abstrakt

Evropská unie je největším obchodním partnerem Ruska v oblasti zemědělství a tato spolupráce má dlouhou historii. Uložení sankcí určitým skupinám potravin v roce 2014 významně ovlivnilo obchodní vztahy. Gravitační model pomáhá pochopit a vyhodnotit charakteristiky obchodu se zemědělskými produkty mezi zeměmi.

Cílem výzkumu je s použitím regresních modelů porovnat tok zemědělského obchodu mezi Ruskem a Evropskou unií v období 2000–2017 a identifikovat trend a dále pak odhadnout vliv ruského zákazu dovozu na každou evropskou zemi a pro konkrétní druhy zemědělských produktů. Vzorek datového souboru zahrnuje 12 096 pozorování a 29 zemí. Gravitační model závislosti dovozu a vývozu z každé evropské země do Ruska bere v úvahu změny v HDP (hrubý domácí produkt), vzdálenost (km) a fiktivní proměnné (společná hranice, společný jazyk, společná historie, dostupnost námořních přístavů).

Výsledky výzkumu jsou následující: klasický gravitační model funguje pro import z Ruska do zemí EU. Čím je tedy vzdálenost mezi zeměmi menší, tím větší je obchodní tok mezi nimi, a čím větší je HDP země, tím větší je obchodní tok mezi zeměmi. Gravitační model funguje nejen pro země, ale také pro konkrétní skupinu produktů. Výsledky klasterové analýzy ukázaly/potvrdily dopad sankcí na všech 24 skupin zboží importovaných do Ruska (nejen na výrobky, které byly pod ruským zákazem). Lze říci, že dopad sankcí je hlubší, než se dříve myslelo.

Klíčová slova: Rusko, zemědělství, trh, gravitační model, komodity, teritorium, hodnota, vývoj, ruský zákaz importu/dovozu

Table of content

List of pictures

List of tables

List of abbreviations

ASEAN – Association of Southeast Nations
EAEU – Eurasian Economic Union
EU – European Union
FAO – Food and Agriculture Organization of the United Nations
FTA – Free trade area
GATT – General Agreement on Tariffs and Trade
GDP – Gross Domestic Product
HS – Harmonised System
NAFTA – North American Free Trade Agreement
MEROCSUR – Southern Common Market
OECD – Organization for Economic Cooperation and Development
RU - Russia
UN – United Nations
US – The United States of America
USA – The United States of America
WTO - World Trade Organization

1 Introduction

In recent decades, the globalization of economic processes has continued, and international trade has been growing continuously, faster than output. The creation of the GATT, then WTO, and other forms of preferential trade agreements, the establishment of international institutions to facilitate and promote trade, one way or another, simplify the exchange of products and services. The international trade process, representing alternative production technology, modifies and internationalizes traditional technologies. The global model of production is becoming more and more familiar. Its various intermediate components are produced in different countries on different continents, and many large manufacturing firms of the corporation have become transnational long time ago. Almost all countries, except for Cuba, North Korea. Iran, are actively involved in international trade. The recent economic crisis has revealed that although such a model of the global economy implies greater diversification, serious problems of the trade key participants will be transferred along the product chain to almost all economies in the world. In such circumstances it is greatly significant to understand the mechanisms and limitations of international trade in agricultural products, factors, affecting the volume, and direction of trade flows.

Exploring trade flows and testing the hypothesis about the application of the gravity model in relation to agriculture will help to understand the patterns that govern agricultural trade between Russia and EU countries.

Moreover, the analysis of trade flows in dynamics will provide estimation of the impact of Russian import ban both on individual countries and on specific agricultural products.

2 Objectives and Methodology

2.1 Objectives

The aim of the research is to compare agricultural trade flow between Russia and European Union for the period of 2000-2017, find some regularity and estimate influence of Russian import ban.

The tasks of the research were set in order to achieve the aim:

- Estimation of current conditions of agricultural trade in Russia and European Union;
- Making regression models for countries and for particular types of agricultural products.
- Making the cluster analysis for the particular group of argicultural products

2.2 Methodology

The present research is aimed to estimate current condition of agricultural trade between Russia and European Union countries using the gravity model approach.

To achieve the aim of the research, it is necessary to use methods of quantitative and qualitative analysis – the document analysis, the econometric analysis, the statistical analysis, the analysis of panel data and time series, the cluster analysis, etc.

The Doment anlisys included the traditional document anysis (to study the statistical data and an international agreement between countries) and the expert survey (to study experts' opinion about modern economic situation). Empirical base of the document anlisys contains official governmental documents (legal text of WTO, ban decree), the statistical data (Faostat, Eurostat, Worldbank) and unique publications (FAO publication).

For agricultural product groupe analysis it was essential to use 2-digit level of the Harmonized System (HS). Names of agicultural groups are listed in Table 1.

Table 1 HS main agricultural items (24 commodities)

Group number	Commodity group name
1	Live animals
2	Meat and edible meat offal
3	Fish, crustaceans, molluscs, aquatic invertebrates
4	Dairy products, eggs, honey, edible animal products

5	Products of animal origin
6	Live trees, plants, bulbs, roots, cut flowers etc.
7	Edible vegetables and certain roots and tubers
8	Edible fruit, nuts, peel of citrus fruit, melons
9	Coffee, tea, mate and spices
10	Cereals
11	Milling products, malt, starches, inulin, wheat gluten
12	Oil seed, oleaginous fruits, grain, seed, fruit, etc.
13	Lac, gums, resins, vegetable saps and extracts
14	Vegetable plaiting materials, vegetable products
15	Animal, vegetable fats and oils, cleavage products, etc.
16	Meat, fish and seafood food preparations
17	Sugars and sugar confectionery
18	Cocoa and cocoa preparations
19	Cereal, flour, starch, milk preparations and products
20	Vegetable, fruit, nut, etc. for food preparations
21	Miscellaneous edible preparations
22	Beverages, spirits and vinegar
23	Residues, wastes of food industry, animal fodder
24	Tobacco and manufactured tobacco substitutes

Source: Comtrade database

The research involves the dataset with the data about export and import of agricultural products (24 types) from each of 28 countries of EU for 18 years. The data source is UnComtrade, Faostat, Worldbank database for the period of 2000-2017.

The data was under cleaning process and check normality. In order to eliminate inflation's influence the data was transformed into the form of constant price with using the annual producer price index from Faostat for import and export trade flow and constant prices GDP. Software STATA 15 was used for calculations.

The gravity model was made for the econometric analysis of trade flows. This method is quite popular as its results can be easily compared with intuitive results. The first model was suggested by Tinbergen (1962, p.271). It was very simple and consisted trade import and export with such variables as the GDP import, the GDP export and the distance.

Here the suggested model shows dependence between import, export, the GDP RU, the GDP EU, the distance and the dummy variables (a boarder, a language, a history, availability of sea ports)

$$F(\text{agri trade flow}) = Imp_i \times Exp_i \times GDP_i \times GDPru \times D_i \times B_i \times L_i \times H_i \times S_i \times BN_i \quad (1)$$

Where:

i – a country of 28 EU countries

Imp_i – import from Russia to each of EU countries in US dollars

Exp_i - export into Russia from each of EU countries, US dollars

D_i - distance between capitals of each of EU countries and Russia (Moscow or Sankt-Petersburg), km

B_i - availability of a common border

L_i - related language,

H_i – a common history,

S_i - availability of sea ports.

BN_j – import ban (sanction)

The gravity model, made in terms of research, presented dependence of volume of each of 24 imported/exported products. Used dataset included more than 24,000 observations.

Several types of econometric models were used in the research (OLS, GLS). Various tests were carried out for data heteroskedasticity, missing variables and tests for choosing the best model (Ramsey test, White test, Breuch Pagan test, Hausman test).

The ordinary least squares (OLS) model (Dougherty, 2007, p.89)

In the research the OLS model for the 4th models was implemented as it is basic one.

$$y_t = \alpha_1 x_{i1} + \alpha_2 x_{i2} \cdots + \alpha_p x_{ip} + \varepsilon_t \qquad (2)$$

The generalized least squares (GLS) (Wooldridge, 2004, p.589**)**

In the research the GLS was implemented as it is modification of OLS and the classic model didn't confirm BLUE. The GLS model solves the problem of heteroscedasticity.

The generalized squares is a modification of OLS which takes into account the inequality of variance in the observations.

$$L \propto -\ln(\sigma^2) - \frac{1}{2}\ln|\boldsymbol{V}| - \frac{1}{2\sigma^2}(\boldsymbol{y} - \boldsymbol{X}\boldsymbol{\beta})'\boldsymbol{V}^{-1}(\boldsymbol{y} - \boldsymbol{X}\boldsymbol{\beta}) \qquad (3)$$

The GLS estimators are the maximum likelihood estimators

The panel data (Baum, 2006, p.219)

In the research the panel data was implemented as it took into consideration specificity of the dataset which provided mutilated estimation of the OLS.

$$y_{it} = \sum_{k=1}^{k} x_{kit}\beta_{kit} + e_{it} \quad i = 1\ldots..M,\ t = 1\ldots\ldots T \qquad (4)$$

Where n is a number of individuals and T is a number of periods.

The analysis comprised 2 kinds of models - the random effect model and the fixed effect model. The fixed effect model takes into consideration unclear effects which are out of estimation. However, in this case the dummy variable and the distance were omitted from the model as they were not changed as time passed and the model eliminated them.

The random effect model

$$y_{it}=\beta_0+\beta_1*x_{it}+u_i+\varepsilon_{it} \quad (5)$$

This model assumes that individual differences are random. Individual effects u_i – a random variable.

The best solution was implementation of the random effect model as it provided the most reasonable results.

The fixed effect model (Stock, 2010, p.540)

$$y_{it}= \beta_1 x_{1it}+ \quad .... \quad + \beta_k x_{kit} + a_i + u_{it} \quad (6)$$

Where i=1....n, t=1...T; X_{1it} is the value of the first regressor for entity i in time period t, X_{2it} is the value of second regresor and so forth; a_1.....a_n are entry-specific intersepts.

The models were subjected BLUE test. The classic tests Breusch-Pagan test and White test were made to identify heteroscedasticity. Ramsey test was made to check validity of the model specification.

Ramsey test (ovtest). A test regression is a specification-error test for omitted variables. This test amounts to fitting y=xb+zt+u and then testing t=0. Powers of the fitted values are used for z.

Breusch-Pagantest for heteroskedasticity (hottest) Test presents an evidence against the null hypothesis that t=0 in Var(e)=sigma^2 exp(zt). The null hypothesis also includes the assumption that the regression disturbances are independent-normal draws with variance sigma^2.The normality assumption is dropped from the null hypothesis.

White test (estatimtest, white) performs an information matrix test for the regression model and an orthogonal decomposition into tests for heteroskedasticity, skewness, and kurtosis

Hausman test was utilized to compare the fixed effect model and the random effect model and Breusch – Pagan LM test – to compare the GLS model and the LM model.

Hausmanspecification test (Hausman fixed random). This test is used in the research for comparison of two models.

Breusch - PaganLM test for random effects (xttest0) presents Breusch and Pagan (1980, p.239) Lagrange multiplier test for random effects, a test that Var(v_i)=0. Used in research for comparison of the panel gravity model. This test is used in the research for comparison of two models.(Stata, 2019, p.2248)

The research comprized the cluster analysis based on Ward's methods as it implemented the analysis of variance to estimate the distance between clusters. Generally this method is very efficient but it tends to create small clusters.

The cluster analysiswas based on Ward's methods (Ward, 1963, p.236).

Ward method is suggested to estimate distance between two clusters A and B using sum of square.

$$\begin{aligned} \Delta(A,B) &= \sum_{i\in A\cup B} \|\vec{x}_i - \vec{m}_{A\cup B}\|^2 - \sum_{i\in A} \|\vec{x}_i - \vec{m}_A\|^2 - \sum_{i\in B} \|\vec{x}_i - \vec{m}_B\|^2 \\ &= \frac{n_A n_B}{n_A + n_B} \|\vec{m}_A - \vec{m}_B\|^2 \end{aligned} \tag{7}$$

Where m_i is the center of the cluster j and n_j is the number of points in it. Δ is called the merging cost of combining the clusters A and B.

3 Basic concepts of world trade

3.1 Economic theories as a precondition for international trade

The development of world trade is based on the benefits that it provides to countries engaged in trade. The theory of international trade provides the basis for profit from foreign trade or the concept of foreign trade flows. International trade is a tool for countries to accumulate their experience in order to increase the productivity of available resources, thereby increasing the number of products and services that they produce, and improving the welfare of the population.

There are a lot of theories of international trade – the mercantilism theory, Adam Smith theory, David Ricardo ideas, Heckschler-Olin theorem, Levitt ideas, Ribshinsky theorem, the theory of Samuelson and Porter trade theory.

The mercantilism theory is a system of opinions of economists of XV and XVII centuries, focused on active intervention of the state in economic activity. The main representatives are Thomas Mann and William Stafford.

The mercantilism theory of international trade arose during initial accumulation of capital and great geographical discoveries, based on the idea that the presence of gold reserves is the basis of the prosperity of the nation. Mercantilists believe that foreign trade should be focused on obtaining gold, as utilized ordinary goods cease to exist in case of a simple exchange of goods but the gold is accumulated in the country and can be rThe EUsed for international exchanges.

At the same time, trading was considered a zero-sum game when the winning participant automatically turns into the losing one, and vice versa. To maximize the benefits, it was proposed to strengthen government intervention and monitor the state of foreign trade. The trade policy of mercantilism, called protectionism, boils down to creating barriers to international trade that protect domestic producers from foreign competition, stimulate exports and limit imports by imposing tariffs on foreign goods and foreign trade in gold and silver in exchange for their goods (Reinert, 2009, p.704).

The absolute advantage theory of Adam Smith. In the book "An Inquiry into the Nature and Causes of the Wealth of Nations" Smith discussed with mercantilists the idea that countries are interested in free development of international trade, since they can benefit from it, no matter they are exporters or importers (Smith, 2017, p.16). Each country

should specialize in the production of products for which it has an absolute advantage - an advantage based on different amounts of production costs in countries participating in foreign trade. The refusal to produce products for which the countries do not enjoy absolute advantages and the concentration of resources on the production of other products lead to an increase in the total production volumes, an increase in the exchange of products of their work between countries.

Adam Smith's theory of absolute advantage suggests that the real wealth of the country is the goods/products and services available to its citizens. If a country can produce a particular product in greater volume and cheaper than other countries, then it has an absolute advantage. Some countries could carry goods/products more effective than others. The country's resources are channelled into profitable industries as the country cannot compete in unprofitable industries. This leads to an increase in the productivity of the country as well as the qualification of the workforce; Long periods of production of homogeneous products encourage the development of more efficient working methods. Natural benefits for one country: climate; territory; resources. Benefits acquired for a single country: production technology, that is, the ability to produce a variety of products.

The theory of comparative advantages of David Ricardo. In the book "Principles of Political Economy and Taxation," Ricardo showed that the principle of absolute advantage was only a special case of the general rule and supported the theory of comparative (relative) advantage. When analyzing the guidelines for the development of foreign trade, two factors must be taken into account: on the one hand, economic resources - natural, labor, etc. - are unequally distributed across countries and, on the other hand, that the actual production of different goods requires different technologies or combinations of resources. (Ricardo, 2004, p.260)

According to Ricardo, the benefits available to countries are not once and for all, so even countries with absolutely higher production costs can benefit from trade. It is in the interest of each country to specialize in a production in which it has the greatest advantage and the least weakness and for which it is not absolute, but the relative benefit is the greatest - such is the law of comparative advantage of David Ricardo. According to him, total output will be maximum when each product will be manufactured by the country in which the opportunity costs (imputed) are lower. Thus, a relative advantage is an advantage based on lower opportunity costs (imputed) in the exporting country. From

there, the two countries participating in the exchange will benefit from specialization and trade.

The Heckscher–Ohlin theorem. This theorem refers to the neoclassical concepts of international trade. The main provisions of their theory were as follows: firstly, in countries there is a tendency to export products for which the factors of production available in the country are used in excess and, on the contrary, to import products for production of which relatively rare factors are necessary; secondly, in international trade, "factor prices" tend to be equalized; thirdly, the export of goods can be replaced by the movement of factors of production beyond national borders. The neoclassical concept of Heckscher-Olin is proved useful in explaining the reasons for the development of trade between developed and developing countries, while in exchange for raw materials imported into developed countries, machinery and equipment were imported into the countries in development. However, not all international trade phenomena fit into Heckscher-Olin's theorem, as the center of gravity of international trade is gradually moving towards mutual trade of "identical" products between "identical" countries. (Reinert, 2009, p.198).

