IS EURASIAN CUSTOMS UNION TRADE CREATING? GRAVITY MODEL ANALYSIS.

by

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A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Arts

in

Economics

at

NAZARBAYEV UNIVERSITY
SCHOOL OF SCIENCES AND HUMANITIES

2020

Abstract

The paper presents a thorough analysis of the consequences of economic integration for the countries of the Eurasian Customs Union. The main objective of the paper is to evaluate the economic efficiency of the Union by measuring its trade creation and trade diversion effects. To empirically estimate the effects of ECU the gravity model was applied to the data sample of 51 countries over the period of 2003-2018 years. The analysis of trade creation and trade diversion effects of ECU as a whole showed that Union had been efficient in promoting internal trade and increasing the net export of its members to non-union countries, which is certainly beneficial for the economies of nations. Despite the presence of the import trade diversion, the scope of intra-bloc trade creation effect is larger, so that the Union can be considered as a net trade creator. Having examined the consequences of the membership in ECU for each country we can state that while there are positive effects for some members, the advantages for Russia outweigh those for other countries.

Keywords: economic integration, Eurasian Customs Union, trade creation and trade diversion, gravity model.

1. Introduction

Integration processes played an important role in the economic development of most countries of the world since the end of the 1960s. Now almost every country is a member of at least one or even several regional integration associations.

84% of such agreements are in the form of Free Trade Areas (Baier et al, 2019). At the regional level, the majority of organizations are concentrated in Europe, where deeper forms of integration interactions take place. However, after the fall of the USSR regional integration proceeds in the Asian region as well.

Nursultan Nazarbayev's proposal on the creation of the Eurasian Union of states in 1994 is considered to be a starting point for the formation of economic relations in the direction of trade development between countries of the post-Soviet space (Vinokurov, 2017). In 2010 the Customs Union (CU) of the Republic of Belarus, the Republic of Kazakhstan and the Russian Federation began to function. As a result, tariffs on trade between Russia, Kazakhstan and Belarus were eliminated and a common external tariff on imports from non-CU countries was imposed. Having observed the success of the Customs Union, heads of the three states intended to further develop mutual integration. So, in 2015 the Treaty on the Eurasian Economic Union (EEU) came into force. "Under the present Treaty Parties shall establish the Eurasian economic Union and ensure free movement of goods, services, capital and labor as well as coordinated, agreed or common policy in the economic sectors defined in the present Treaty and in the international agreements within the EEU" (Treaty on the EEU, 2015: 3). Currently, members of EEU are the Republic of Armenia, Republic of Belarus, the Republic of Kazakhstan, the Kyrgyz Republic and the Russian Federation.

However, the functioning of the Common economic space between those countries from the moment of its creation causes a large number of discussions, the main scope of which is an assessment of economic efficiency of this integration association. Critics of the ECU (Mostafa and Mahmood, 2018; Schenkkan, 2014) usually state that the following factors can lead to inefficiency of the Union:

- The prevailing weight of Russia in the economy of the Union (in terms of GDP, population, trade and investment flows). Hence, ECU is likely to have more potential benefits for Russia in terms of trade, while other members will suffer losses;
- Long distances and the high cost of transportation. Considering the huge size of the territory of Russia, distances between some participants of EEU (for example, between Belarus and Kazakhstan) are very big;
- Insignificant volumes of mutual trade in the Union. Actually, members of EEU trade generally with Russia, but not with each other.

The statistics provided in the TableA1, TableA2, TableA3 of the Appendix indeed capture the existence of the above-mentioned trends.

In this regard the need for carrying out the complex analysis which would allow to estimate the effects of realization of integration processes within ECU is obvious. The objective of the paper is to evaluate the economic efficiency of the Eurasian Economic Union by measuring its trade creation and trade diversion effects. In order to empirically estimate the effects of ECU the gravity model was applied, which is commonly used technique for the analysis of the possible consequences of the formation of different regional trade agreements (RTA). The main idea behind the gravity model is that the bilateral trade between two countries is likely to have positive correlation with the size of the economies and negative relationship with the distance between the partners. The model was applied to the sample of 51 countries and the period of 2003-2018.

The paper's contribution to the literature is twofold. Firstly, because of the relatively small period of ECU's functioning the issue of its effectiveness for the participants is not studied thoroughly by authors. For this reason, the empirical estimation of the effects of the integration on the post-Soviet space is quite relevant and significant. Secondly, although some papers include the analysis of ECU's trade effects, the recently occurred changes in the structure of the Union is not considered. In particular, Armenia became a member of ECU in January 2015, while Kyrgyzstan's accession to the Union was completed only in August 2015 (Vinokurov, 2017). The number of studies regarding this issue is limited, due to the fact that possible consequences of countries' participation in the Union could be properly assessed only after several years. In this regard, the attempt to fill this gap in the literature is made as well.

As a result of the empirical analysis, we cannot reject the hypothesis that it is mostly Russia that benefits from the formation of the Union. Although there are members for which positive effects of participation in the ECU do exist, they also experience some significant losses which are fully compensated for Russia but not for others. For Belarus and Kazakhstan, which are expected to gain similar positive effects because they have been members of ECU since its formation, the significant degree of import (Kazakhstan) and export trade diversion (Belarus) is observed. Such results indicate that for Belarus and Kazakhstan the participation in the Union is less beneficial than for Russia. While for Kyrgyzstan the participation in ECU may be beneficial in some ways, Armenia's joining to the Union is certainly welfare-decreasing, since the country is estimated to trade less with out-of-union countries while the degree of trade within the ECU did not increase much.

The rest of the paper is organized in the following way: Section 2 covers the relevant literature review, Section 3 is devoted for the preliminary descriptive analysis of the trade within the ECU which is based on the statistical data available, Section 4 and 5 give the precise description of the methodology and data used for analyzing the problem, Section 6 presents and discusses the results obtained and in Section 7 the main conclusions of the paper are presented based on the performed research.

2. Literature Review

2.1. Theoretical basis of the gravity model

The establishment of the General Agreement on Tariffs and Trade (GATT) in 1948 marked the beginning of the new trend for the need of the trade openness which was predicted to be the necessary condition for the economic prosperity of the country (Grossman, 2016). As a consequence, the number of formed RTAs increased significantly in the subsequent years, especially in Europe (WTO, 2011). The economists were curious about the truth of the widespread assumption according to which there was an absolute benefit of the deeper integration in the world trade. This fact led to the series of works which tried to empirically analyze whether the participation in a certain RTA was welfare increasing or welfare decreasing for the countries.

The fundamentals of modern theory of customs union were originated by Viner (1950) who was the first to mention that regional trading blocs do not necessarily lead to the increase in the welfare of the members, they actually can be welfare-decreasing in some cases.

The author distinguished two cases of changing in supply sources of goods. In case if creation of custom union resulted in transition to consumption of the goods made with the lowest costs (even if they are made by the third country, not being the participant of the union), there is an effect of creation of trade. To the contrary, when member countries of the union close the market from cheaper import, there is a transition to consumption of the products created with higher expenses by parties of the bloc. In this case the effect of trade diversion arises, which, according to Viner is welfare decreasing.

The effect of trade creation and diversion which were discovered first by Viner (1950) in fact determined further development of the economic theory of custom unions. During 1960-70 the whole series of works by Lipsey (1960), Corden (1972) was published, in which every author tried to develop the Viner's ideas. The authors used different methods to estimate the effects of regional trade agreements on their members' economy. Gravity model approach is considered to be the most popular one (Porojan, 2001). Head and Mayer (2014) stated that the gravity model is one of the most stable empirical dependencies in the economic analysis.

The gravity model equation was derived in analogy to Newton's law of universal gravitation: the mutual trade of two countries depends on the degree of development of the partners' economies and the distance between those countries (Dascal et al, 2002).

Tinbergen (1962) was the first who applied the logic of Newton's law to describe the international trade flows. Having taken the Newton’s equation as a basis, he determined the gravity model equation as

$$TRADE_{ij} = C*(GDP_i*GDP_j)/DISTANCE_{ij}$$

In the original work Tinbergen estimated model in a logarithmic form by method of the least squares, and adding two dummy variables: 1) standing for whether the countries are adjacent; 2) indicating if goods from country i received preferential treatment from country j.

Due to the fact that the gravity model was formulated on the basis of the fundamental physics' law and lacked the background from the economic theory, its application for the explanation of the economic factors (trade, migration) has been criticized by various authors.

And the first to justify such relationship between the trade volumes and the size of the country's market in terms of economic principles was Anderson (1979). The author derived the gravity equation based on the two underlying assumption: 1) preferences have constant elasticity of substitution; 2) goods are differentiated not only according to their type, but also with respect to the place of origin. By the means of the scale effect and monopolistic nature of the market Helpman and Krugman (1985) described the existence of the gravity model in the case of trade of differentiated goods. Due to the increasing returns to scale countries would rather focus on the production of specific good and import other differentiated products from trade partners (Krugman and Obstfeld, 2003). Later on, Deardorff (1998) used the Heckscher-Ohlin model approach which assumes that countries having an excessive labor force would export labor intensive products while the goods the production of which requires more capital would be imported.

The development of the theoretical explanation of the gravity model continued in the XXI century as well. One of the most significant extension was made by Anderson and van Wincoop. The authors initially proposed the inclusion of the multilateral resistance terms (MRT) in the model, arguing that the important determinant of the trade between two countries is the degree of the remoteness of the specific nation from the rest of the world (Anderson and van Wincoop, 2003). Even though we might observe identical distance between two pairs of countries, the volume of goods imported/exported from one another may decrease (increase) if the countries are located near (far from) other markets. Hence the issue of omitted variable bias was present in the previous specifications of the gravity model due to the exclusion of relative trade prices. Most commonly MRTs in the literature are proxied by the constructed remoteness indexes (Gómez-Herrera, 2013), accounted for by including exporter and importer time-fixed effects (Feenstra, 2002) or approximated by Taylor series expansion (Baier and Bergstrand, 2009).

Moreover, Anderson and van Wincoop (2004) stated the importance of inclusion of trade costs in the model, since for some goods they are estimated to be 9 times higher than the production cost (Feenstra, 1998). The authors have described in detail each type of trade cost which may arise starting from the time when the good is produced until it has reached its destination, including the formulation of the methods that can measure any costs. However, it is often the scarcity and inaccuracy of the direct measurements of trade costs: they either present only for the certain type or even only for the certain countries in the sample (Anderson and van Wincoop, 2004). In addition to that, indirect measurements of trade costs which include those obtained from the data on the quantities and those based on the prices of the products can be used. It is worth noticing that quantity-based techniques have become popular among the researchers (Mattoo et al, 2007). Anderson (2011) have proposed another approach of indirect trade costs' measurement which is based on the comparison of what could be the outcome in a "frictionless" (same prices for products) market and observations from the actual data.

One of the concerns that bothers scientific community is that nevertheless technological advances are continuously implemented to the process of shipping of the products, there is no

significant difference in the estimated distance coefficient between the researches conducted in the second half of the 19th century and more recent ones. One of the possible reasons could be the case when the distance is not a proxy for trade costs but rather the measurement of the decrease in export values due to decrease in the remoteness of the partners (relative trade levels at 5 versus 500 kilometers) (Rauch, 2016). In this aspect, the observation of stable distance coefficient while the fall in the transportation costs is observed is reasonable. Another attempt to explain such stable magnitude of the coefficient was made by Chaney (2018). The author states that under the assumption that larger companies are able to perform trade on more remote distances, no variation in the coefficient of interest will be observed until the distribution of the firms is changed.

Despite the fact that gravity model has emerged more than a half century ago and all above-mentioned developments made to make the equation more realistic, authors still try to modify the equation such that more reliable and consistent results will be obtained. So further research and developments are only to emerge.

2.2. Estimating the gravity model

Given the wide range of the estimation techniques which can be used in order to estimate the gravity model it is often the issue of choosing the most appropriate and reliable method the usage of which will result in consistent and reliable outcomes. Among the most commonly applied estimation techniques are OLS, Tobit, Fixed effect and Poisson Pseudo Maximum Likelihood methods.