Leontief's paradox. An American economist has questioned the rules of the Hecksher-Ohlin theory, and the results showed that after the war, the US economy specialized in types of production requiring relatively more labor than capital. The paradox of Leontief lies in the fact that the share of capital-intensive goods in exports can increase, while labor-intensive goods can be reduced. In fact, the proportion of labor-intensive products did not decrease in the analysis of the US trade balance. The reason for solving Leontief’s paradox is that the labor intensity of US imports is very high, but the price of labor in the cost of goods/products is well below the price of the hand of US exports. The US labor force is capital and labor intensive, which can have a significant impact on labor prices on exports. The share of labor-intensive supply in US exports is increasing, confirming Leontief's paradox. This is due to the increased share of services, labor prices and the structure of the US economy. This has led to an increase in the labor intensity of the entire US economy and does not exclude exports (Meade, 2005, p.824).

The theory of Samuelson. In the mid-twentieth century, American economists P. Samuelson and V. Stolper improved the Heckscher-Ohlin theory, imagining that in the case of uniform factors of production, equipment identity, perfect competition and of the

complete mobility of goods/products, international trade equalized the price of the factors of production. The authors base their concept on the Ricardo model with the additions of Heckscher and Ohlin and consider the trade not only as a mutually beneficial exchange, but also as a way of reducing the gap in the level of development between countries (Leamer, 1995, p.15).

The theory of the product life cycle. Theodore Levitt explained and justified in his opinion that the product, as soon as it appears on the market and before leaving it, goes through a cycle in five stages. (Levitt, 1965, p.82). First stage is product development. The company finds and implements a new product idea. Currently, sales are zero, costs increase. Second stage brings the product to the market. Due to the high costs of marketing activities, sales are not increasing. The third stage is rapid market conquest, increased profits; The fourth stage is maturity. Sales growth is slowing, with most consumers already attracted. The level of profit remains unchanged or decreases due to an increase in the cost of marketing activities to protect the products of the competition. The last stage is decline. Lower sales and reduced profits.

The Rybchinsky's theorem consists in the assertion that, if the value of one of the two factors of production increases, in order to maintain constant prices for goods and factors, it is necessary to increase the production of products in which this factor increased is used intensively and to reduce the production of other products using intensively a fixed factor (Leamer, 1994, p.9). For prices of goods to remain constant, the prices of the factors of production must remain unchanged. The prices of the factors of production can only remain constant if the ratio of the factors used in the two sectors remains constant. If a factor increases, this can only happen if production increases in the sector in which this factor is intensively applied and production decreases in another sector, which will result in the release of a fixed factor which will become available for be used with a growing factor in the expanding sector.

The modern theory for international trade was suggested by Porter. **The Michael Porter Trade theory** was reflected in his book “The Competitive Advantage of Nations”. This theory introduces the concept of national competitiveness. (Porter, 1998, p.758) From Porter’s point of view, national competitiveness determines the successes and failures of a particular sector and the country's position in the global economy. National competitiveness depends on industry capabilities. The interpretation of a country's

competitive advantage is based on the role of the country of origin in stimulating renewal and improvement, that is, stimulating innovation. Government measures to maintain competitiveness:

- The influence of government on factor conditions;
- The influence of the state on demand conditions;
- Government influence on related and supportive industries;
- The influence of government on business strategy, structure and competition.

Full competition in the domestic market is an important incentive for success in the global market. From Porter’s point of view, the predominance of state-supported enterprises is a negative decision that leads to wastefulness and inefficient use of resources. Porter's theoretical premise is to develop a national-level recommendation base to increase the competitiveness of foreign trade in the United States, New Zealand, and Australia.

3.2 Regulation of international trade

The regulation of international trade is divided into state regulation and regulation through international agreements and the creation of international organizations.

Methods of regulating international trade by states can be divided into two groups: tariff and non-tariff (Guzheva, 2009, p.50).

1. Tariff methods are reduced to the use of tariffs - special taxes imposed on products of international trade. Customs duties - a levy collected by the state for the clearance of goods and other valuables abroad. Such a tax, called a tax, is taken into account in the price of the products and is ultimately paid by the consumer. Customs duties involve the use of import duties to prevent the importation of foreign goods into the country, as export duties are less used.

The form of calculation distinguishes rights:

- ad valorem, which are invoiced as a percentage of the price of the goods;
- specific, are billed in the form of a certain amount of money the volume, mass or unit of goods.

The most important objectives of the use of import duties are both a direct restriction on imports and a restriction of even unfair competition. Its extreme form is dumping - the sale of goods on the foreign market at prices lower than those of an identical product on the domestic market.

2. Non tariff methods suggested combination direct and indirect constrains on non-national economic activity using wide spectrum of political, administrative and economic measures. Non tariff methods include:

- quotas - the establishment of quantitative parameters in which certain foreign trade operations are possible. In practice, quotas are usually constituted in the form of lists of goods whose free importation or exportation is limited to a percentage of the volume or value of their domestic production. When the quantity or amount of the quota is exhausted, the export (import) of the corresponding product ceases;
- licensing - issuing special permits (licenses) to commercial entities for the conduct of foreign trade operations. It is often used with quotas to control licensed quotas. In some cases, the licensing system is a kind of customs tax used by the country to generate additional customs revenue;
- embargo - a ban on import-export operations. It can apply to a specific group of products or be introduced for particular countries;
- exchange control - a restriction in the monetary sphere. For example, a financial quota may limit the amount of money an exporter can receive. Quantitative restrictions may apply to the volume of foreign investment, the amount of foreign currency exported by citizens abroad, etc .;
- taxes on import-export transactions - taxes as non-tariff measures that are not governed by international agreements, such as tariffs, and are therefore levied on both domestic and foreign goods. Government subsidies to exporters are also possible;
- administrative measures, which are mainly associated with restrictions on the quality of products sold on the domestic market. An important place is taken by national standards. Failure to meet country standards may result in a ban on importing imported products and selling them domestically. Similarly, the system of national freight rates often creates benefits to be paid for the transportation of goods to exporters in relation to importers. In addition, other forms of indirect restrictions may also be used: closure of certain ports and railway stations to foreigners, control of the use of a certain proportion of

domestic raw materials, prohibition of the purchase by public bodies of imported goods in the presence of national counterparts, etc.

The following are terms that are important for understanding economic cooperation and development, which is necessary in trade relations. OESD offers a follow-up definition of these terms (OESD, 2019).

Free trade area (FTA): This is a group of countries in which tariff and non-tariff barriers are often removed. Countries that draw up a free trade agreement remove trade barriers, but they can also coordinate their trade policies with countries that are not part of the free trade agreement. An example would be The North American Free Trade Agreement (NAFTA) and Association of Southeast Nations (ASEAN).

Customs Union: This is an agreement according to which the parties to the agreement agree to establish a free trade zone among themselves, introduce a common external tariff for goods from countries that are not members of the union, and coordinate their activities with the activities of third countries. Foreign trade policy. - member states. An example is The Southern Common Market (MEROCSUR). The European Union (the EU) is perhaps the best example of a well-functioning customs union in which its members trade freely with each other and support a common trade policy in non-member trade.

Common market. This is a customs union, which provides for the liberalization of the flow of regional factors of production, in particular labor and capital. Once again, the EU is a good example of a common market because it allows labor and capital to move freely across borders.

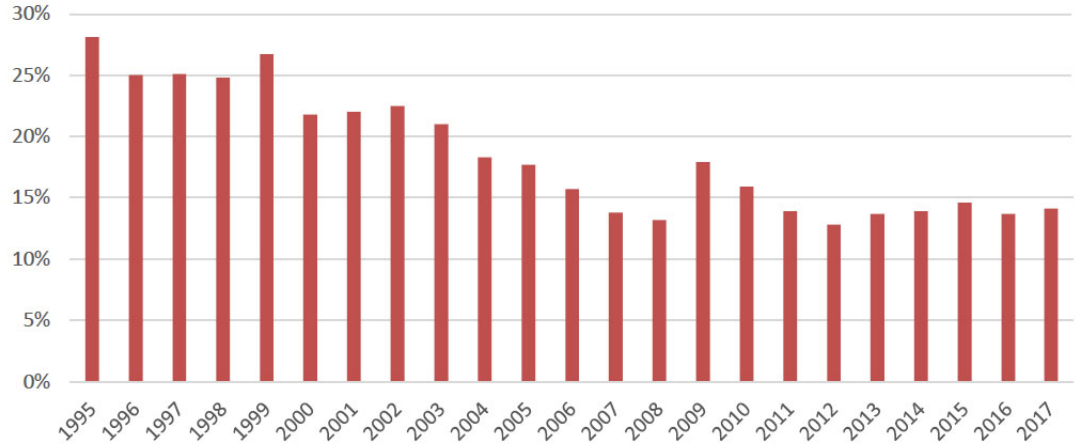
The Economic Union: An economic union is a common market, with the management of certain economic policies, in particular macroeconomic and regulatory policies. The use of a universal currency and the delegation of market surveillance functions to supranational entities are one example. The EU is an example of an economic union - the only modern example. EATHE EU is becoming an effective economic union and has not yet ensured effective coordination of macroeconomic and regulatory policies across the group.

3.3 Current state of International trade in Russia

3.3.1 Specifics of agricultural trade in Russia

Considering Russia's international trade in agricultural products, it is worth noting that, the share of food products in the structure of Russia's imports still remains high (14-15%) and exceeds exports in absolute terms (Figure 1), despite a significant drop in imports from the second half of 1990th years (Figure 2).

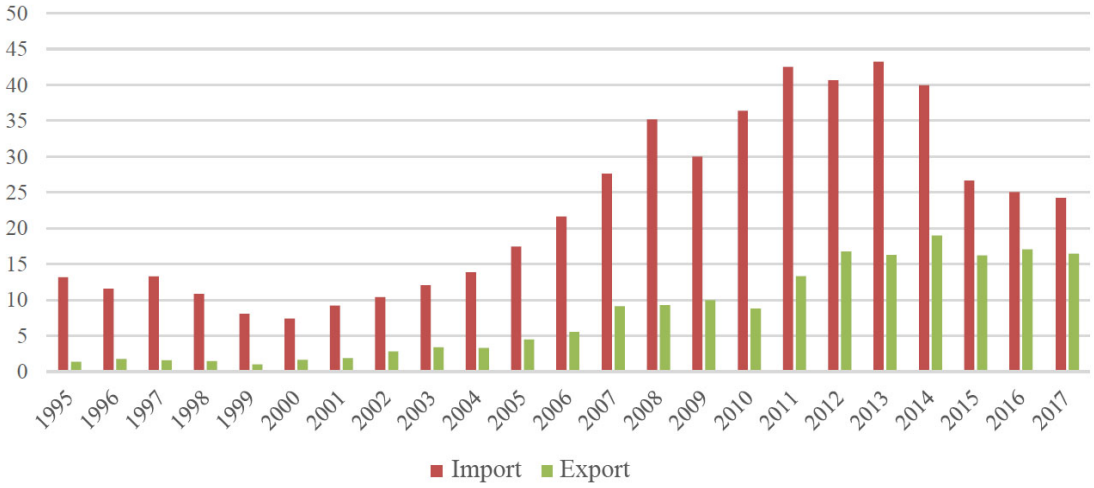
Figure 1: The share of food products in the structure of imports of Russia



Sourse: Rosstat, 2019

In addition, over the past 10 years there has been a steady positive trend in agricultural exports. At the same time, since 2014, the volume of imports of food products and agricultural raw materials has been reduced.

Figure 2: Dynamics of Russian exports and imports of agricultural products. bln. US doll.



Sourse: Rosstat, 2019

It indicates that the course on import substitution, announced in 2014, has a serious effect on the agricultural sector. Russia has become significantly less likely to consume imported agricultural products and at the same time has increased its export volumes in the agricultural sector (Figure 2).

Also, we can see that the crisis of 2008-2009 and 2014-2015 did not significantly affect Russia's foreign trade in agricultural products. Thus, exports even increased slightly in 2009 against the backdrop of a general slowdown in world markets. The dynamics of production volumes in the industry is lagging in relation to GDP due to the presence of strict long-term international contracts for the purchase of agricultural products, plant vegetation, etc. Therefore, the fall in GDP usually precedes the drop in production in the agricultural sector and agricultural exports. At the same time, imports declined significantly in 2014, primarily due to the introduction of a food embargo by Russia against Western countries, and also due to a significant deterioration in trade relations with Ukraine.

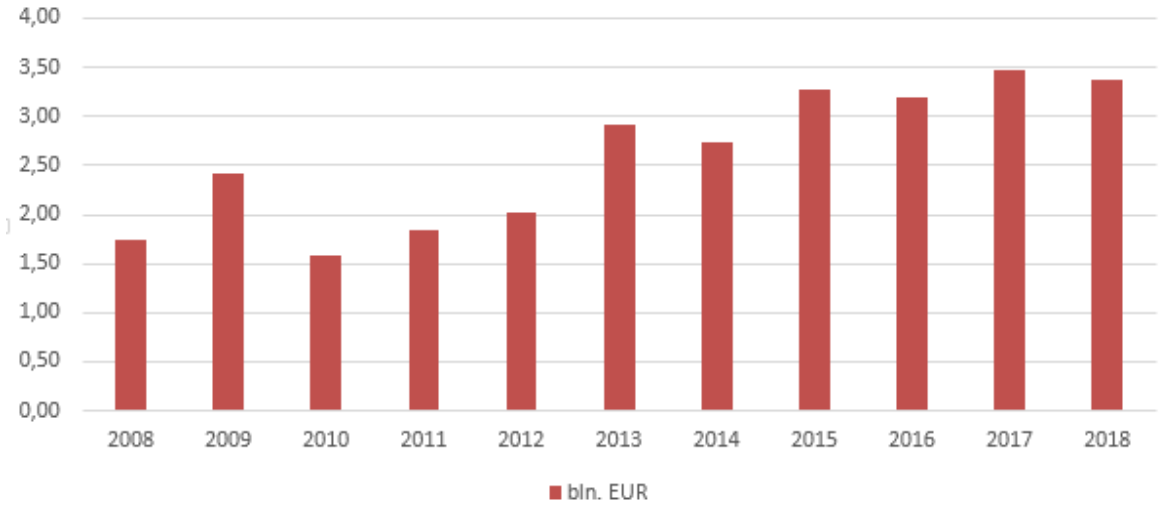
3.3.2 Government support of Russian agriculture

In EU countries, agricultural support is highly developed and government support for agricultural enterprises is very important for the entire population of the country and ensuring food security

However, the study (Webb, 2010, p.23) provides the opposite point of view. Developed countries such as the USA, Canada, Germany have very good support for agriculture, but agricultural producers, in order to make more profit, focus on the production of “cheap products” such as corn syrup instead of fruits, etc. This negatively affects the health of the end user.

In Figure 3. You can see the amount of money allocated to agriculture in Russia by years. And it is necessary to take into account the fact that in 2014 there was a sharp drop in the ruble exchange rate, which provoked a large increase in inflation, which partially devalued the allocated money.

Figure 3: Subsidy assistance dynamics in agriculture of the Russian Federation in 2008-2018



Source: Ministry of Russian agriculture report, authors 'calculation, 2019

Due to the extensive form of agriculture in Russia, the Russian government decided to send most of the state support, about 40% to cover the interest rate on investment loans for the development of the material and technical base of agriculture in the Russian Federation. (Kontsevaya, 2017, p.28)

According to the government subsidies for investments program, any agricultural organization or farm can take part in it at a time and receive subsidized loan rates to develop its material and technical base for the creation of intensive production. However, the number of organizations using this program is quite low.

The reason this program has a low popularity is comprehensive. This is a very large amount of documents that must be filled upon receipt, and low awareness of organizations on the possibility of obtaining state support, a high interest rate for using an investment loan, a high level of inflation and insecurity in public policy in the future.

Lending to agricultural organizations, especially investment, is not popular among banks. This is due to a high level of risk, seasonality of production, low liquidity of collateral assets.

3.4 Russian import ban

In 2014 7th August, Canada, Australia, Norway, the United States and the European Union countries imposed sanctions against Russia, and Russia, in turn, introduced counter-

sanctions against Western countries, including an embargo on the supply of certain types of agricultural products to the country (certain types of meat, fish, milk and dairy products , vegetables, fruits and nuts), raw materials and foodstuffs, the country of origin of which is the state that made the decision to impose economic sanctions against Russia. This export trade flow covered as a result, the import substitution policy that has been pursued earlier has gained particular importance, and today, and in the near future, is one of the key and most relevant areas of agricultural development. In Table 2 is presented import trade flow per commodity to Russia from the European Union, which was under ban in 2014.

Table 2 Ranking of commodity types affected by Russian import ban in 2013.

Commodity type (RH classification)	thou. US dollars	%
2 Meat and edible meat offal	1 028 024	22,47
4 Dairy products, eggs, honey, edible animal product nes	917 701	20,06
8 Edible fruit, nuts, peel of citrus fruit, melons	735 050	16,07
21 Miscellaneous edible preparations	502 554	10,99
7 Edible vegetables and certain roots and tubers	452 361	9,89
19 Cereal, flour, starch, milk preparations and products	394 418	8,62
20 Vegetable, fruit, nut, etc food preparations	313 778	6,86
16 Meat, fish and seafood food preparations nes	126 043	2,76
3 Fish, crustaceans, molluscs, aquatic invertebrates nes	104 553	2,29
Total	4 574 482	100

Source: Comtrade database, own calculation, 2014

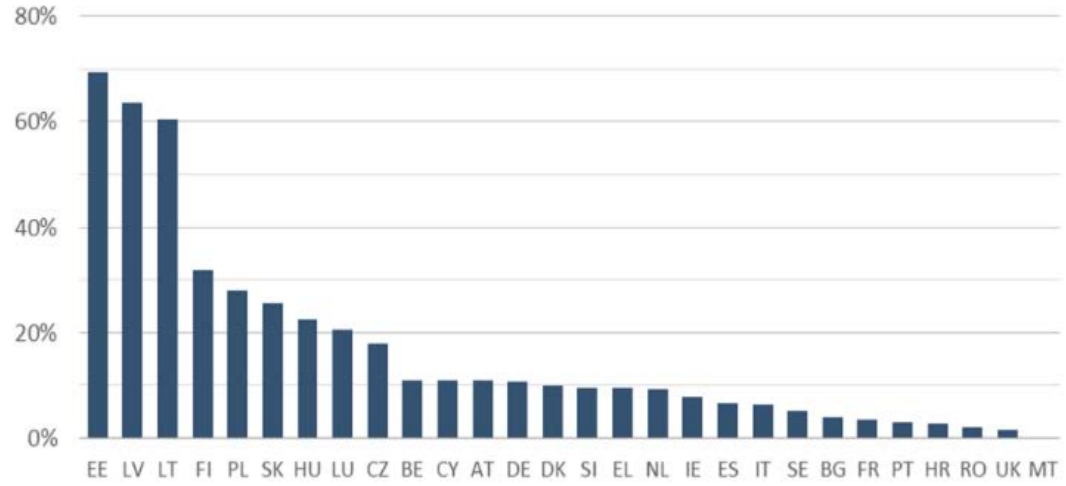
We can see that meat, dairy product and fruits share is covered 58,6% in total banned amount. The European Union is under the greatest influence; Norway Australia, Canada and Norway are less affected

Despite the fact that the sanctions were not aimed directly at Russian producers of agricultural products, Russian producers benefited from their introduction. So, the introduction of sanctions led to a strong weakening of the ruble, as a result, exporting agricultural products became more profitable. However, the sanctions also led to a drop in competition in the agricultural market, which almost inevitably leads to lower quality. Consumers outside Russia are still more demanding on the quality of products, and therefore, it is expected that those products that were previously supplied to the western market also became of worse quality and, accordingly, less attractive to EU consumers (Zhuravleva, 2016, p.361).

In addition, food ban, gradually expanding to cover the number of countries and the list of sanctioned goods, significantly limited the import of food products into Russia, including fruits and vegetables. This kind of protectionist policy expectedly led to the replacement of imported agricultural products with local ones (Donnik, 2015, p.55). So, the volume of imports of products in 2014 amounted to 39.9 billion US dollars, and in 2015 it decreased by one third to 26.5 billion. Import substitution as a whole gave an impetus to the development of the agricultural industry, in particular, increasing the profitability and financial stability of enterprises in the industry (Ryabovol, 2016, p.275). However, as a result, as already mentioned above, competition in the industry has weakened, and manufacturers have been able to increase production volumes, maintaining relatively high prices.

On the other hand, the food embargo led to a shortage of imported goods on the Russian market, and, accordingly, in order to satisfy Russia's own needs both for unprocessed goods as milk, fruit and processed agricultural products as cheeses, sausage. It was necessary to reduce the export of agricultural products, since it is impossible to quickly increase the production base. At the same time, agricultural products produced in the European Union did not end up in Russia as a result of ban, and there was an overabundance of agricultural products in some markets (Polish apples serve as a vivid example), as a result, the prices of these goods became cheaper, European and American consumers rebuilt their consumption and overall the need to export other agricultural products from Russia fell (Smirnov, 2018, p.38).

Figure 4: Share of agri-food exports to Russia in 2013 (%)

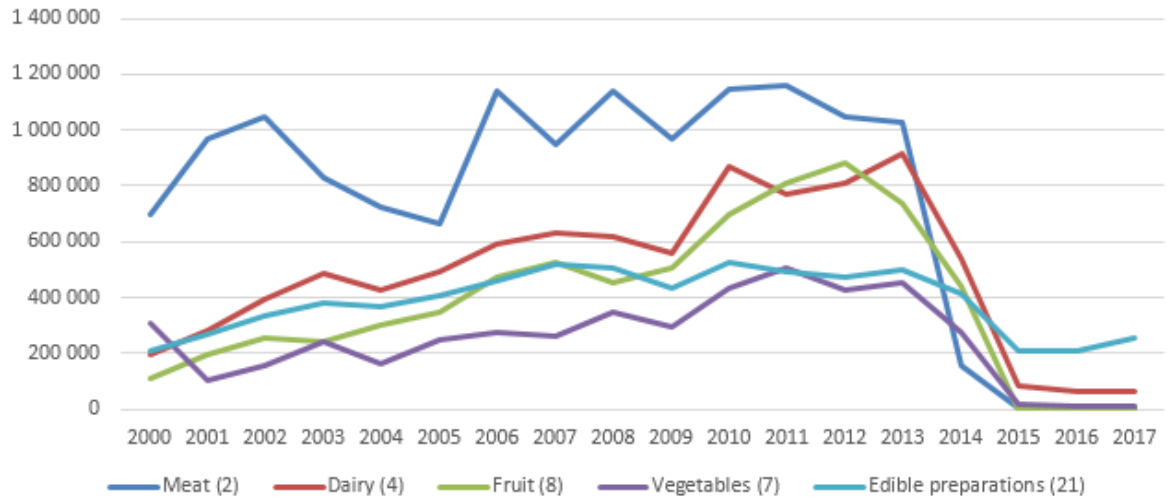


Source: (Smutka, 2016, p.297)

As evident from the Figure 4, three countries, which had greatest influence of import ban, are Estonia, Latvia and Lithuania. Agricultural trade with Russia consists more than 60% of total agricultural trade. For countries from Eastern bloc (Poland, The Slovak Republic, Hungary and The Czech Republic) and nearest neighbor Finland, the agricultural trade is only 20%. For the rest of EU countries the share of Russian export is less than 10 %, this amount is relatively small and can easily redistributed to other countries.

Figure 5 presents three of most affected commodity by Russian ban – meat, dairy, fruit, which covered 80 % of total amount of banned agricultural products.

Figure 5: Five banned products covered 80% of Russian ban, mln. US dollars



Source: Comtrade database, own calculation, 2018

As it can be observed in Figure 5 all products have dramatic drop, meat and dairy has the biggest influence. However, in Russia meat was substituted by imported one from Paraguay, Brazil and Belarus.

Latvia and Poland had more than half banned products in import trade flow to Russia (see Figure 6). Moreover, comparison of Figure 6 and Figure 4 shows that double press – big share of export to Russia in total agricultural export and biggest share of banned products.

Figure 6: Share of banned products in exports to Russia in 2013 (million The Euros)

Source: (Smutka, 2014, p.295)

Smutka devoted his work to Russian import ban. It also increases the overall competitiveness of Russian agricultural trade, On the other hand, the competitiveness of certain product groups has been decreased (Smutka, 2016,p 439).

As an example of quality of import substitution, there is interesting study devoted to cheese. Paper (Mirzobobo, 2018, p.371) examines the preferences of Russian cheese consumers. Russian consumers do not consider Russian cheese hazardous to health, and believe that buying local cheese is the right thing and supports Russian farmers and milk producers. However, the study also shows that with the growth of education and income level, people prefer foreign cheese.

3.5 Evolution of agricultural trade

3.5.1 Main players

Since 2000 agricultural trade has grown significantly. The rapid growth in agricultural trade from 2000 to 2008 led to reduction in 2009-2012 and has since grown slowly. With the changing demand and the emergence of new importers and exporters of agricultural products, world production continues to grow. The scope and structure of international trade has also expanded significantly. The growing importance of emerging economies, such as Brazil, China, India, Indonesia, and the Russian Federation, has become a major event in global agricultural markets. Changes in the structure of trade also include increased trade between developing countries.

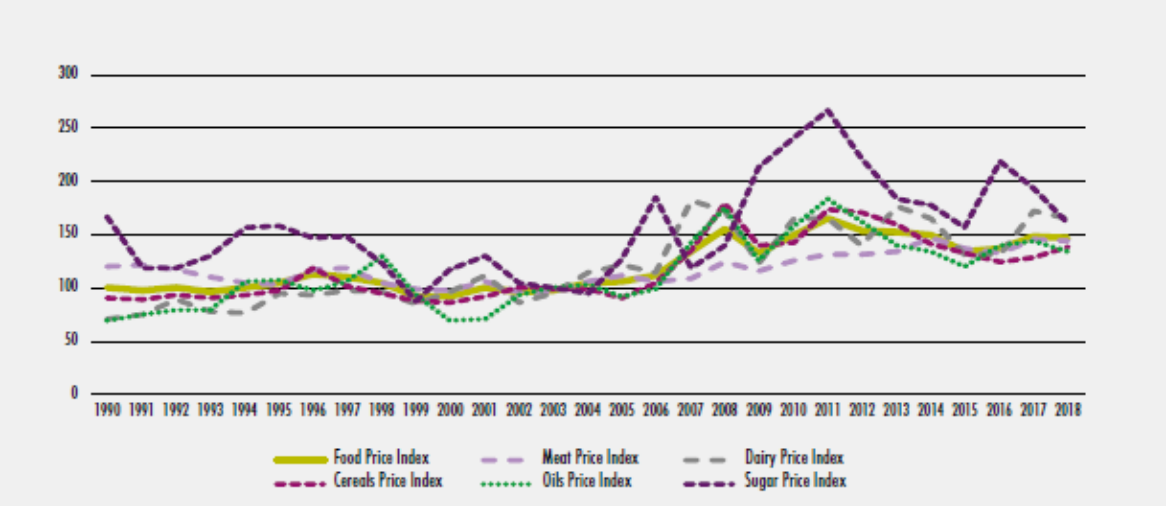
From 2000 to 2016, the global agricultural trade volume tripled. On average, agricultural trade grew by more than 6% per year: from $ 570 billion in 2000 to $ 1.6 trillion in 2016 (FAO, 2009). Trade growth is associated with the economic condition of the industry. After the financial crisis of 2008, global trade in commodities (including fuel and mining products, agricultural products and manufactured goods) was inactive due to weak economic growth. Agricultural trade is more sustainable than fuel and mining products. Industrial goods reduce investment and, as a result, weak demand, slow down trade. After the financial crisis, investment was reduced in developed economies.

Compared to fuels, mineral products and manufactured goods, agricultural trade is less affected by changes in investment policies. It is directly related to population growth and changes in income. Since 2002, agricultural trade growth was suddenly interrupted by the global economic downturn in 2008. Although it recovered in 2010 and 2011, the global economy has slowed, especially in emerging economies such as China. Very strong effect is for of commodity prices. The unprecedented growth in agricultural demand over the past decade has been driven by China's growth and global biofuel production. The recent slowdown in income and demand growth in China, as well as a reduction in household spending on food, led to 11% drop in global agricultural trade in 2015 (Gordienko, 2017, p.26).

The price of a product reflects the main forces of supply and demand and strongly affect world trade. Since 2000, rising agricultural prices and agricultural price spikes in 2008 and 2011 were the result of structural changes in the global agricultural market. Due to the high demand for food and feed, reduced use of stocks and increased biofuel production, the agricultural market received market shocks and price volatility. Currently, prices for agricultural products are still higher than in 2007, but currently they have a tendency to decrease. In 2015 and 2016, world prices also reflected a stronger dollar (Figure 7).

Developing market economies are becoming increasingly important and since 2000 have become a major factor in the development of the global agricultural market. The European Union occupies the 1st place, and the share of Russia over 18 years increased from 1.7 to 1.9 in terms of the share of world imports.

Figure 7: Agricultural Price indices, 1990-2018



Sourse: Faostat

China's share in world imports dramatically increases from 2.3% in 2000 to 8.2% in 2016 ranks third among the 20 largest importers in the US and the EU. (Table 3). In developed countries, such as the United States and Japan, which share in world imports declined (or remained stable), although they are still among the top 20 importers.

Table 3 Major importers of agricultural products, share of total import value, 2016 and 2000

	2016			2000	
Country	Rank	Share	Country	Rank	Share
The The EUropean Union	1	39,1	The The EUropean Union	1	45,3
United States of America	2	10,1	United States of America	2	10,1
China	3	8,2	Japan	3	8,7
Japan	4	4,2	Canada	4	2,8
Canada	5	2,7	Mexico	5	2,3
Mexico	6	2	China	6	2,3
China, Hong Kong SAR	7	1,9	China, Hong Kong SAR	7	2
India	8	1,9	Republic of Korea	8	2
Republic of Korea	9	1,9	Russian Federation	9	1,7
Russian Federation	10	1,9	Saudi Arabia	10	1,2
Indonesia	11	1,4	Switzerland	11	1,2
Total		73,3			75,6

Sourse. FAO report, own calculation, 2018

Changes in export structure underline the importance of emerging economies in the global agricultural market. Although traditional exporters such as the European Union and the United States of America continue to top the list in terms of total exports, Brazil's share increased from 3.2% in 2000 to 5.7% in 2016. China has become the fourth largest exporter, and its share in total exports has grown from 3.0% in 2000 to 4.2% in 2016. Emerging economies such as India and Indonesia have significantly increased their agricultural exports with Brazil and China. In 2016, these four countries accounted for 14.5% of the world export value, compared to 8.5% in 2000. In 2000, Russia was not one of the twenty largest exporters of agricultural products. However, in 2016 it took 16th place in the ranking (Table 4).

Table 4 Major exporters of agricultural products, share of total export value, 2016 and 2000

	2016			2000	
Country	Rank	Share	Country	Rank	Share
The The EUropean Union	1	41,1	The The EUropean Union	1	46,9
United States of America	2	11	United States of America	2	14
Brazil	3	5,7	Canada	3	3,9
China	4	4,2	Australia	4	3,7
Canada	5	3,4	Brazil	5	3,2
Argentina	6	2,8	China	6	3
Australia	7	2,5	Argentina	7	2,7
Indonesia	8	2,4	Mexico	8	1,9
Mexico	9	2,3	New Zealand	9	1,6
India	10	2,2	Thailand	10	1,5
Thailand	11	2	Malaysia	11	1,4
Malaysia	12	1,8	India	12	1,2
New Zealand	13	1,6	Indonesia	13	1,1
Viet Nam	14	1,3	Turkey	14	0,9
Turkey	15	1,3	Colombia	15	0,7
Russian Federation	16	1,1	Chile	16	0,7
Chile	17	0,9	Singapore	17	0,7
Total		87,6	Total		89.1

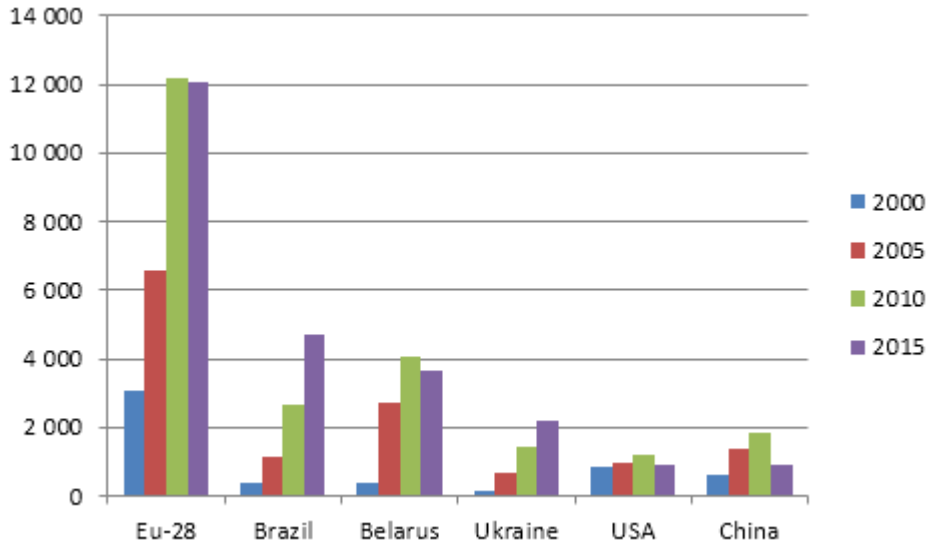
Sourse. FAO report, own calculation, 2018

For 17 years, the United States, the European Union, Australia and Canada (all of them traditional exporters) accounted for a total of 10 percent of total exports, from 68.5% in 2000 to 58.0% in 2016. The share of developing economies in world trade in

agricultural products reflects their development way. Over the past two decades, rapid economic growth and growth in per capita incomes in these countries have led to increased demand for agricultural products and, together with an increase in population, have led to a significant increase in imports. This increase in income coupled with a reduction in poverty increases the demand for food and leads to an increase in agricultural imports. Between 2000 and 2017, per capita GDP in Russia increased from $ 1,657 to $ 10,743 at current prices (Worldbank, 2019). The emerging economies of Brazil and China will continue to be important importers of agricultural products. Although the tendency to spend extra income on food decreases as per capita incomes increase, it can slow down their imports.