Earlier papers (Buch and Piazolo, 2001; Feenstra et al. 2001; Musila 2005) which included the analysis of the trade trends based on the gravity model mostly used cross-sectional data set, which resulted in the wide application of the OLS estimation method. However, the usage of OLS has been proven to be inadequate in the case of cross-sectional data due to the fact that some of the underlying model assumptions are not satisfied or unrealistic (Kareem et al, 2016). For example, the omittance of country specific unobservable time invariant effects, which are highly expected to be correlated with other explanatory variables, leads to the violation of the exogeneity assumption. Moreover, the OLS estimation results in homogeneity of the effects for individual countries while it is reasonable to state that evaluated parameters should change contingent upon the nations included in the sample.

The analysis of trade flows between partner countries should be based on three dimensions: exporter and importer specific characteristics and time (Matyas, 1997). Since the cross-sectional data sets lack the time component panel data-based analysis has become increasingly popular among researchers (Kepaptsoglou et al, 2009; Melitz, 2007; Baier and Bergsrtand, 2007). The introduction of such type of analysis solves the issue of omitted variable bias, since panel data makes it possible to track the dynamics of different factors affecting the trade, thus broadening the set of independent variables. Hence, fixed (FE) and random effect (RE) estimation techniques were applied by various authors (Henderson and Millimet, 2008; Glick and Rose, 2002).

RE method assumes that the individual effect is a random error invariant in time for each observed unit. In other words, the individual differences here are randomly distributed (Wooldridge, 2016). Furthermore, unlike the fixed effect model, the random effect assumes that these errors are uncorrelated with regressors, i.e. the individual effect has nothing to do with the explanatory variables. While one of the main FE method's assumption states that there is unobserved time-invariant heterogeneous component which tends to have different impact on each country (Wooldridge, 2016). But among the disadvantages of the FE method's application the failure of estimating the effect of time-invariant independent variables is the most disturbing. As a consequence, the variables which account for distance, common language, past colonial ties, adjacency of the trade partners are omitted. Since these factors are assumed to measure the trade costs, we lose significant portion of important information. Despite that it is the fixed effect estimation method that is more popular in the literature mostly because consistent and unbiased estimators using RE can be obtained only if the assumption of normally distributed MRTs is satisfied. But such statement has not been proven to be realistic (Shepherd, 2013).

There are other challenges when it comes to analyzing the trade by the means of gravity model. Particularly, sometimes the data for the export flows between certain countries is unobservable or equal to zero. Since initially multiplicative gravity equation is log-linearized at the first stage of the estimation process, the zero trade flows in this case are dropped. And none of the above-mentioned estimation methods solves this issue. The application of the Tobit model was suggested as a tool to deal with the zero equal bilateral export flows since this method is appropriate for the cases which limit the number of observations due to some measurement errors or due to the fact that obtained results do not meet expectations.

Earlier studies widely used exactly this method for dealing with missing values in dependent variable (Kucera and Sarna, 2006; Martin and Pham, 2008; Longo and Senkat, 2004). While it seems reasonable to apply Tobit as gravity equation's estimation technique, recently this model has become less popular among authors.

Martin and Pham (2008), have shown that coefficients of the independent gravity variables estimated by Tobit model are biased and Silva and Tenreyro (2011) have discovered that the bias is much larger in the magnitude when the sample size is increased.

In addition, Silva and Tenreyro (2011) have argued the efficiency of commonly used log-linearized gravity equation. The authors have stated that such transformation leads to getting inconsistent results because of the unsatisfied assumption about the error terms, in particular their constant variance and the expected value which is not usually the case when the trade data is analyzed. So, the original multiplicative form of the gravity model was proposed to be estimated by the Non-linear methods, which include PPML. This method simultaneously solves two major issues: zero export flows and observed heterogeneity. However, the drawbacks that are often pointed out by the opponents of the model include the possibility of the presence of over-dispersion and unreliable results if significant proportion of the dependent variable equals to 0. But there is an evidence of getting consistent estimations as a result of applying PPML even if over-dispersion is present (Head and Mayer, 2014) or the significant observations' part equals to 0 (Staub and Winkelmann, 2012).

Sample selection estimation models are also used to evaluate the gravity equation. One of the most popular one is Heckman two-stage method, which was developed by Helpman (2008). In the first step, within the binary selection model (selection equation), the probability of export occurrence between two partners is calculated. In the second step, the stochastic form of the equation for the export volume from one country to another is evaluated by the OLS.

To identify the parameters of the selection equation in Hekmann-type models, the exclusion restriction condition is of great importance: there are variables in the regression set of the selection equation, which may not be included in the second equation. Choosing such variables is quite controversial task. While some authors use the same set of variables in both equations (Linders and de Groot, 2006), Helpman et al (2008) suggest using cultural features, such as common language for exclusion restriction.

Summing up the discussion of methods of estimating the gravitational model, we emphasize that none of them is a priori the most preferable. The choice of a particular technique depends mostly on the properties of the data in question. In modern applications, the use of several evaluation methods at once with the possible choice of the "best" technique according to any criterion is considered a good tone.

2.3. Application of the model for trade effects analysis

Many authors by the use of the gravity model study the effects that certain trade agreement has on the trade dynamics between its members.

For instance, trade creation effects in the European Economic Community (EEC) and European Free Trade Association (EFTA) throughout different years in the second half of the 20th century were examined by Aitken (1973), Bergstrand (1985), and Thursby and Thursby (1987). The authors modified the original gravity model equation by considering additional characteristics, such as common land border, exchange rate volatility and relative prices. They discovered that both EEC in the 1960s and EFTA in the 1970s had trade creation effects, which have range of 50-280 % increase in trade depending on the observed year.

Frankel and Wei (1993) considered the data for 63 countries in order to check whether NAFTA or APEC had trade creating effects over the 1990s. Such variables as shared borderline, GDP per capita and exchange rate volatility were incorporated into the gravity model equation. As a result, the powerful evidence of trade creation within the RTAs was found. However, there is significant variation in scales of such effects among different trade arrangements. While APEC is estimated to intensify the trade by at least 170%, the same indicator for EEC is only 25%.