Figure 8 shows the world's major agricultural exporters to Russia. Obviously, the EU takes first place in exports, followed by Brazil, China and the United States. It only confirms Table 1, (shown above) that these countries are the main exporters. Ukraine and Belarus are the closest neighbors, so they are also among the six largest exporters to Russia.

Figure 8: The main Agricultural Export to Russia from All-World countries in 2000-2015, bln. US dollars.

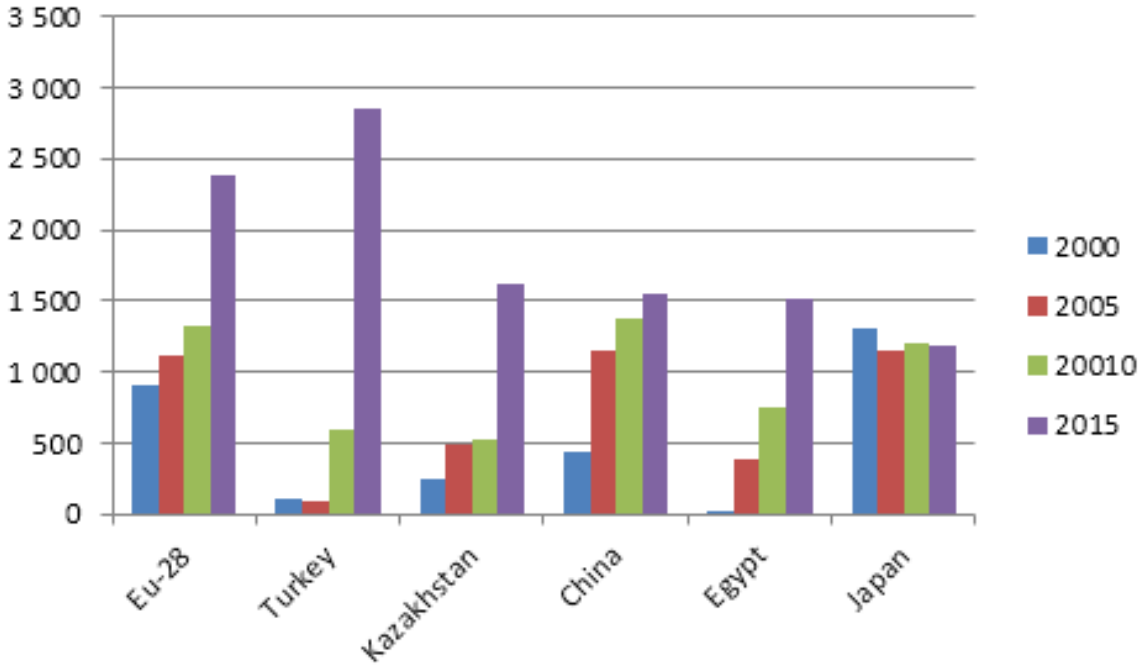


Source: Comtrade database, own calculation, 2016

However it is completely different picture with imports from Russia, imports of agricultural products is greatly dependent on their demand. Some countries buy almost only one type of agricultural product (Figure 9). For example, Japan prefers to buy fish

from Russia. Moreover, Russia prefers to sell fish in Japan than to sell fish in the domestic market. This is because Japan can pay more.

Figure 9: The main agricultural import from Russia to All-world countries in 2000-2017, bln. US dollars



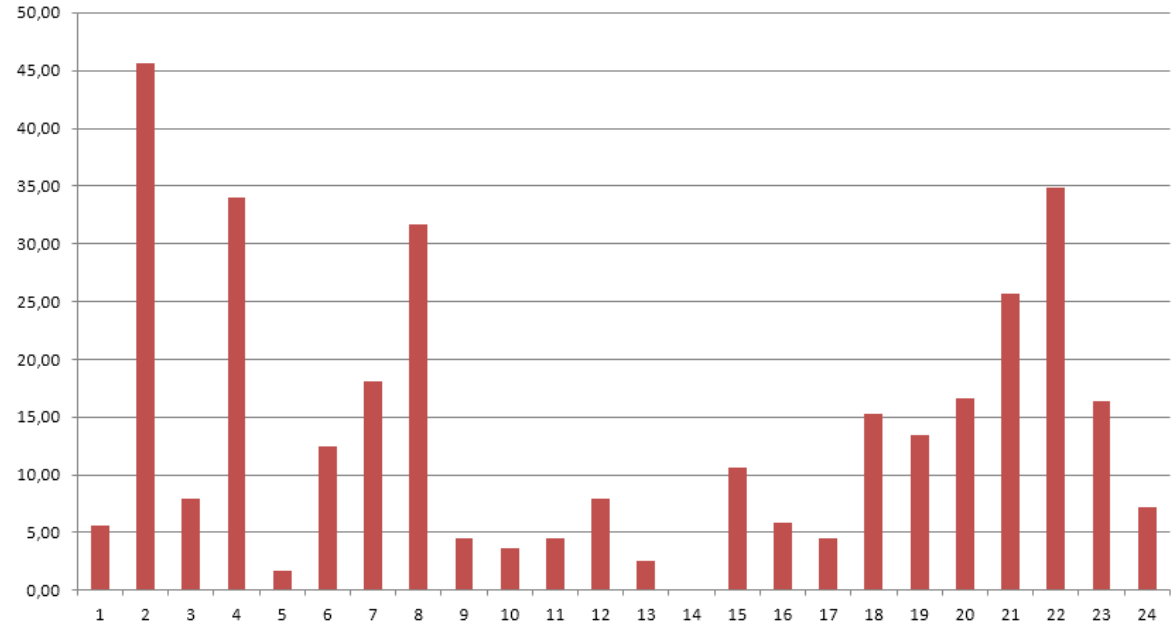
Source: Comtrade database, own calculation, 2016

Turkey and Egypt mainly buy cereals and animal and vegetable fats. Very often the choice of the main importer of products from Russia depends on the current political situation and can change very quickly.

3.5.2 Commodity structure overview

During 17 years, Russia has been actively importing agricultural products from the European Union. In Figure 10 we can see average Export to Russia from the EU for each of 24 product. The full name of the proukts is listed in Table 1. The mostly attactive product for Russia are Meat (2), Dairy (4), Fruit (8) and Beverages (22). In addition, Meat, Dairy, Fruits nowadays under import ban. Moreover, these three products make up about 50% of the total trade flow, which came under the influence of sanctions.

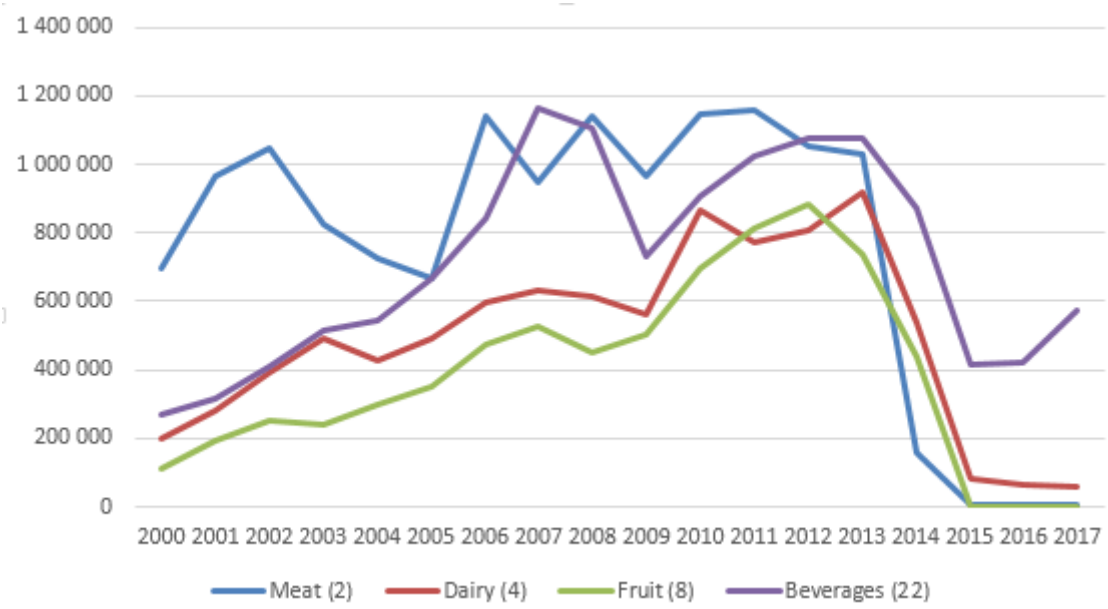
Figure 10: The Mean Export to Russia from the EU per commodity 2000-2017, bln. US dollars



Source: Comtrade database, own calculation, 2017

As illustrated in Figure 11, the influence of import ban for four most popular commodity is clearly visible. There is a significant drop in 2015. Moreover, beverages also shows decrease, but for the other reason.

Figure 11: Most popular imported products to Russia from the EU, mln. US dollars

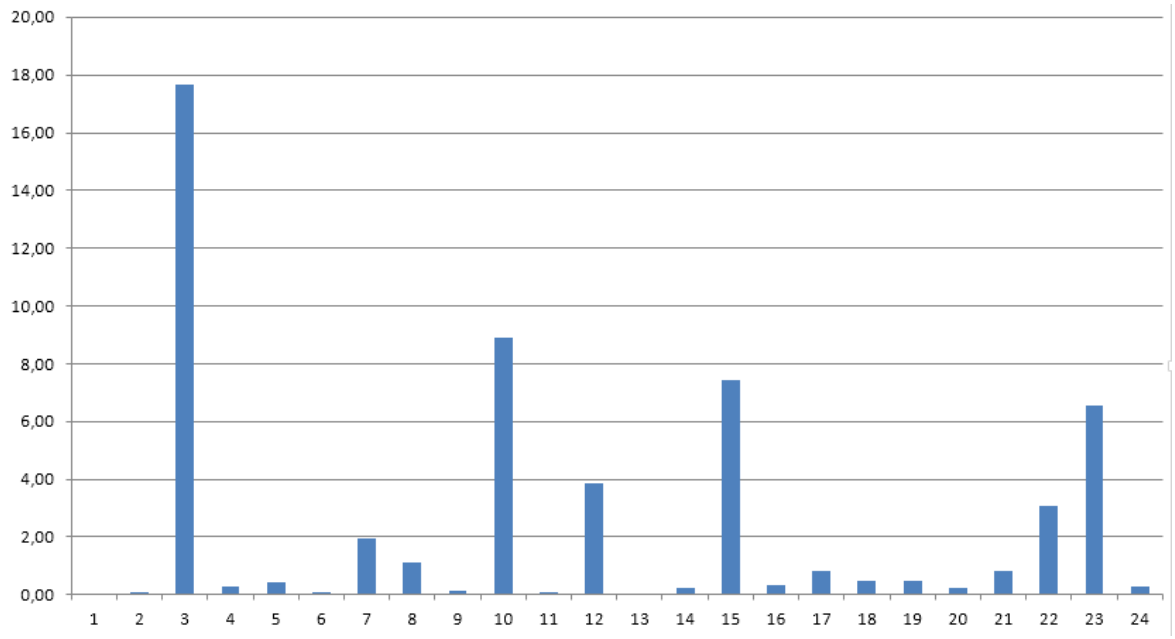


Source: Comtrade database, own calculation, 2018

The possible answer could be that, after the collapse of the ruble, Russians's purchasing power has declined, while wine belongs to replaceable groups of goods. Moreover, the Russian government has banned state purchases of foreign wines.

As we can see in Figure 12, Russian Export to the European Union is mainly concentrated in four group of commodity – Fish (3), Cereals (10), Animal and vegetable fats and oils, and food residuals (23). Fish is the most significant part of Russian agricultural export not on to the EU Countries, but to Japan also.

Figure 12: The Mean Import from Russia to the EU per commodity 2000-2017, bln. US dollars

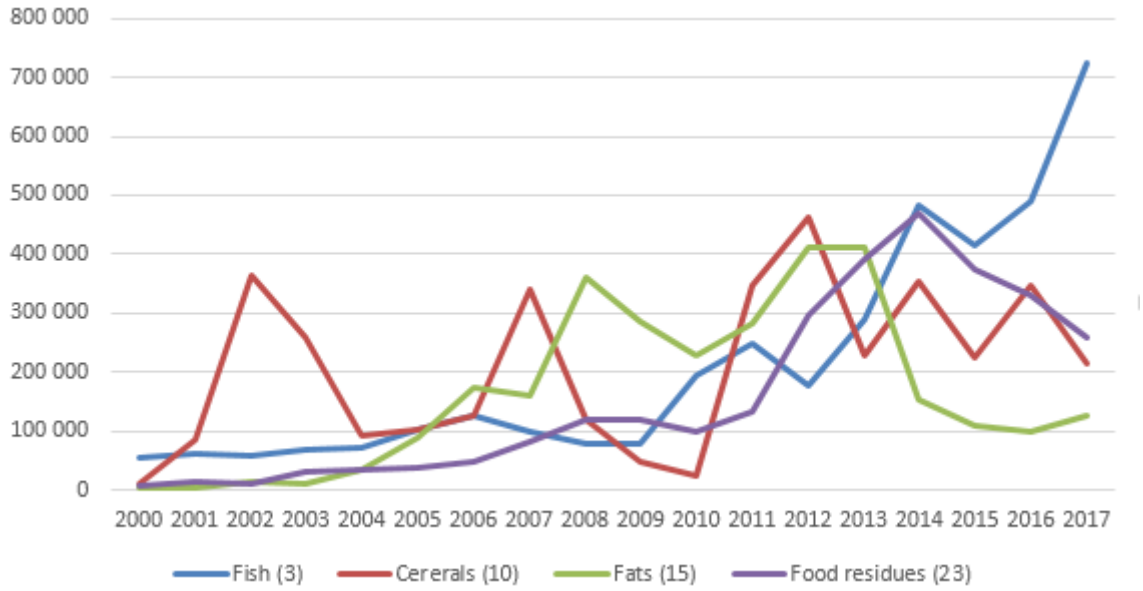


Source: Comtrade database, own calculation, 2018

During fishing process the cheapest fish as a cod, a haddock and a flounder goes to the domestic market. The caught red fish goes to the foreign market for sale to the European Union and Japan. This is because in Russia there is no solvent demand for expensive red fish.

As evident in Figure 13, there is a significant growth in nearest five years for fish.

Figure 13: Most popular exported products from Russia to The EU, mln. US dollars



Source: Comtrade database, own calculation, 2018

Cereals have tremendous volatility during 17 years, because of speculation on trade market and weather condition. For example, it was a great drought in 2010.

3.5.3 Agricultural policy trends

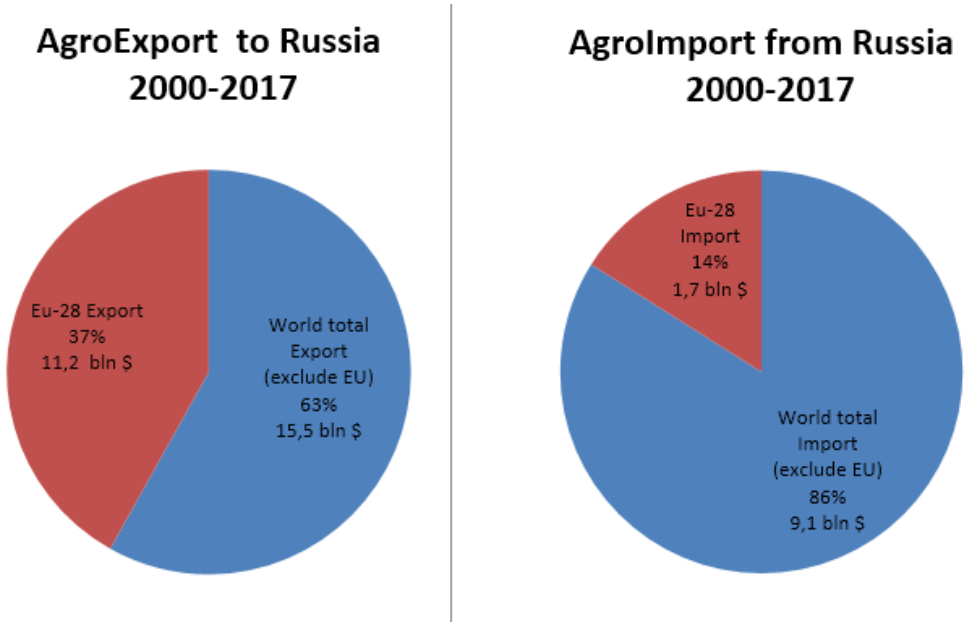
Since the founding of the WTO in 1995, the opening of market access has also contributed to the expansion of agricultural trade since 2000. The average level of applied tariffs has declined as countries have fulfilled their obligations under the WTO Agreement. However, this average figure masks huge differences in border protection for individual products. Many countries retain high import barriers for dairy products, rice and sugar products that have historically been well protected. Since 2000, after the implementation of the Agreement on Agricultural Products, the protectionism of developed countries, distorting trade. Trade-distorting domestic support, such as support for market prices, subsidies for the export and import of raw materials, especially in the European Union, has declined. In some developed economies, for example, in the EU, a decrease in trade-distorting support is accompanied by an increase in the so-called “green box” measures. In the same period, in some countries with developing and developing economies, higher levels of development, increased per capita incomes and increased demand on products have led to increased support for farmers and, in some cases, through measures such as

protectionism to support market prices. Import ban in Russia also provided indirect support to local agricultural producers, substantially reducing competition (Smutka, 2016 p.493).