In the later works Frankel et al. (1995) studied both trade creation and trade diversion effects of regional trade agreements over the span of 25 years (i.e. 1965-1990). They, however, included more factors (common language and relative factor endowments) to the equation. Frankel and his colleagues revealed that EU and NAFTA tend to do both create and divert trade at the same time.

The trade effects of RTAs, established in Latin America, were examined by Aitken and Lowry (1972), Garman et al. (1998). Despite controlling for different variables in the gravity model equation, using various data sets each author came to the same conclusion: the trade agreements formed in the Latin America and Central America, such as CACM and LAIA, have trade creation effects.

Apart from above-mentioned factors Rose (2000) and Feenstra et al. (2001) controlled for such variables as whether countries have ever belonged to the same colony, whether the country is remoted or not, does it have access to the sea and country's territory. The broadest set of independent variables (30) for gravity equation was used by Rose (2000). Moreover, instead of including single dummy variable for trade within trade agreement they added a bunch of dummy variables for everyone. The implementation of such changes to the gravity equation have not only supported the conclusions of former works, but also have strengthened the statement of trade creation within RTAs even more because despite the different selection of countries and time intervals the coefficient on the variable RTA was positive and statistically significant.

The issue of ECU's trade creation or diversion effects has not been studied properly. There exist a few works concerning the problem, but most of them have been too predictive or have used the narrow range of observations. Vinhas de Souza (2011) found out that it is likely that establishment of Eurasian Custom Union will be resulted in trade diversion for all member countries, especially for Belarus, where GDP will decrease to the greatest extent. Isakova et al (2016) discovered evidence of little trade creation within the Union for Kazakhstan and Belarus. The amount of export from China to Kazakhstan decreased dramatically, which indicates the presence of trade diversion effects. However, there were significant trade creation effects between Russia and EU due to decrease in the tariff rates. It is worth noting, that the authors have analyzed very short period of time (2009-2011) while it is necessary to assess longer periods in order to get the true degree of trade effect of ECU on member countries.

3. Primary analysis of bilateral trade between the members of Eurasian Custom Union

The scale for creation of trade within the Eurasian Custom Union is not significant because the majority of the members of the Union had already traded with each other tariff-free in regard to a considerable part of the goods due to the existence of implicit free-trade agreements within the Commonwealth of Independent States.

The same opinion concerning the trade creation effects of the ECU was held by Michalopoulos and Tarr (2014). These authors were the first to analyze the potential benefits and losses resulting from the integration of post-Soviet Union countries. Michalopoulos and Tarr have identified three major shortcomings of trade associations with Russia for the states in the post-Soviet space:

1) Giving that Russia's external tariffs applied to export from other countries are relatively high in comparison to other ECU members such as, Kazakhstan, Armenia, Kyrgyzstan the trade

diverting effects for these countries will be dominated. Because for the purpose of trade policy harmonization any country that has the trade agreement with Russia will somehow increase the tariffs thereby limiting import of goods from efficient trade partners towards less effective suppliers within the union, particularly to providers from Russia. This fact stands for dominance of trade diversion effects;

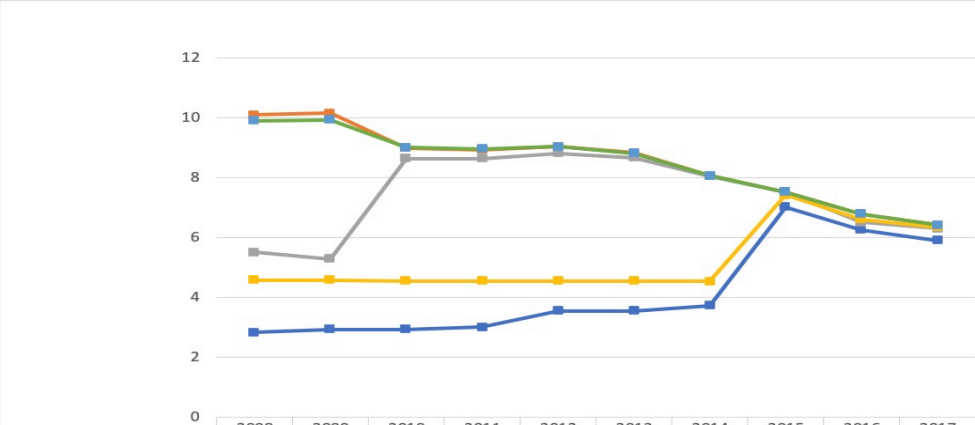
2) The maintenance of a free trade zone with other custom union members results in elimination of tariff revenues which would add the substantial amount to the income of the State budget if there was an increase in trade flows between countries (which is also the evidence of trade diversion);

3) Increased prices for the import from partner countries are likely to be observed because due to the raise of external tariff rates suppliers are safe from competition with third countries.

It has to be admitted that these predictions made by Michalopoulos and Tarr can be applied to describe the effects of accession to the ECU for some CIS countries.

First, there indeed was a significant gap between external tariffs of current ECU members and Russia. Graph 1 shows to which extent Armenia, Kazakhstan and Kyrgyzstan had to increase their tariffs in order to have approximately the same external tariffs. For example, Kazakhstan raised the tariff lines by more than 3 p.p. in 2010 (from 5.3% to 8.67%) just after the ECU was formed. The same degree of tariff's raise was recorded in Kyrgyzstan (from 4.54% in 2014 to 7.43% in 2015). But the most drastic reforms in external trade politics were implemented in Armenia, where the tariff rate in 2015 was actually doubled in comparison to the previous years, reaching 7.01%. Even though the average tariff rates dropped to approximately 6% in 2015 for all countries they are still higher than the initial applied level for Kazakhstan, Kyrgyzstan and Armenia. The only country, except Russia, for which convergence of tariff rates was beneficial is Belarus. So, theoretically Belarus should experience extra-block trade creation due to decrease in average tariff rate.

Graph 1. Convergence of Average Tariff Rates, %



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Armenia	2,85	2,93	2,93	3,01	3,56	3,55	3,73	7,01	6,27	5,92
Belarus	10,1	10,18	9	8,93	9,04	8,84	8,07	7,52	6,79	6,42
Kazakhstan	5,52	5,3	8,63	8,64	8,81	8,68	8,06	7,52	6,53	6,31
Kyrgyz Republic	4,59	4,59	4,56	4,55	4,55	4,55	4,54	7,43	6,62	6,36
Russian Federation	9,9	9,95	9,01	8,96	9,06	8,83	8,07	7,52	6,79	6,42

Source: The World Bank: http://www.worldbank.org

Table 1 was aimed at testing the hypothesis that with the establishment of the free trade area with other member countries of the Union Russia gained an opportunity to expand the export of goods to these countries while Armenia, Kazakhstan, Belarus and Kyrgyzstan were likely to get little from this integration. As Table 1 shows the export of goods from Russia to Kazakhstan and Belarus indeed increased significantly after the ECU was formed. Particularly, in 2012 Kazakhstan's current account deficit with Russia increased by 340% compared to 2010. Belarus over the same period of time experienced an increase by 38% in its account deficit. However, it is worth mentioning that during the recent years the current account deficits of Kazakhstan and Belarus decreased. Moreover, these values in 2018 are lower than the levels of deficits in the years preceding the formation of ECU. The same dynamics can be observed for Armenia and Kyrgyzstan too. There was almost twofold decrease in Kyrgyzstan's trade deficit with Russia since its joining ECU. Such data may indicate that Kazakhstan, Belarus, Armenia and Kyrgyzstan increased their export volumes to Russia during last years, thus ECU is likely to have positive effects on the trade between its participants. This assumption is supported when Russia's account surpluses are analyzed (the increase in the trade volumes between Russia and each participant of the Union is observed, except for Armenia). At this stage of analysis, no solid justification of the absolute ECU's benefit for Russia at the expense of other member countries is not found.

Table 1. Current account deficits/surpluses of each ECU member state, USD million

	Kazakhstan		**Belarus**	
	Russia	*ECU*	*Russia*	*ECU*
2008	-7 537,5	-7 494,6	-12 955,5	-12 711,5
2009	-5 349,6	-5 387,8	-10 003,2	-9 684,1
2010	-2 355,2	-2 283,4	-8 127,0	-7 953,8
2011	-8 754,5	-9 009,1	-10 421,6	-9 654,3
2012	-10 363,2	-10 558,2	-11 242,0	-10 393,5
2013	-12 096,5	-12 399,4	-6 067,5	-5 170,6
2014	-7 419,2	-7 786,2	-7 009,2	-6 114,9
2015	-5 981,8	-6 084,2	-6 744,8	-6 197,5
2016	-5 843,1	-5 933,4	-4 358,8	-3 994,3
2017	-6 857,1	-7 027,4	-6 701,4	-6 063,1
2018	-6 990,1	-7 133,3	-9 632,9	-8 827,0
	Armenia		**Kyrgyzstan**	
	Russia	*ECU*	*Russia*	*ECU*
2013	-776,4	-801,2	-1 836,5	-2 113,8
2014	-785,9	-801,2	-1 725,8	-1 885,5
2015	-722,1	-745,6	-1 114,3	-1 604,2
2016	-616,2	-618,9	-654,6	-1 174,3
2017	-616,0	-645,4	-967,3	-1 324,6
2018	-594,1	-614,0	-941,9	-1 217,3

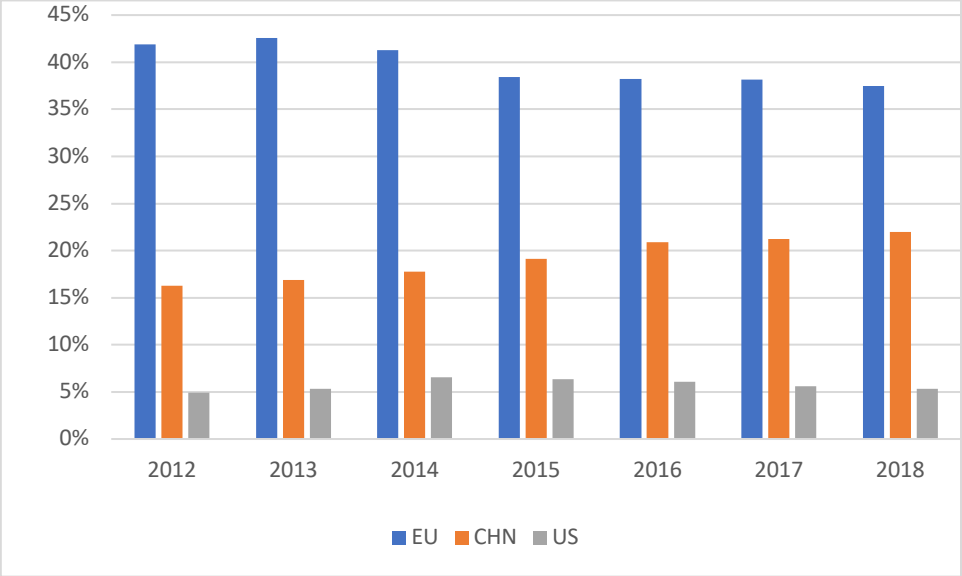
	Russia				
	ECU	*Armenia*	*Belarus*	*Kazakhstan*	*Kyrgyzstan*
2008	21 278,7	490,7	12 989,9	6 975,5	822,6
2009	16 068,6	267,3	10 003,0	5 253,9	544,5
2010	13 257,5	237,5	8 127,0	4 304,6	588,4

2011	11 406,9	195,5	4 503,4	5 851,4	856,6
2012	19 195,7	614,7	11 658,2	5 484,5	1 438,3
2013	20 579,4	645,6	6 269,0	11 745,5	1 919,3
2014	16 800,2	779,8	7 634,6	6 716,4	1 669,4
2015	14 542,1	851,7	6 543,7	5 918,8	1 227,9
2016	11 873,0	577,3	4 620,0	5 823,8	852,0
2017	15 958,5	726,1	6 827,0	7 217,2	1 188,2
2018	19 281,9	703,5	9 678,2	7 514,2	1 385,9

Source: IMF data: http://data.imf.org

When considering effects that ECU has on Russia's trade dynamics, the growth of import from non-member countries is expected to be observed due to the decline in the tariff rates. The expectations are partially true**.** There are a lot of factors that need to be concerned when we analyze the trade flows between EU and Russia. Particularly the fact that in 2014 some European countries have imposed sanctions on Russia, which were then followed by counter-sanctions, had negative effect on Russia's import from EU. However, China, which is the second biggest trade partner, significantly increased its import share to Russia's market of goods from 16% in 2012 to 22% in 2018. Thus, Russia is the only country of ECU which might have experienced at least slight degree of trade creation.