3.6 Present economic trend between RU and the EU

As was mentions before in the previous chapter, Russia and the European Union are strong trading partners and the European Union is the largest importer and exporter of agricultural products. Figure 14 shows that the share of the European Union to Russia is 37% of the total imports to Russia, while agricultural products exported from Russia to the European Union account for only 14% of the total exports from Russia.

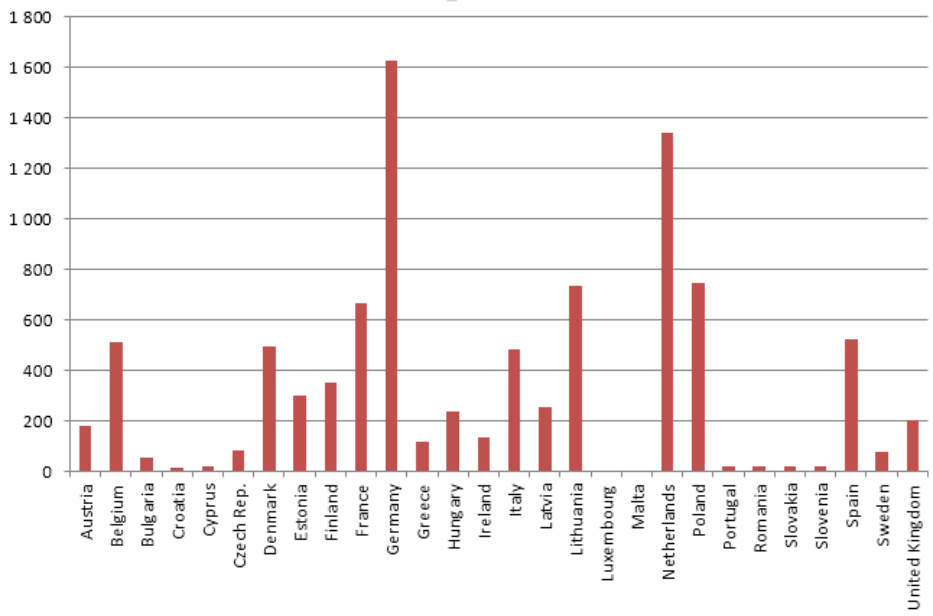
Figure 14: Share of trade volume of import and export agricultural prodacts in Russia 2000-2017 year, bln. US dollars.



Source: Comtrade database, own calculation, 2018

If we look over 18 years in terms of export and import, the most active supplier of agricultural products to Russia is Germany and the Netherlands. (Figure 15). If we consider the import of agricultural products from Russia - that is the main trading partner again Germany. Cooperation with Italy and England is still actively.

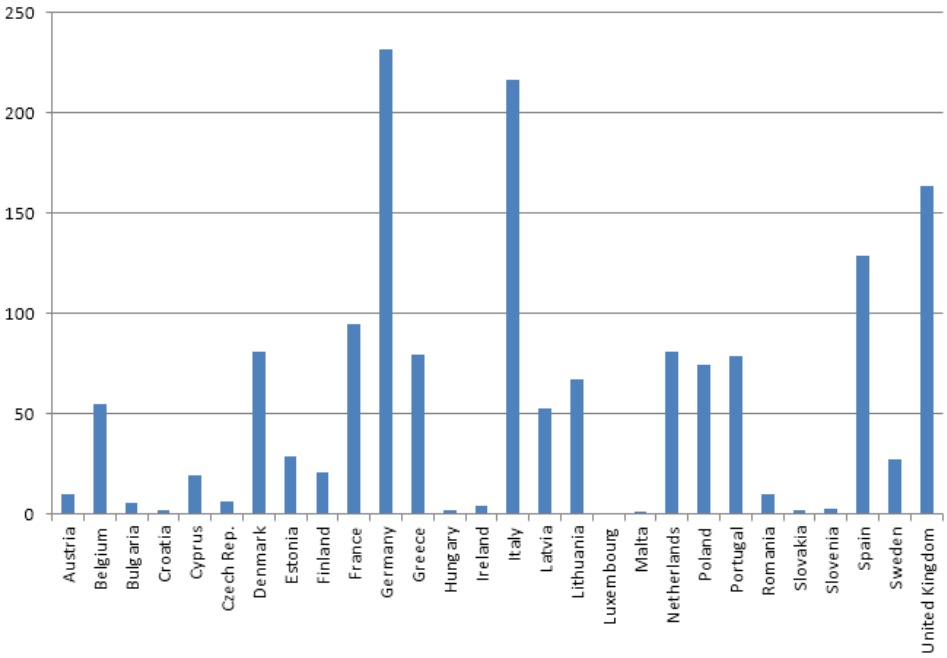
Figure 15: The mean import to Russia from the EU per country 2000-2017, bln. US dollar



Source: Comtrade database, own calculation, 2018

However, Germany and Netherlands have large agrarian sector. Russia's part in the total export of these countries does not exceed 10%. Poland and Lithuania big trade partner for Russia also, mostly because of common history and neighborhood location.

Figure 16: The Mean Export from Russia to the EU per country 2000-2017, bln. US dollar



Source: Comtrade database, own calculation, 2018

In figure 16 was presented export from Russia to the European Union during 18 years. Again, the largest trading partner is Germany, trade with Italy, England and Spain is also active.

In the next section, we will cover the gravity models of exports and imports between Russia and the EU countries.

4 Gravity model concepts in international trade

4.1 Theoretical concepts of the gravity model

Timbergen, J. (1962, p.371) is famous as a father of the gravity model in international trade. The gravity model concept is based on Newton's law of universal gravitation. As for the theme of the research, an idea of the gravity model states that trade flows are directly related to the economic size of the countries involved, and inversely related to the distance between them.

Newton's law of universal gravitation according to the encyclopedia «Britanica» (2019) is following

$$F = G*(m1*m2)/R2 \quad (8)$$

where:

F – the magnitude of the attractive force

G - (the gravitational constant)

m1 and m2 - product of the masses

R - the distance

However, 20 years before Zipf (1946, p.60) used gravity concepts for migration modelling. After this publication the gravity model idea became very popular.

Timbergen, J. suggested following version of the gravity model. Leamer, E (1995, p. 1339) mention that the gravity model is the most stable empirical relationship in economics.

First version of the gravity model equation by Timbergen is following:

$$\ln X_{ij} = \underbrace{\ln G}_{a_0 \equiv \text{constant}} + \underbrace{a_1 \ln M_i + a_2 \ln M_j}_{\text{economic attractors}} + \underbrace{a_3 \phi_{ij} + a_4 N_{ij}}_{\text{distance}} + \underbrace{a_5 V_{ij}}_{\text{policy}} + \underbrace{\varepsilon_{ij}}_{\text{iid}} \quad (9)$$

Xij – the size of trade flow between two countries

Mj – the amount of exports from the country i to the country j

In 1979 the model was supplemented by Anderson (Anderson, 1979, p. 106). In this article he argues that the main determinants of foreign trade are the population and the GDP. He conducts his analysis based on various premises:

1. The country specializes in production of one product, which is sold abroad.

2. The country specializes in production of tradable and non-tradable products.

In his work, he was able to theoretically justify utilization of proxies for transportation costs and utilization of dummy variables for policy tools in the gravity model. The background of this model partially corresponds to the present. Indeed, when choosing a supplier of a product or service, the main selection criteria are the supplier remoteness and the delivery cost. Thus, the optimal supplier will be the one who can deliver the products of appropriate quality at the lowest price within the specified time. Nevertheless, diversification of suppliers becomes necessary to strengthen the country's international security.

The model proposed by Andersen is based on the premise that each country specializes in production of either one traded product or one traded and one non-traded product. This premise has caused controversy in the scientific community about whether it is possible to use the gravity model for one industry. It was believed that to build the gravity model, the data should have sufficient degree of aggregation.

4.2 Application of the gravity model in different economic sectors

Traditionally, the gravity models used pooled ordinary list square, but Koo (1994, p.81) in his work “A Gravity Model Analysis of Meat Trade Policies” proved that for one product utilization of both pooled and time sampling is more efficient. Using the panel data allows taking into account both temporary effects and individual characteristics of countries when building their foreign trade relations. Koo was the first to build such a model for the specific product group. The article was devoted to the search for factors influencing world trade in meat and meat products. The achievement of this article is theoretical justification for the possibility of using the gravity model for one industry. However, Koo notes the limitations of using such model. He argues that utilization of the gravity model for one product or one product group is possible only when using the panel data. Previously, his gravity model was commonly built for spatial sampling. Assessment of flows of foreign meat trade between countries proved that the control variables, such as income and the distance, remained significant regardless of the products. The optimal model in the study was a model with deterministic individual effects. An additional verification criterion, in addition to the Hausman and Broche-Pagan tests, was the introduction of a dummy variable for individual meat exporting countries. The introduction

of this variable was based on quality of supplied meat. The hypothesis about influence of meat quality on export volumes was confirmed. In addition, a hypothesis was put forward on the effect of barriers to trade on its volume. The barrier in meat trade was poor reputation of countries, which manifested in the presence of diseases in livestock. This hypothesis has also been confirmed.

More recent studies have also built the gravity model for estimating tourist flows (Mehmet, 2010, p. 585) trade in services (Keith, 2006, p. 183) of wine trade (Dascal 2002, p. 135).

Dascal's paper “An analysis of EU wine trade” was based on Koo's theoretical background for building the gravity model in wine trade. In their work, researchers paid attention to the theoretical foundations of building the gravity model of foreign trade. In their work, the authors sought to find factors influencing export of wine. The analysis included the GDP per capita variables of partner countries, the distance, EU membership, the wine production index and the exchange rate. As a result of the assessment, it was found that countries with higher GDP per capita export more wine, with an increase in the index of wine production, so wine export increases. An unexpected conclusion was only the positive impact of remoteness of countries on wine export.

Another important study is the construction of the gravity model of foreign trade for agricultural sector of Egypt (Assem, 2005, p.134). In this study, the authors focused on the selection of control variables to search for factors influencing foreign trade in agricultural sector. In their research they used the UNComtrade and FAO database to collect information on the volume of foreign trade between countries. The top 50 importers from Egypt were selected for the analysis. When analyzing the list of Egypt's trading partners, it was found that the top 96 trading partners of Egypt generated 96.6% of foreign trade, but the top 50 corresponded to 94.5% of trade. Therefore, it was decided to shorten the sample to 50 trading partners. In their analysis, they relied on a transformed basic gravity model. As an independent variable for the analysis, GDP of partner countries and GDP per capita was used in an alternative model, presence of common state language, a common border and distance between capitals. The coefficient of openness of the economy was also used as an experiment. As a result of the analysis, the experimental parameter turned out to be insignificant, GDP per capita had negative impact on the volume of Egyptian exports to agro-industrial complex as opposed to GDP, the presence of Arabic and a common border

contributed to an increase in exports. It would be interesting to compare the results of the evaluation presented this article with the results of determining the general factors of influence on foreign trade in agro-industrial complex of Egypt and Russia. Egypt's participation in regional trade associations was not statistically significant. The summary of abovementioned models is presented in Table 5.

Table 5 Applications of different gravity models

Researcher	Model Specification
Koo, Won W et.al., A Gravity Model Analysis of Meat Trade Policies (1994, p.83)	$X_{ij=\alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} C_{ij}^{\alpha_3} T_{ij}^{\alpha_4} P_i^{\alpha_5} P_j^{\alpha_6} E_{ij}^{\alpha_7} e_{ij}}$ Y – GDP, C – transport cost (c.i.f.), T – trade barriers, P – cost of good, E – currency exchange
Daskal, D., An analysis of EU wine trade: A gravity model approach (2002, p.137)	$lnX_{ijt} = \alpha_{0i} + \alpha_1 lnY_{it} + \alpha_2 lnY_{jt} + \alpha_3 lnD_{it} + \alpha_4 lnP_{ijt} + \alpha_5 lnA_{it} + \alpha_6 lnE_{ijt} + \alpha_7 EU_y + \delta_{ijt}$ D – distance between countries, A – index of wine production, EU – member of EU
Assem Abu Hatab, et.al., Determinants of Egyptian Agricultural Exports: A Gravity Model Approach (2005, p.134)	$nX_{ij} = \alpha_0 + \alpha_1 lnY_i + \alpha_2 lnY_j + \alpha_3 lnD_i + \alpha_4 lnOP_i + \alpha_5 lnOP_j + \alpha_6 lnE_{ij} + \alpha_7 CommonL_{ij} + \alpha_8 CommonB_{ij} + \alpha_9 RTA_{ij} + \delta_{ijt}$ Common L – existence of a common language Common B – existence of common boarder OP – open economy RTA – regional trade agreement
Keith Walsh. Trade in Services: Does Gravity Hold? A Gravity Model Approach to Estimating Barriers to Services Trade (2006, p.183)	$lnM_{ijt} = \alpha_{ij} + \alpha_1 lnYpc_{it} + \alpha_2 lnYpc_{jt} + \alpha_3 lnD_{it} + \alpha_4 CommonB_{ij} + \alpha_5 lnPop_{it} + \alpha_6 lnPop_{jt} + \alpha_7 EU_{ij} + \alpha_8 L_{ij} + \delta_{ijt}$ D – distance between countries

	Common B – existence of common boarder Pop - population EU – member of EU
Mehmet Erigyt, Erdogan Kotil. Factors affecting international tourism flows to Turkey: a gravity model approach	$lnF_{ij}^{t} = \alpha_0 + \beta_1 \ln(Ypc_j^t x Ypc_i^t) + \beta_2 \ln\left(\frac{TCI_i}{TCI_j}\right)$ $+\beta_3 lnCom_{ijt} + \beta_4 \ln(Pop_{it} x Pop_{jt})$ $+\beta_5 \ln(TPI_{ijt}) + \beta_7 R_1 + \beta_8 R_2 + \beta_9 R_3$ $+\beta_{10} B_{ij} + \varepsilon_{ijt}$ F – amount of tourists, TCI – index of touristic climate, Com – foreigen trade turnover, TPI – price concumer index taking into account currancy exchange, R – dammy variable (terract 11th of September, the earthquake in 1999, the War in Iraque)
Simeon Djankov and Caroline Freund. New borders Evidence from the former Soviet Union (Djankov, 2002, p.499)	$lnX_{ijt} = \alpha_{0i} + \alpha_1 lnY_{it} + \alpha_2 lnY_{jt}$ $+ \alpha_3 POP_i + \alpha_4 POP_j + \alpha_5 DIST_{ij}$ $+ \alpha_6 RUSSIA_{ij} + \delta_{ijt}$ TRADEij - log of shipments from region i to region j, Yi and Yj - logs of gross regional product in regions i and j, POPi and POPj - logs of total population of regions i and j, DISTij - log of the distance from i to j, RUSSIA - dummy equal to one for intra-Russian trade and zero for region to Republic trade

Source: own construction

As it is noted in the article (Mehmet, 2010, p. 185), when constructing the gravity model, regardless of whether it is common for the industry, the researchers rely on the basic formulation of the gravitational model, supplementing it with the variables of interest.

4.3 Random and fixed effect in the gravity model application

To study the gravity model, scientists usually take the cross-sectional analysis method using pooled ordinary list square (OLS) and fixed OLS.

The Pooled OLS method was very popular in the past, many researchers used it. Rose (2000, p.8), Kankge (2006, p.493) etc. Pooled OLS is fairly easy to use and learn, so it attracts a lot of followers. However, in case of the gravity model, such a regression does not meet the requirements of BLUE (best linear unbiased estimated) and therefore its estimates are biased and not the best. Buiding the gravity model using Pooled OLS is susceptible to endogenous, heteroskedasticity and autocorrelation effects.

Utilization OLS with fixed-effects helps to cope with a popular drawback of the model - missing variables. Missing variables occurs when the variable cannot be measured or included into the model. A lot of scientists analyze trade flows using the fixed effects model Matiywas (1997, p.363), Garcia (2013, p.336). The fixed-effects model takes into account individual unobserved effects for each country. Temporal average is subtracted from the actual value of the explanatory variable. This method is also called ‘within-group estimation’; it has the effect of excluding an unobservable variable from the error term, which correlates with explanatory variables. There is another method for using Fixed-effects that is introduction of dummy variables to a country or time (possibly simultaneously). Thus, the unobservable time-invariant effect, which varies from country to country, disappears. This methodology is also known as (LSDV) Least Square Dummy Variable.

Matiywas (1997, p.363) argues that the correct specification of a model using fixed-effects should include a dummy variable and a separate dummy for the exporter and for the importer. Thus, these dummies absorb time-invariant and unobserved unique characteristics for each country. The dummies with time effects for absorption are the same for all countries. They can take into account such effects as the global financial crisis and global inflationary trends. Additionally, these dummies capture trade barriers faced by every importing and exporting country (Adam, 2007, p.40). This dummy also traps physical phenomena for the exporter and for the importer. For example, a country might be located on an island in the middle of the Pacific Ocean or suffers from lack of access to the sea.

However, multilateral resistance terms are not constant and can both increase and decrease. An example of decline in multilateral resistance terms is the example of China's trade with Lithuania. To supply the goods to Lithuania until 2010, China had to go through three customs zones - Kazakhstan, Russia and Belarus. Each of these zones added own trading cost to the total one. These costs were presented not only in direct cash , but also in time of the check at the border. After establishment of European Customs Union in 2010, Chinese goods destined for Lithuania pass customs control on the border of Kazakhstan and on the border of Lithuania and European Union. Thus, the control procedure on Russian and Belarus borders was abolished so resisting terms were reduced. China got the opportunity to trade at lower costs with EU countries.

Baier (2007, p. 72) notes that time-invariant dummies for importers and exporters can define multilateral resistance terms and cannot find time changing multilateral trade resistance effects. Moreover, they do not solve endogenous problems. Endogeneity occurs when importers or exporters have personal preferences for trading with any country.

Sheptherd (2012, p.23) suggests that the endogeneity problem might be solved by including policy variables in the model. He doubts in existence of causal relationships between trade policy and international trade having experience of significant effect of pre-existing trade on politics. For example, those countries which gradually developed open economy in past, easier enter into a free trade agreements or customs unions.

Bladwin (2007, p. 780) proposes to add dummy country-time effects for both importer and exporter country and time-invariant country-pair effects to solve this problem. It helps to take into consideration maximum unobservable and time-varying conditions of trade resistance, which affect the country's decision to join a trade agreement with another country.

The random-effects OLS is also used to research involved gravity models. The main difference between the OLS model with random-effects and the OLS model with fixed-effects is that changes between objects are random and are not related to explanatory variables in the model. As a comparison, in models with fixed-effects, unobserved effects are correlated with independent variables. It means that there are certain factors within countries that affect non-existing explanatory variables (GDP and distance). It is a bold hypothesis, since many unobservable variables are believed to correlate with the basic

components of the gravity model (GDP, population, distance). Many authors Carre (2006, p.223), Lee (2007, p.783) used random effects models in their researches.

5 Application of the gravity model

5.1 Data and variables description

The sample consists of 12,096 observations in 29 countries for the period 2000-2017. To build the gravity model, there is a basic set of variables: GDP of partner countries, population, and transportation costs. In the process of evolution of the gravity model, the aforementioned set consisted of more variables, such as presence of a common language, availability of preferential terms of trade between countries, etc.

By results of a preliminary analysis, the following variables were selected:

Import, Export - import and export between EU countries and Russia, respectively

GDP RU - logarithm of Russia's GDP

GDP EU - logarithm of the GDP of each European country

Sanction - dummy variable denoting sanctions' Russia (ban)

Border - dummy variable indicating the presence of a common border

Language - dummy variable indicating presence of Russian as an acceptable language of office work

Sea port - dummy variable indicating direct access to a sea

History - dummy variable representing active past history

Distance - dummy variable representing the distance between capitals of states.

It should be noted that variable Distance is the distance between the capital of each EU country and Moscow, excluding four countries - Finland, Estonia, Latvia, Sweden. In case of these countries the distance is taken between the capital and Sankt-Petersburg. A more detailed description of the model is in the appendix.

All studies implementing the gravity model as a research method suffer from the approximation of transportation costs. The standard solution is to create proxy variables for distance between countries and presence of a common border. In this case, the distance between capitals is taken as the distance between countries, but the distance between capitals does not accurately describe transportation costs. Utilization of these proxies does not allow assessing quality of road surfaces over which products will be transported, tariff and non-tariff restrictions in trade, and do not reflect transport costs depending on the delivery of goods by ship, truck or railway. However, there is an alternative approach to solve this problem. Given resource (DIST, 2019) provides an opportunity to calculate the

duration of transportation depending on the type of transport used. Thus, the unit of measurement of transport costs will not be kilometers, but travel time, taking into account road surfaces, duration of customs clearance and waiting time at a border. Troekurova (2014, p.133) states that this indicator slightly improves the results of the study. However, these improvements are not significant. Presented model involves calculations based on the dummy variable of presence of a a common border and distance between capitals of states. Figure 17 shows main statistical description of gravity model variables.

Figure 17: Dataset descriptive statistics for the gravity model

Variable	Obs	Mean	Std. Dev.	Min	Max
Export_thou	12,096	1610126	1.13e+07	0	6.44e+08
Import_thou	12,096	7989822	2.46e+07	0	4.39e+08
Distance	12,096	1856.321	854.511	300	3907
Boarder	12,096	.1785714	.3830089	0	1
Language	12,096	.3571429	.4791772	0	1
History	12,096	.2857143	.4517726	0	1
SeaPort	12,096	.8214286	.3830089	0	1
GDP_RU_mln	12,096	3094072	550526.6	2059806	3693841
GDP_EU_mln	12,096	606072.5	859280.8	9605.484	3740232
sanction	12,096	.2222222	.4157569	0	1

Source: Comtrade database, own calculation, 2018

Import and export flow data is measured in thousand US dollars taken from UnComtrade (2019).

The data on the GDP of Russia and each country of European Union are taken from the Worldbank website (2019), they will be turned into billion US dollars. It was not possible to use thousand US dollars unit to measure GDP because STATA did not accept such large numbers. During data processing, data on imports, exports and GDP were adapted to 2010 prices by means of the Producer Price Index from the FAO website (2019).

The Boarder variable indicates presence of a common border. This dummy variable varies from 0 to 1.

The Language variable is presence of a common language. This variable was used in the work of Troekurova (2014, p.133) and this variable is brought about due to absence of

expenses for translation of documents and easier communication between partners. The dummy variable varies from 0 to 1.

The History variable was selected due to common value judgment. It takes into consideration interaction intensity between the countries over the past 200 years. For example, Russia and Germany over the past 200 years have been interacting quite actively, while Russia and Ireland had a few contacts. The dummy variable varies from 0 to 1.

The Sea Port variable indicates access to the sea. Commercial shipping by sea is several times cheaper than shipping by air and or by land. In author's opinion, it should reduce the country's trade costs significantly. The data sources for the model are presented in details in Table 7.

Table 6. Data Sources for the gravity model

Variables	Measuring	Measurement units	Data source
Import	Trade flow from European Union countries to Russia, in constant prices 2010.	US dollar	Faostat UnComTrade
Export	Trade flow to European Union countries from Russia, in constant prices 2010.	US dollar	Faostat UnComTrade
GDP	GDP in constant prices 2010.	US dollar	World bank
Distance	The distance between the capitals	km	http://www.distancefromto.net/
Border	A common border	0 or 1	Google maps
Language	The presence of a common language for office work	0 or 1	(Blažek and Novotná 2005, p.51)
History	Having an intensive history of collaboration	0 or 1	Author's opinion
Sea port	Availability of access to the sea	0 or 1	Google maps
Sanction	Presence of sanctions against Russia	0 or 1	Kutlina-Dimitrova (2017, p.537)

Source: own construction

When analyzing descriptive statistics, a large scatter of data was found on all cost indicators. Since indicators range from zero to several millions or trillions, there is a need for data normalization. There are several ways to normalize data. In the first case, these indicators can be reduced by the same number of orders. However, the difference within the indicator in this way will not be removed. The next way is to bring these indicators to

those per capita. This method has already been used in a number of studies. The disadvantage of this method is that the obtained per capita GDP, for example, will reflect, rather, the standard of living of the population than the mass of the object itself. As a result, the third method was chosen, which consists of the logarithm of indicators that cause problems. The disadvantage of this method is the loss of observations due to the properties of the logarithm. The sample contains countries for which imports from Russia are not made, i.e. the volume of import operations is zero. Accordingly, during the logarithm, the observation will be lost. To avoid this problem, it was decided to add a unit to all observations before the logarithm. From the point of view of export-import relations, exports of $ 1 are infinitely small, however, sufficient to maintain observations.

In this way, the indicators of import, export, GDP and distance were logged. New dataset description is in Figure 18.

Figure 18: Descriptive statistics for the gravity model

Variable	Obs	Mean	Std. Dev.	Min	Max
Language	12,096	.3571429	.4791772	0	1
History	12,096	.2857143	.4517726	0	1
SeaPort	12,096	.8214286	.3830089	0	1
lnDist	12,096	7.371076	.6359064	5.703783	8.270525
lnGDPru	12,096	14.9274	.1926908	14.53812	15.12218
lnGDPeu	12,096	12.36597	1.459271	9.17009	15.13466
lnExp	6,418	11.809	3.17348	-.176338	20.28387
lnImp	9,158	13.70837	3.008016	-.7262558	19.90011
sanction	12,096	.2222222	.4157569	0	1

Source: Comtrade database, own calculation, 2018

The final set of variables used in the analysis, the variable and the source of literature being relied on when choosing this variable is presented in Table 7.

Table 7 Variables utilized for the model and their sources

Variabels	Meaning	Utilization in other researches
LnGDP	Logarithm of GDP	Witt (1995, p.447), Lim (1997, p.835), Eilat (2004, p.1315), Naudee (2005, p.365)
LnDist	Logarithm of the distance	Witt (1995, p.447), Lim

	between countries	(1997, p.835), Crouch (1995, p.103)
Border	Dummy variable «border»	Witt (1995, p.447), Lim (1997, p.835)
Language	Dummy variable «language»	Troekurova (2014, p.133)
History	Dummy variable «common history»	Author's opinion
Sea port	Dummy variable «access to the sea»	Author's opinion
Sanction	Dummy variable «sanctions against Russia»	Kutlina-Dimitrova (2017, p.537)

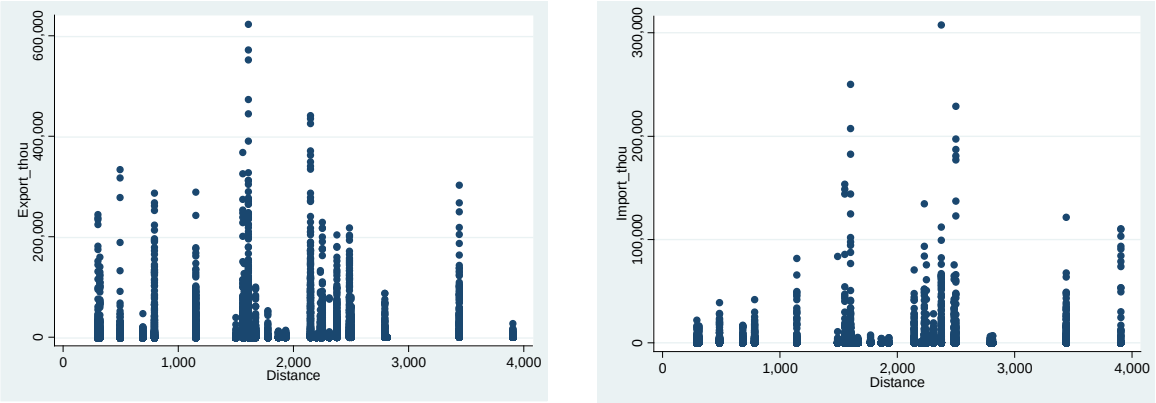
Source: own construction

Next Section provides application of the gravity model. The range of investigation consists of the gravity model of the entire country and the gravity model for various agricultural products.

5.2 Application

To starting analysis, the data should be glimpsed to trace dependencies. Figure 19 below presents dependence of imports and exports on distance. Obviously, determination of the dependence does not work. Nevertheless, the null hypothesis of the absence of dependencies should not be rejected. It is necessary to make more detailed analysis of the model.

Figure 19: Dependence between distance and import/export, thou US dollarsl



Source: Comtradedatabase, own calculation, 2018

The models of two types will be considered in the the current research. One gravity model takes the volume of imports and exports from country to country as a whole. Another model divides imports and exports into 24 types of goods. In fact, the same data array is analyzed with two different models.

5.2.1 The "Country" gravity model

In this Section, the basic model for the analysis of import and export flows across countries was specified. Seven types of models were built and checked according to BLUE assumption. After comparison tests, the best model was chosen.

Firstly, the simple linear regression model (1st OLS) was built for import and export trade flow. The model shows marvelous result, F statistic and t-statistic is statistically significant and R-square is quite high (Table 8 and Table 9). Testing omitted variables and BLUE assumption shows poor results.

Ramesy RESET test was used to determine missing variables, whether all factors were taken into account in the model. The results of Ramsey test for export is presented in Figure 20 and result for import is presented in Figure 21.

Figure 20: Ramsey RESET test for export, the model 1st OLS

```
Ramsey RESET test using powers of the fitted values of lnExp
       Ho:  model has no omitted variables
                 F(3, 403) =     54.58
                  Prob > F =      0.0000
```

Source: Comtrade database, own calculation, 2018

Ramsey test suggests null hypothesis that model containes no omitted variables and if P-value less than 0.05, the null hypothesis cannot be rejected.

Figure 21: Ramsey RESET test for import, the model 1st OLS

```
Ramsey RESET test using powers of the fitted values of lnImp
       Ho:  model has no omitted variables
                 F(3, 405) =     10.17
                  Prob > F =      0.0000
```

Source: Comtrade database, own calculation, 2018

Ramesy test for both trade flow proved that the null hypothesis cannot be rejected, as there are missing important variables. Thus, suggested model does not take into account

each factor affecting trade flows of imports and exports or the model has wrong specification.

Breusch-Pagan test to check for heteroskedasticity for import and export is presented in Figure 22 and Figure 23. It is essential indicator for BLUE assumption.

Figure 22: Breusch-Pagan test for Export, the model 1st OLS

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lnExp

         chi2(1)      =   221.15
         Prob > chi2  =   0.0000
```

Source: Comtrade database, own calculation, 2018

Breusch-Pagan is in the same situaton as described in the previous test. To confirm heteroskedasticity, the P-value should be less than 0.05.

Figure 23: Breusch-Pagan for import, the model 1st OLS

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lnImp

         chi2(1)      =    56.00
         Prob > chi2  =   0.0000
```

Source: Comtrade database, own calculation, 2018

According to Breusch-Pagan test for both trade flows, probability is very small, hence, there is a heteroskedasticity in the both models.

To interpret the coefficients of the regression, the stability, efficiency and bias of the results should be verified. In this regard, tests were carried out in accordance with BLUE. In the first OLS model, heteroskedasticity was found. The hypothesis of normality of distribution was rejected.

The robust method was implemented to struggle with heteroskedasticity. The model, taking into account White's corrections, practically does not differ in explanatory power from the initial setting. Therefore the 2nd OLS robust model was build (Table 8 and Table 9)

White test for heteroskedasticity with using the robust method also revealed heteroskedasticity in exports and imports. Results of White test are shown in Figure 24 and Figure 25.

Figure 24: White test for export, the model 2nd OLS Robust

```
White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(36)      =    245.07
         Prob > chi2   =    0.0000

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	245.07	36	0.0000
Skewness	97.13	8	0.0000
Kurtosis	7.44	1	0.0064
Total	349.64	45	0.0000

Source: Comtrade database, own calculation, 2018

White test on heteroskedasticity also shows P-value less than 0.05. It means that there is heteroskedasticity in the model.

Figure 25: White test for import, the model 2nd OLS Robust

```
White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(36)      =    124.66
         Prob > chi2   =    0.0000

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	124.66	36	0.0000
Skewness	52.45	8	0.0000
Kurtosis	4.65	1	0.0311
Total	181.75	45	0.0000

Source: Comtrade database, own calculation, 2018

As a result, it might be declared that the robust method did not solve the problem of BLUE assumption.

As mentioned before, there is the problem of heterogeneity in the dataset, some data is too large, still other is too small. This problem can be solved by logarithm. The data on import and export, GDP and distance was subjected to logarithmation. The result of the evaluation of the model is also presented in Table 9 and Table 10 for 3rd OLS ln. However, testing BLUE assumption showed the same poor result. Even the robust method did not help to solve the problem with heteroskedasticity (the model 4th OLS ln Robust) in Table 8 and Table 9. White test shows identical results for each of 4 models.