Graph 2. Top 3 Russia's import partners' shares, %

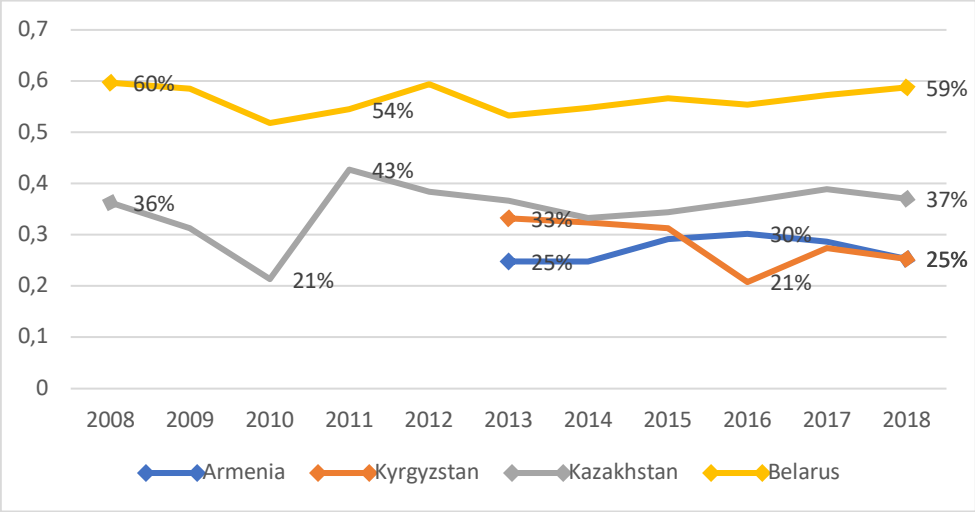


Source: IMF data: http://data.imf.org

The import share of Russia in overall goods imported by every other member was also analyzed in order to check for whether Russia indeed used the ECU market in order to increase the scope of its export to Kazakhstan, Armenia, Belarus and Kyrgyzstan.

Graph 3 shows that for Kazakhstan, Belarus and Armenia Russia's import share stayed almost the same (37%, 59%, 25% respectively). More surprisingly, the scope of Russia's export to Kyrgyzstan had reduced by 8 p.p. since 2013. This data does not support previously made assumptions about trade creation and beneficial effects of ECU for Russia. So, the issue of absolute benefit of ECU for Russia is quite ambiguous.

Graph 3. Russia's import share in total import of ECU members, %



Source: IMF data: http://data.imf.org

Such controversial results obtained from the primary analysis of trade trends between ECU members make it necessary to carry out more thorough evaluation of the effects which may arise as a consequence of entering the ECU for each participant.

4. Empirical model

Since many authors have proven the validity of the gravity model application when estimating the trade effects of various RTAs, the same model will be used to study the consequences of ECU formation on trade flows between its parties and with the rest of the world. The analysis of the literature showed that there are different specifications of the gravity model equation, depending on which explanatory variables to include.

As the first step, the following gravity equation will be estimated in order to evaluate the trade creation or diversion effects of the ECU as a whole:

$$lnX_{ijt} = const + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 DIST_{ij} + \beta_4 CONTIG_{ij} + \beta_5 LANGUAGE_{ijt} + \beta_6 COLONY_{ijt} + \beta_7 CURRENCY_{ijt} + \beta_8 LANDLOCKED_i + \beta_9 LANDLOCKED_j + \beta_{10} lnREMOTE_{it} + \beta_{11} lnREMOTE_{jt} + \beta_{12} RTA_{ijt} + \beta_{13} CUSTone_{ijt} + \beta_{14} CUSTboth_{ijt} + \beta_{15} EXPdiv_{ijt} + u_{ijt}$$

where Xijt, dependent variable, is the amount of aggregate export from country i to country j in year t, GDPt is used as an approximation for market size of the countries, DISTij counts for measuring the trade costs which arise as a result of transportation of the good and is constructed as the population weighted bilateral distance between exporter and importer in kilometer. LANDLOCKEDij is a dummy variable included as another proxy for the costs of delivering the products, as it is assumed that for the countries suffering from the access to the sea or ocean it is more costly to export/import.

As was mentioned in Section 2 in addition to transportation costs the price of a good comprises of other expenses as well, which are accounted for in this model by the set of dummy

variables. CONTIGij, COLONYt, LANGUAGEt are dummies reflecting the fact of sharing common border, historical past, cultural features respectively and are responsible for reflecting the information costs. It is assumed that search costs are significantly smaller in the magnitude for the firms of the adjacent countries, since the degree of knowledge about the market conditions, economic situation is higher than of another more remote country. Moreover, sharing common history or language is beneficial in the sense that countries similar in cultural profile are likely to know more about each other, including business practices which is likely to decrease the trade costs. Another type of expenses that is associated with bilateral trade is the price if entering the foreign market. Since the data on tariffs is limited and hard to be obtained, custom trade barriers in the model are accounted by the dummy RTAijt, which reflects the fact of the pair's participation in the same custom union. CURRENCYijt is a dummy used to reflect the transaction costs associated with the usage of different currencies.

Including not only direct trade costs but also accounting for the relative ones is crucial, since omitting MRTs results in obtaining biased estimates. In the model multilateral resistance is captured by the variables lnREMOTEi, lnREMOTEd, which are calculated by the formula used by Head (2003).