The results of the assessment of four OLS models is presented in Table 8 (export) and Table 9 (import).

Table 8 Regression results for export

Variables	1st OLS	2nd OLS Robust	3rd OLS ln	4th OLS ln Robust
Distance,	-74.46***	-74.46***	-1.005***	-1.005***
	(27.41)	(22.34)	(0.207)	(0.204)
Boarder	138,330*	138,330**	1.821***	1.821***
	(73,450)	(59,957)	(0.408)	(0.312)
Language	-253,295***	-253,295***	0.745***	0.745***
	(52,018)	(35,563)	(0.246)	(0.281)
History	307,069***	307,069***	-0.883***	-0.883***
	(59,342)	(49,782)	(0.276)	(0.246)
Sea Port	177,072***	177,072***	-0.0988	-0.0988
	(51,135)	(34,768)	(0.233)	(0.261)
GDP RU	0.127***	0.127***	0.229	0.229
	(0.0172)	(0.0168)	(0.866)	(0.823)
GDP EU	0.279***	0.279***	1.412***	1.412***
	(0.0260)	(0.0306)	(0.0659)	(0.129)
Constant	-133,261*	-133,261**	-592.9	-592.9
	(79,356)	(57,068)	(1,371)	(1,261)

R-squared	0.517	0.517	0.626	0.626

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Source: Comtrade database, own calculation, 2018

Table 9 Regression Results for import

Variables	1st OLS	2nd OLS Robust	3rd OLS ln	4th OLS ln Robust
lnDist	8.619**	8.619**	-0.0879	-0.0879
	(3.488)	(3.676)	(0.186)	(0.167)
Boarder	31,318***	31,318***	1.928***	1.928***
	(9,349)	(7,002)	(0.369)	(0.281)
Language	-22,151***	-22,151***	-0.767***	-0.767***
	(6,621)	(4,308)	(0.220)	(0.230)
History	18,557**	18,557***	0.385	0.385*
	(7,553)	(5,962)	(0.246)	(0.197)
Sea Port	28,292***	28,292***	1.780***	1.780***
	(6,508)	(4,086)	(0.211)	(0.224)
lnGDPru	0.0142***	0.0142***	-1.389*	-1.389*
	(0.00219)	(0.00227)	(0.774)	(0.715)
lnGDPeu	0.0653***	0.0653***	0.880***	0.880***
	(0.00331)	(0.00462)	(0.0569)	(0.0844)
Constant	-54,327***	-54,327***	-3,063**	-3,063***
	(10,100)	(9,648)	(1,226)	(1,080)
R-squared	0.692	0.692	0.614	0.614

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Source: Comtrade database, own calculation, 2018.

Possible solution for the problem of BLUE is utilization of the models based on the panel data – OLS paneled model with fixed effect and OLS paneled model with random effect. It is possible to obtain effective unbiased estimates by constructing a regression using the generalized least squares method (GLS). In such a regression, it is possible to get rid of autocorrelation and heteroskedasticity, but in its structure this regression is still cross-

cutting and does not take into account individual effects. Due to the focus of the study, it is incorrect to use models that give stable but ineffective estimates, so it was decided to evaluate the model using the Generalized List Square (GLS).

The GLS model turns out to be BLUE, and, since the errors in the transformed equation are serially uncorrelated and homoskedastic, t and F statistics from the transformed equation are valid (Wooldridge, 2004, p.389)

A model with fixed-effects is based on the premise that the observations in the sample have a unifying characteristic, which is incorrect in relation to this sample. Also, a model with fixed-effects does not evaluate invariant variables. In this model, such variables are the presence of a common border and a common language, etc. All dummy variables were omitted. As a result, the model with random individual effects was selected on the base of the specification. The results of the coefficient estimates in the three models are presented below in Table 10 and Table 11.

Table 10 Panel regression results for export

Variables	5th Gravity Panel Random effects GLS	6th Gravity Panel Random effects ML	7th Gravity Panel Fixed
Distance,	-1.128*	-1.128	omitted
	(0.656)	(0.760)	
Boarder	1.812	1.799	omitted
	(1.294)	(1.500)	
Language	0.959	0.943	omitted
	(0.761)	(0.879)	
History	-1.056	-1.036	omitted
	(0.855)	(0.986)	
SeaPort	-0.245	-0.235	omitted
	(0.730)	(0.845)	
GDP RU	0.556***	0.561***	0.635***
	(0.110)	(0.117)	(0.208)
GDP EU	1.515***	1.504***	1.345***
	(0.181)	(0.203)	(0.425)
Constant	-7.244	-7.192	-14.35***
	(5.125)	(5.900)	(2.578)

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Source: Comtrade database, own calculation, 2018

Table 11 Panel regression results for import

Variables	5th Gravity Panel Random effects GLS	6th Gravity Panel Random effects ML	7th Gravity Panel Fixed
lnDist	-0.113	-0.112	omitted
	(0.666)	(0.569)	
Boarder	1.921	1.913*	omitted
	(1.317)	(1.125)	
Language	-0.675	-0.688	omitted
	(0.778)	(0.666)	
History	0.326	0.340	omitted
	(0.873)	(0.748)	
SeaPort	1.791**	1.798***	omitted
	(0.743)	(0.636)	
lnGDPru	0.488***	0.491***	0.376
	(0.130)	(0.122)	(0.279)
lnGDPeu	0.927***	0.919***	1.172**
	(0.190)	(0.165)	(0.572)
Constant	-9.713*	-9.677**	-10.24***
	(5.288)	(4.577)	(3.478)
R-squared			0.196

Standard errors in parentheses*** p<0.01, ** p<0.05, * p<0.1

Source: Comtrade database, own calculation, 2018

To confirm the suggestion, the model 5th Gravity Panel Random GLS with the panel data proved to be better than the previous model 4th OLS ln Robust. Comparison of both models was made by Brousch-Pagan test. The 5th model showed more accurate results. The outcomes of the tests can be found below in Figure 26 and Figure 27.

Figure 26: Breusch and Pagan test for export, comparison of the model 4th OLS ln Robust and 5th Gravity Panel Random effects GLS.

```
Breusch and Pagan Lagrangian multiplier test for random effects

        lnExp[cntr,t] = Xb + u[cntr] + e[cntr,t]

        Estimated results:
                         |       Var      sd = sqrt(Var)
                ---------+------------------------------
                   lnExp |   6.332855        2.516516
                       e |    .432578        .6577066
                       u |   1.530593        1.237171

        Test:   Var(u) = 0
                                 chibar2(01) =   1559.68
                              Prob > chibar2 =    0.0000
```

Source: Comtrade database, own calculation, 2018

Figure 27: Breusch and Pagan test for import, comparison of the model 4th OLS ln Robust and 5th Gravity Panel Random effects GLS..

```
Breusch and Pagan Lagrangian multiplier test for random effects

        lnImp[cntr,t] = Xb + u[cntr] + e[cntr,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+------------------------------
                   lnImp |   4.972841        2.229987
                       e |   .7862285        .8866953
                       u |   1.632541        1.277709

        Test:   Var(u) = 0
                                chibar2(01) =  1019.26
                             Prob > chibar2 =   0.0000
```

Source: Comtrade database, own calculation, 2018

LM method is suitable for verification of the random effect model. The evaluation result is also shown in the model 6th Gravity Panel Random effects ML (Table 8 and Table 9). To determine better method, the GLS or LM, the Houseman test was implemented for comparison of the models. Hausman test results are presented in Figure 28 and Figure 29

Figure 28: Hausman test for export, comparison of the model GLS and ML random effect.

```
                 ---- Coefficients ----
                 |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                 |    fixed        random       Difference          S.E.
-----------------+------------------------------------------------------------
        lnGDPru  |   .3758399     .4878153      -.1119754        .2469618
        lnGDPeu  |   1.172034     .9265577       .2454761        .5396239
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
        B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =         0.21
                Prob>chi2 =       0.9001
```

Source: Comtrade database, own calculation, 2018

Figure 29: Hausman test for mport, comparison of the model GLS and ML random effect.

```
hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+------------------------------------------------------------
      lnGDPru |     .6346835     .5562318       .0784516        .1758859
      lnGDPeu |      1.34463     1.514768      -.1701388         .384178
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =          0.20
                Prob>chi2 =        0.9068
                (V_b-V_B is not positive definite)
```

Source: Comtrade database, own calculation, 2018

Obviously, the results of the LM and the GLS models are the same. Therefore, the GLS Random Effects model is chosen.

Thus, the gravity model in relation to agricultural export is confirmed by the model with panel data random-effect.

5.2.2 The “Commodity” gravity model

In this Section, the hypothesis, stating that the gravity model is feasible for grouping by product is tested.

The previous data set is taken for the research, but the regression for each type of 24 agricultural products is checked. Export and import are investigated separately.

As in the previous section each product is checked with different types of regressions and the Gravity Panel Random effects GLS is utilized.

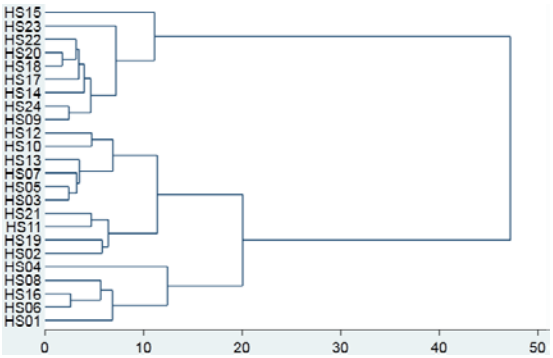
For each of 24 agricultural products, the procedure was carried out for export and import separately, similarly with the Country gravity model section. Tests of White, Breusch - Pagan, Hausman, Wald were conducted. The methodology was similar to the “country” gravity model. The GML model with random effect was recognized as the best solution. The appendix contains GLS regression for all 24 goods for export and import.

Obviously, the gravity model in the classic version is suitable for rare case of product groups. For some groups of goods (Meat, Fruits, Vegetables) there are the classical gravity

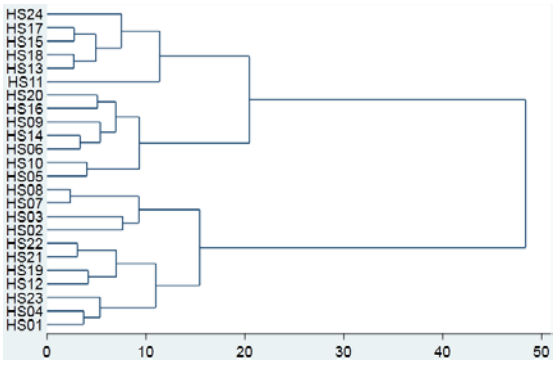
dependence presented by Timbergen, J. (1962, p.371). Other products have no dependence on the variable distance, but there is dependence on the variable language. Surprisingly, the variable sanction is significant even among those products that were not sanctioned. Thus, it can be concluded that the effect of sanctions is much deeper than was once stated. Dendrogramms for grouping products by significant variables are represented in Figure 30

Figure 30: Dendrogramm for cluster analysis, export and import .

Export



Import



Where: 1-Live animals; 2-Meat and edible meat offal; 3-Fish, crustaceans, molluscs, aquatic invertebrates etc; 4-Dairy products, eggs, honey, edible animal product etc; 5-Products of animal origin; 6-Live trees, plants, bulbs, roots, cut flowers etc; 7-Edible vegetables and certain roots and tubers; 8-Edible fruit, nuts, peel of citrus fruit, melons; 9-Coffee, tea, mate and spices; 10-Cereals; 11-Milling products, malt, starches, inulin, wheat gluten; 12-Oil seed, oleaginous fruits, grain, seed, fruit, etc; 13-Lac, gums, resins, vegetable saps and extracts; 14-Vegetable plaiting materials, vegetable products; 15-Animal,vegetable fats and oils, cleavage products, etc; 16-Meat, fish and seafood and food preparations; 17-Sugars and sugar confectionery; 18-Cocoa and cocoa preparations; 19-Cereal, flour, starch, milk preparations and products; 20-Vegetable, fruit, nut, other food preparations; 21-Miscellaneous edible preparations; 22-Beverages, spirits and vinegar;

Source: Comtrade database, own calculation, 2018

As for import, four clusters of goods were identified with a significant variable: Distance, Boarder, History Language.

As for import, three clusters of goods were identified with a significant variable: Distance, Boarder, Language.

As for export trade flow, the variables language and border work together. While for import trade flow the same variables work separately, the variable language is significant for certain groups of goods, the variable border for others.

As for import, the variable sanction is always significant for all groups of goods (even for commodities that were not subject to sanctions), and for export, the variable sanction is almost never significant.

The GDP of Russia and EU countries is significant in most cases for both export and import, which confirms Timbergen's conclusions on the gravity model.

6 Results and Discussion

Studying the theme of agricultural trade between Russia and EU countries included various methods of documentary statistics and the econometric analysis. Implementation of the gravity model in agricultural trade will help to see future competitive advantages and assess the impact of sanctions in the long run. The purpose of the analysis conducted in the research is to provide answers to questions formulated in objectives.

The first research question of the investigation is aimed to estimate current conditions of agricultural trade in Russia and European Union

Russia is dependent on food imports, although this dependence has been declining over 18-year period studied. Food imports exceed exports of other products several times. It is caused by many reasons; one of the main reasons is small state support of agriculture. European Union is the main trading partner for Russia, but in 2014 Russia imposed sanctions on certain types of agricultural products exported to Russia from European Union, the USA and Canada. One of the possible ban's reasons is the support of Russian agricultural producer. Such products as meat, dairy and fruits, which were the main imported products from European Union to Russia, were banned. Despite the fact that Germany and the Netherlands are the main trading partners from European Union, Latvia and Poland have mostly suffered from the ban. These two countries had the largest volume of agricultural products produced for Russia in the total volume of exported products - about 50%. Moreover, most of these imported products to Russia were banned. The volume of agricultural products produced for Russia in Germany and the Netherlands is less than 5%. The implications for Russia from the import ban are different. The quality of local food products decreased in the absence of competition and re-export of food products through Belarus was increased. However, the ban also helped Russian agricultural producers to increase production amount due to the lack of competitors - suppliers from Europe. The main goods exported to European Union from Russia are fish, cereals, and oils, and the exponential growth is observed for fish exports throughout the entire 18 year period.

The second research question of the investigation is aimed to make regression models for countries and for particular types of agricultural products.

This research examined trade flows of imports and exports between EU countries and Russia for the period of 2000-2017. Dataset sample consists of 12,096 observations

and 29 countries. The gravity model of the dependence of imports and exports from each European country to Russia takes into account such variables as GDP (US doll), distance (km), and dummies (common boarder, a common language, common history, seaport availability). Seven different specifications of the models (OLS, GLS, ML) were investigated, the BLUE assumption was checked, and the best model specification was selected using Breush-Pagan and Hausman tests. The most suitable model is the panel data generalized list square model with random effect. This gravity model with random effect was used to investigate the movement of imports and exports in individual EU countries. The import flow model confirmed the hypothesis that the gravity model works in the field of international agricultural trade. Thus, the smaller the distance between countries, the greater the trade flow between them and the larger both countries' GDP, the greater the trade flow between them.

Also, this model specification was tested for each of 24 types of products. The methodology of model verification and testing by product was the same with the previous model by the country. As a result, we can say that the gravity model is suitable tor a commodity group too.

The third research question of the investigation is aimed to make the cluster analysis for the particular group of products

The results of evaluating the model with random effect were exposed to the cluster analysis. The model was formed for import clusters and three export clusters. For some products (fruits, meat, vegetables), the trade flow-distance relationship was confirmed. Moreover, some models confirmed importance of a common language for office work and a common border. The effect of sanctions was observed on absolutely all goods exported to Russia. Thus, the analysis showed the impact of sanctions on each of 24 groups of goods imported into Russia (not just those products that have been under Russian ban). It should be said that the impact of sanctions is deeper than previously thought.

The choice of the model is a matter of discussion. The classical gravity model was utilized in this research to estimate international agricultural trade. The research involves influence of nontariff regulating barrier that is Russian ban. However, to estimate influence of nontariff barriers on definite agricultural products reasonably, Babula (2005) studied influence of quota on wheat import in the USA and offered the vector autoregression model as it provides more robust estimation. Such authors as Deardorff and Stern (1998,

p.7), Ferrantino (2006, p.16), Solodkovska and Olefirenko (2014, p.966) consider the gravity model reasonable and suitable in this case and the estimation made with help of this model is robust.

7 Conclusion

Estimation of current conditions of agricultural trade in Russia and European Union shows that import of agricultural products is greater by several fold than export in Russian and European Union is the main supplier of agriltural products in Russia. In 2014 import ban on some imported agricultural products was inroduced to increase self-sufficiency. It greatly impacted trade flow between European contries and Russia. Latvia and Poland suffered most of all because Russia was their main trade partner. Quality of Russian agricultural products was decreased due to absense of European competitors in the market.