It is worth noticing that during the period of 2003-2018 there were two major economic crises, which occurred in 2007-2009 and 2014-2015. In these periods the economic slowdown was observed in all parts of the world which obviously had consequences on the trade flows between countries. The bilateral trade volumes decreased significantly during these periods, so there is negative effect of the crisis on the trade which crucially needs to be accounted for. So, the dummy variables for each year were added. While the effect of the financial crisis of 2007-2009 was negative for all nations, the effect of 2014-2015 crisis was heterogeneous: large oil-rich countries suffered greatly, while the ones importing oil benefitted. Thus, the interaction terms of 2014, 2015, 2016 year dummies and the dummy indicating whether the country is a major exporter of the oil were also added.

In order to measure the trade creation and trade diversion effects dummy variables CUSToneijt (is equal to 1 if the importer country j is the custom union member, while country i is not), CUSTbothijt (is equal to 1 if both the exporter and importer country are custom union members) and EXPDIVijt (is equal to 1 if the exporter country j is a custom union member while the importer j is not) were introduced in the model. Such variables were used by Endoh (1999) in order to analyze the intensity of trade diversion and creation effects within European Economic Community (EEC), the Latin American Free Trade Association (LAFTA) and the Council of Mutual Assistance (CMEA).

Endoh (1999) implemented the variable CUSTone in order to capture any trade diversion effects in the import trends of the country. If the coefficient in front of the variable is negative in sign and statistically significant the shift in the import from non-member countries to member economies is performed by the ECU participants. CUSTboth is the measure of trade creation effects, which are created by the custom union if the coefficient is positive and statistically significant. EXPDIVt is predicted to estimate the export trade diversion, which arises when the custom union members tend to export more to other participants of the union, thus decreasing export to the non-member nations.

At the second stage of the analysis modified version of the initial equation will be estimated for the evaluation of ECU trade effects on each member separately:

$$lnX_{ijt} = const + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 DIST_{ij} + \beta_4 CONTIG_{ij} + \beta_5 LANGUAGE_{ijt} + \beta_6 COLONY_{ijt} + \beta_7 CURRENCY_{ijt} + \beta_8 LANDLOCKED_i + \beta_9 LANDLOCKED_j + \beta_{10} lnREMOTE_{it} + \beta_{11} lnREMOTE_{jt} + \beta_{12} RTA_{ijt} + \beta_{13} ARMone_{ijt} + \beta_{14} BLRone_{ijt} + \beta_{15} KAZone_{ijt} + \beta_{16} KGZone_{ijt} + \beta_{17} RUSone_{ijt} + \beta_{18} ARMboth_{ijt} + \beta_{19} BLRboth_{ijt} + \beta_{20} KAZboth_{ijt} + \beta_{21} KGZboth_{ijt} + \beta_{22} RUSboth_{ijt} + \beta_{23} ARMexp_{ijt} + \beta_{24} BLRexp_{ijt} + \beta_{25} KAZexp_{ijt} + \beta_{26} KGZexp_{ijt} + \beta_{27} RUSexp_{ijt} + u_{ijt}$$

In this equation CUSTone was substituted by five dummy variables: ARMone, BLRone, KAZone, KGZone, RUSone, each of which takes the value of 1 in the case when these countries are importers of goods from out-of-union countries. CUSTboth was substituted by ARMboth, BLRboth, KAZboth, KGZboth, RUSboth. ARMboth is a dummy variable, which equals to 1 if Armenia is a receiver of the import from another ECU member. The same logic is applied for the rest of variables. ARMexp, BLRexp, KAZexp, KGZexp, RUSexp are the dummy variables which take the value of 1 when each of these countries exports goods to non-member countries. The addition of these variables will make it possible to estimate the trade creation and trade diversion effects for each member of ECU.

Poisson Pseudo Maximum likelihood estimation

According to PPML methodology rather than logarithm of export flows, the export volumes in levels should be used as the dependent variable, while the independent regressors should be used in logs. So, the model to be estimated by the PPML is

$$X_{ijt} = \exp[\ln\beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 DIST_{ij} + \beta_4 CONTIG_{ij} + \beta_5 LANGUAGE_{ijt} + \beta_6 COLONY_{ijt} + \beta_7 CURRENCY_{ijt} + \beta_8 LANDLOCKED_i + \beta_9 LANDLOCKED_j + \beta_{10} lnREMOTE_{it} + \beta_{11} lnREMOTE_{jt} + \beta_{12} RTA_{ijt} + \beta_{13} CUSTone_{ijt} + \beta_{14} CUSTboth_{ijt} + \beta_{15} EXPdiv_{ijt}] + \eta_{ijt}$$

where η_{ij} has log-normal distribution with mean 1 and variance σ_i^2. Since independent variables are in logs, the coefficients will be interpreted as elasticities.

Heckman selection model

As was mentioned in Section 2 in order to apply Heckman estimation method, we need to specify selection and outcome equations. The probit model indicating whether there is trade between two partner-countries is estimated as the first step. And in the second step the actual export flows are estimated conditioning on the country trading. The crucial moment is to identify the selection variable, which is likely to influence whether the country is likely to trade rather than the current trade volumes. In this study the exclusion restriction is the dummy variable indicating whether countries have common religion or not. Helpman et al (2008) by using the same dummy found significant and robust results.