The regression model analysis for researched period 2000-2017 identified two factors impacting trade flow between Russia and European Union that is distance between countries and economic size of a country, in other words, the less the distance between countries and the bigger the economic size the more intensive trade between countries. The regression analysis of each of 24 imported and exported products in Russia revealed impact of a common border factor and a common language for office work together with factors of the distance and the economic size. The common border and the common language increase trade activity between countries.

The cluster analysis revealed impact of sanctions on absolutely all groups of agricultural products imported in Russia, even non-sanctioned products suffered from this impact. It should be said that sanctions made greater influence than expected.

So import of agricultural products in Russia from European Union is significant and greatly impacted by import ban. More than that this impact will be as great as it is now.

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8 Appendix

App.1 The example table of Gravity model

Countries	Dist-ance*	Boarder	Lang-uage	His-tory	Sea Port	Ex-port	Im-port	GDP RU	GDP EU	Ban
Austria	1 670									
Belgium	2 252				1					
Bulgaria	1 777		1		1					
Croatia	1 867		1		1					
Cyprus	2 312				1					
Czech Rep.	1 667		1	1						
Denmark	1 559				1					
Estonia	317	1	1		1					
Finland	300	1	1	1	1					
France	2 486				1					
Germany	1 608			1	1					
Greece	2 232				1					
Hungary	1 569									
Ireland	2 795				1					
Italy	2 376				1					
Latvia	491	1	1	1	1					
Lithuania	790	1	1	1	1					
Luxembourg	2 196									
Malta	2 815				1					
Netherlands	2 147				1					
Poland	1 151	1	1	1	1					
Portugal	3 907				1					
Romania	1 498				1					
Slovakia	1 631		1	1						
Slovenia	1 932		1		1					
Spain	3 440				1					
Sweden	691				1					
United Kingdom	2 501				1					

Sourse: http://www.distancefromto.net/,own calculation

App 2.1 Regress Export Each commodity (constant Price)

VARIABLES	Live animals	Meat and edible meat offal	Fish, crustaceans, molluscs, aquatic invertebrates nes	Dairy products, eggs, honey, edible animal product nes	Products of animal origin, nes	Live trees, plants, bulbs, roots, cut flowers etc	Edible vegetables and certain roots and tubers	Edible fruit, nuts, peel of citrus fruit, melons	Coffee, tea, mate and spices	Cereals	Milling products, malt, starches, inulin, wheat gluten	Oil seed, oleagic fruits, grain, seed, fruit, etc, nes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
lnDist	0.803	-2.955***	0.564	-1.999	1.757	-0.734	-0.0636	-3.560***	0.998	0.771	-1.101	0.878
	(0.620)	(0.880)	(1.273)	(1.348)	(1.266)	(1.144)	(1.381)	(1.101)	(1.289)	(0.678)	(1.400)	(0.794)
Boarder	0.864	-7.731***	2.817	-2.127	1.997	-1.657	3.709	2.090	4.371*	3.049**	-0.768	3.382**
	(1.197)	(2.710)	(2.625)	(2.698)	(2.230)	(2.113)	(2.893)	(2.090)	(2.538)	(1.325)	(2.319)	(1.545)
Language	-1.109	4.702**	-0.702	0.409	-0.230	0.362	-1.387	-3.084**	-0.231	-2.337***	1.620	-1.794*
	(0.836)	(2.382)	(1.947)	(1.952)	(1.402)	(1.675)	(2.111)	(1.408)	(1.784)	(0.809)	(1.293)	(0.979)
History	1.808***	1.043	0.144	1.862	0.914	1.504	0.109	1.086	0.447	-0.641	0.428	0.191
	(0.694)	(1.271)	(1.561)	(1.513)	(1.290)	(1.287)	(1.637)	(1.234)	(1.508)	(0.784)	(1.203)	(0.936)
SeaPort	-0.102	0.587	-0.0942	-1.164	1.011	0.318	-0.875	-0.141	-0.840	2.225***	1.424	0.786
	(0.720)	(1.487)	(1.488)	(1.614)	(1.300)	(1.686)	(1.720)	(1.244)	(1.527)	(0.766)	(1.254)	(0.897)
lnGDPru	-2.663***	4.193***	0.132	-7.938***	0.870	-1.631	1.189*	0.497	4.223***	0.903	2.581***	1.648***
	(0.644)	(1.442)	(0.477)	(1.239)	(0.689)	(1.414)	(0.620)	(0.537)	(0.721)	(0.591)	(0.722)	(0.570)
lnGDPeu	0.0519	0.285	0.609	-0.180	0.388	0.0449	1.041**	0.844**	-0.0637	0.000276	0.110	0.781***
	(0.223)	(0.409)	(0.449)	(0.441)	(0.438)	(0.553)	(0.437)	(0.398)	(0.484)	(0.210)	(0.405)	(0.273)
sanction	-0.301	-1.231**	0.121	3.402***	0.242	0.0441	0.609**	-0.178	0.324	0.233	0.857***	-0.0890
	(0.325)	(0.564)	(0.211)	(0.684)	(0.311)	(0.682)	(0.272)	(0.232)	(0.296)	(0.270)	(0.273)	(0.253)
Constant	41.37***	-33.83	-1.020	143.3***	-21.74*	37.29*	-18.44	19.57*	-60.16***	-6.898	-24.12*	-28.72***
	(10.74)	(22.30)	(11.45)	(20.69)	(12.96)	(21.63)	(13.57)	(10.92)	(13.91)	(10.01)	(14.45)	(10.13)
Observations	241	79	322	160	218	87	331	286	281	340	242	358
Number of cntr	25	17	25	24	24	18	24	24	25	28	23	27

Source: Uncomtrade database, own calculation

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

App 2.2 Regress Export Each commodity (constant Price)

	Lac, gums, resins, vegetable saps and extracts nes	Vegetable plaiting materials, vegetable products nes	Animal,vegetable fats and oils, cleavage products, etc	Meat, fish and seafood food preparations nes	Sugars and sugar confectionery	Cocoa and cocoa preparations	Cereal, flour, starch, milk preparations and products	Vegetable, fruit, nut, etc food preparations	Miscellaneous edible preparations	Beverages, spirits and vinegar	Residues, wastes of food industry, animal fodder	Tobacco and manufactured tobacco substitutes
VARIABLES	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
lnDist	0.701	0.939	1.107	-0.0418	1.507	0.554	-0.549	0.146	-1.096	-0.224	0.528	1.833
	(1.560)	(0.817)	(1.215)	(0.796)	(1.114)	(1.520)	(1.046)	(1.042)	(0.744)	(0.806)	(0.928)	(1.171)
Boarder	1.571	2.937*	3.583	0.357	4.387**	3.963	2.719	3.170	0.742	2.737*	2.041	1.649
	(2.444)	(1.703)	(2.338)	(1.546)	(2.139)	(2.813)	(1.983)	(2.014)	(1.436)	(1.578)	(1.808)	(2.158)
Language	-0.306	-2.101	-1.157	0.540	1.857	0.548	0.232	-0.518	1.258	-0.379	-2.146*	0.0979
	(1.786)	(1.314)	(1.518)	(1.103)	(1.381)	(1.756)	(1.251)	(1.355)	(0.880)	(0.935)	(1.184)	(1.434)
History	0.483	1.476	1.158	0.697	-0.0378	0.0378	0.108	0.895	1.388	0.924	0.890	1.479
	(1.367)	(1.061)	(1.434)	(0.879)	(1.309)	(1.665)	(1.197)	(1.152)	(0.874)	(0.953)	(1.105)	(1.281)
SeaPort	-2.689	1.843	1.925	-0.00557	1.323	1.935	-1.450	0.254	0.163	0.840	3.322***	0.674
	(1.826)	(1.225)	(1.445)	(0.961)	(1.352)	(1.692)	(1.200)	(1.197)	(0.843)	(0.882)	(1.129)	(1.300)
lnGDPru	-0.236	6.201***	10.49***	-0.992	5.025***	4.125***	1.595**	4.041***	2.219***	2.651***	5.826***	3.798***
	(1.687)	(1.056)	(1.029)	(0.824)	(0.841)	(0.763)	(0.656)	(0.790)	(0.561)	(0.381)	(0.685)	(0.861)
lnGDPeu	0.235	0.129	0.589	0.566**	0.634	0.428	0.167	0.440	0.636**	0.710***	-0.161	0.0403
	(0.591)	(0.306)	(0.470)	(0.269)	(0.429)	(0.532)	(0.387)	(0.341)	(0.257)	(0.247)	(0.354)	(0.407)
sanction	1.442**	-0.528	-1.578***	-0.401	0.143	0.0823	-0.896***	-0.220	-0.109	-0.0306	0.593**	0.493
	(0.637)	(0.378)	(0.393)	(0.483)	(0.367)	(0.323)	(0.291)	(0.349)	(0.244)	(0.163)	(0.273)	(0.316)
Constant	4.591	-93.03***	-161.9***	17.84	-86.23***	-63.53***	-10.20	-58.12***	-22.35**	-35.60***	-78.48***	-61.45***
	(25.68)	(16.35)	(17.49)	(13.27)	(14.61)	(15.17)	(11.90)	(13.69)	(9.817)	(8.258)	(12.19)	(14.87)
Observations	87	160	356	223	319	290	341	316	405	444	326	206
Number of cntr	17	21	26	26	26	25	26	25	28	28	26	25

Source: Uncomtrade database, own calculation

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

3.1 Regress Import Each commodity (constant Price)

VARIABLES	Live animals	Meat and edible meat offal	Fish, crustaceans, molluscs, aquatic invertebrates nes	Dairy products, eggs, honey, edible animal product nes	Products of animal origin, nes	Live trees, plants, bulbs, roots, cut flowers etc	Edible vegetables and certain roots and tubers	Edible fruit, nuts, peel of citrus fruit, melons	Coffee, tea, mate and spices	Cereals	Milling products, malt, starches, inulin, wheat gluten	Oil seed, oleagic fruits, grain, seed, fruit, etc, nes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
lnDist	-1.537	-0.624	-0.730	-1.148	-0.127	0.893	1.524	3.296**	-0.694	-2.736***	-1.542**	0.555
	(1.012)	(0.882)	(0.874)	(0.809)	(1.001)	(1.524)	(1.053)	(1.519)	(0.949)	(1.016)	(0.662)	(1.086)
Boarder	1.875	2.491	1.625	1.555	-0.879	6.010**	5.035**	5.359*	3.077*	-2.246	-0.373	-1.480
	(1.955)	(1.707)	(1.847)	(1.565)	(2.017)	(2.942)	(2.089)	(3.003)	(1.835)	(1.827)	(1.305)	(2.122)
Language	-2.631*	-1.852*	-3.432**	-1.398	-1.891	-3.267*	-2.110*	-0.315	-1.429	-2.549**	-1.677*	1.440
	(1.402)	(1.102)	(1.374)	(0.996)	(1.489)	(1.851)	(1.263)	(1.782)	(1.149)	(1.275)	(0.950)	(1.246)
History	1.555	-0.274	0.863	2.071**	1.436	2.602	1.219	-0.291	0.435	1.752	2.887***	0.895
	(1.259)	(1.068)	(1.082)	(0.980)	(1.228)	(1.819)	(1.239)	(1.780)	(1.135)	(1.182)	(0.809)	(1.271)
SeaPort	-1.762	0.384	4.750***	0.00415	1.796	-0.741	-0.813	-0.343	-0.955	0.0845	-0.770	0.852
	(1.178)	(0.994)	(1.092)	(0.895)	(1.213)	(1.696)	(1.268)	(1.824)	(1.062)	(1.084)	(0.794)	(1.205)
lnGDPru	4.572***	0.274	1.604***	2.544***	-0.997*	1.701**	2.350***	2.329***	0.257	0.202	-2.973***	1.800***
	(0.578)	(0.450)	(0.445)	(0.430)	(0.562)	(0.662)	(0.517)	(0.633)	(0.421)	(0.633)	(0.467)	(0.425)
lnGDPeu	0.801*	1.408***	-0.411	0.782***	0.240	0.681	0.733**	1.008**	1.074***	0.276	0.753***	1.318***
	(0.464)	(0.336)	(0.324)	(0.298)	(0.407)	(0.547)	(0.333)	(0.471)	(0.340)	(0.451)	(0.283)	(0.325)
sanction	-1.698***	-2.796***	-2.796***	-1.708***	-0.763***	-0.622**	-2.643***	-3.620***	-0.119	-0.472*	-0.550***	-0.840***
	(0.228)	(0.243)	(0.274)	(0.194)	(0.241)	(0.271)	(0.265)	(0.359)	(0.176)	(0.265)	(0.204)	(0.173)
Constant	-52.63***	-1.981	-3.124	-24.91***	23.08**	-29.41**	-42.05***	-58.76***	0.540	26.74**	59.88***	-35.81***
	(10.81)	(9.213)	(9.128)	(8.551)	(10.85)	(14.71)	(10.85)	(14.54)	(9.194)	(11.52)	(8.139)	(10.21)
Observations	342	305	295	412	299	359	402	372	385	348	364	428
Number of cntr	24	26	24	27	24	27	27	27	27	25	25	28

Source: Uncomtrade database, own calculation

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

3.2 Regress Import Each commodity (constant Price)

	Lac, gums, resins, vegetable saps and extracts nes	Vegetable plaiting materials, vegetable products nes	Animal,vegetable fats and oils, cleavage products, etc	Meat, fish and seafood food preparations nes	Sugars and sugar confectionery	Cocoa and cocoa preparations	Cereal, flour, starch, milk preparations and products	Vegetable, fruit, nut, etc food preparations	Miscellaneous edible preparations	Beverages, spirits and vinegar	Residues, wastes of food industry, animal fodder	Tobacco and manufactured tobacco substitutes
VARIABLES	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
lnDist	-0.440	1.921**	-1.444	-0.866	-0.558	-1.051	-0.756	1.036	-1.311	-0.276	-0.498	0.797
	(1.299)	(0.886)	(0.899)	(1.240)	(0.833)	(0.820)	(0.815)	(0.861)	(0.992)	(0.753)	(0.726)	(0.806)
Boarder	1.447	2.285	-0.278	1.187	0.544	1.753	0.669	2.451	-1.786	-0.114	1.438	1.159
	(2.566)	(1.817)	(1.734)	(2.386)	(1.603)	(1.577)	(1.567)	(1.654)	(1.928)	(1.468)	(1.400)	(1.606)
Language	0.663	-0.987	-1.290	-2.040	-0.317	-0.339	1.546	-0.749	1.173	0.0155	-2.427***	2.450**
	(1.704)	(1.308)	(1.079)	(1.518)	(0.978)	(0.974)	(0.973)	(1.016)	(1.123)	(0.857)	(0.850)	(1.037)
History	-0.691	1.937*	-0.149	2.103	1.809*	0.897	-0.440	0.862	0.700	0.966	1.454*	-1.814*
	(1.566)	(1.096)	(1.081)	(1.447)	(0.977)	(0.979)	(0.980)	(1.023)	(1.144)	(0.878)	(0.829)	(0.988)
SeaPort	-0.311	1.245	1.524	-1.070	0.776	0.498	-0.0672	0.533	0.955	1.087	-0.951	0.625
	(1.450)	(1.167)	(1.000)	(1.456)	(0.918)	(0.900)	(0.895)	(0.942)	(1.074)	(0.816)	(0.844)	(0.915)
lnGDPru	-1.402***	1.203	-1.636***	1.040**	-1.121***	-0.455	1.759***	0.316	0.979***	1.308***	1.978***	-1.233***
	(0.471)	(0.803)	(0.455)	(0.458)	(0.274)	(0.353)	(0.367)	(0.349)	(0.265)	(0.252)	(0.335)	(0.449)
lnGDPeu	1.999***	-0.0413	1.168***	-0.192	1.037***	1.376***	1.563***	0.955***	0.951***	0.912***	0.414*	1.809***
	(0.454)	(0.337)	(0.328)	(0.459)	(0.275)	(0.291)	(0.297)	(0.300)	(0.277)	(0.218)	(0.238)	(0.272)
sanction	-0.538***	-0.358	-0.538***	-1.107***	-0.253**	-0.424***	-0.265*	-0.797***	-0.798***	-0.751***	-0.626***	-1.002***
	(0.200)	(0.352)	(0.194)	(0.200)	(0.111)	(0.148)	(0.157)	(0.146)	(0.107)	(0.106)	(0.144)	(0.200)
Constant	10.05	-26.14**	33.28***	7.479	19.94***	9.775	-26.44***	-10.74	-3.048	-14.75**	-15.14**	2.431
	(11.73)	(13.14)	(9.316)	(11.14)	(7.241)	(7.867)	(7.944)	(8.056)	(8.309)	(6.702)	(7.212)	(8.823)
Observations	335	192	431	392	439	432	466	456	462	484	383	375
Number of cntr	26	23	27	25	27	27	27	27	28	28	26	27

Source: Uncomtrade database, own calculation

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1