So, the set of equation which is to be estimated using the Heckman method is the following:

Selection equation:

$$x^*_{ijt} = const + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 DIST_{ij} + \beta_4 CONTIG_{ij} + \beta_5 LANGUAGE_{ijt} + \beta_6 COLONY_{ijt} + \beta_7 CURRENCY_{ijt} + \beta_8 LANDLOCKED_i + \beta_9 LANDLOCKED_j + \beta_{10} lnREMOTE_{it} + \beta_{11} lnREMOTE_{jt} + \beta_{12} RTA_{ijt} + \beta_{13} RELIGION_{ijt} + \beta_{14} CUSTone_{ijt} + \beta_{15} CUSTboth_{ijt} + \beta_{16} EXPDIV_{ijt} + \varepsilon_{ijt}$$

Outcome equation:

$$lnX_{ijt} = const + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 DIST_{ij} + \beta_4 CONTIG_{ij} + \beta_5 LANGUAGE_{ijt} + \beta_6 COLONY_{ijt} + \beta_7 CURRENCY_{ijt} + \beta_8 LANDLOCKED_i + \beta_9 LANDLOCKED_j + \beta_{10} lnREMOTE_{it} + \beta_{11} lnREMOTE_{jt} + \beta_{12} RTA_{ijt} + \beta_{13} CUSTone_{ijt} + \beta_{14} CUSTboth_{ijt} + \beta_{15} EXPDIV_{ijt} + u_{ijt}$$

5. Data

The above-mentioned models were applied to analyze the trade processes between 51 countries (Table A4) in the time frame of 2003-2018. The choice of the countries in the sample is determined by the main trade flows of the ECU members, i.e. the higher the export share of the country the higher the probability of its inclusion in the analysis. Since the formation of the ECU is likely to affect the existing trade relations between countries rather than create new export/import destinations. The time period is chosen so that by observing the trade flows during 8 years before the formation of ECU and 8 years within the ECU presence it is possible to properly indicate the effects of the union on the economy.

The statistics for GDPs of the countries, the distance between countries, whether they have a common border and share common history or culture was extracted from CEPII dataset that includes relevant information for all countries over the period of 1948-2015. This dataset was extended with the observations over the period of 2015-2018 by the means of The World Bank Database. The data of export flows between countries was obtained from the official website of International Monetary Fund. As a result, panel data with 40800 observations was constructed among which for 618 observaions (1,5%) the bilateral export flows are equal to 0.

6. Empirical results

The estimation results presented in Table2 compare the coefficients obtained from the application of two different model specification: the one excluding the multilateral resistance terms and the one accounting for them. The main conclusion based on the obtained results suggests that the estimation of the gravity model which do not include the resistance terms which are significant when the choice of trade is made produces biased results. In particular, as we can see the coefficients for majority of the independent variables in the second regression is lower than in the first one. Moreover, the adjusted R-squared has increased in the magnitude, which may be

considered as an evidence for better model specification. For this reason, the gravity equation with remoteness variables is chosen for the subsequent analysis.

Table 2. OLS regression results

	Intuitive gravity	**Gravity+remoteness**
lnGDP_exp	1,179*** (0,005)	1,158*** (0,006)
lnGDP_imp	0,923*** (0,005)	0,861*** (0,006)
lnDIST	-1,363*** (0,014)	-1,663*** (0,019)
CONTIG	0,439*** (0,039)	0,254*** (0,040)
COMLANG	0,753*** (0,050)	0,528*** (0,050)
COLONY	0,080*** (0,050)	0,125*** (0,050)
COMCUR	0,191*** (0,040)	0,125*** (0,040)
LANDLOCKED_exp	-0,202*** (0,021)	-0,205*** (0,021)
LANDLOCKED_imp	-0,305*** (0,021)	-0,308*** (0,021)
lnREMOTE_exp		0,399*** (0,028)
lnREMOTE_imp		0,682*** (0,028)
RTA	0,999*** (0,021)	0,881*** (0,022)
CUSTone	0,340*** (0,045)	0,394*** (0,045)
CUSTboth	1,691*** (0,163)	1,778*** (0,162)
EXPdiv	0,269*** (0,045)	0,294*** (0,045)
constant	-26,878*** (0,213)	-42,777*** (0,728)
R2 adjusted	0,7311	0,7352
Year dummies	*yes*	*yes*

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

Table 3 reviews the results obtained from the estimation of the gravity model by the means of the econometric techniques described in Section 2. Due to the log-linearization of the gravity equation some observations of the dependent variable are omitted since export flows between some pairs of the countries is equal to 0. The easiest way to deal with this problem is to apply censored Tobit technique. As a result of this step, the coefficient obtained are of expected sign. However, since the type of the data analyzed is panel, it is more appropriate to use random or fixed effect estimation methods in order to obtain reliable coefficients. Moreover, the average unconditional treatment effects of Tobit were constructed (Table A6), which are similar to ones obtained by OLS. Hence, there is little effect of zero trade flows on the estimation results.

As a next step, panel estimation techniques were applied – fixed effect and random effect methods. In order to choose the most suitable option given the dataset Hausman test was performed, which based on the p-value rejects/accepts the null hypothesis (random effect is consistent). In our case, the result of the Hausman specification test (with p-value=0) suggests that estimates obtained from FE method are more reliable than those of RE.

For the application of the fixed-effects (and RE) estimation method the gravity model should be log-linearized. However, this modification of the equation which was widely used in the earlier studies is now criticized by the various authors.

As was mentioned by Silva and Tenreyro (2006) the log-linearization of the gravity equation requires strict assumptions on the error terms, in particular, $E(\ln(\varepsilon_i)|x_i)$ should be constant. This assumption holds if the data are homoscedastic, but if they are not the expected value of the error term is a function of the independent variables. Generally, the trade data are heteroskedastic, which leads to violation of this assumption. In the presence of heteroskedasticity coefficients are still unbiased, but their variance is not, so the generated t-statistics are not reliable. The results of the estimation of log-linearized and level form equation differ significantly due to heteroskedasticity, even if the fixed effects were controlled for. For this reason, many authors (Burger et al, 2009; Siliverstovs and Schumacher, 2009; Westerlund and Wilhelmsson, 2011) suggest estimating the gravity equation in original multiplicative form.

Performing Breusch-Pagan test for the data set used in this study resulted in the p-value=0, which makes it possible to reject the null hypothesis of the constant variance. So, there is significant evidence for the presence of heteroskedasticity in the sample. That's why the estimation results from FE should be treated cautiously. In addition to that, FE estimation does not take into account zero trade flows, omitting which leads to the loss of some information and presence of the sample selection bias. Another drawback of this technique is omitting significant time invariant variables, which are supposed to reflect trade costs. So, fixed effect estimation is neglected in the favor of methods which cover all necessary information.

Table 3. Gravity equation estimation results

	Tobit	***FE***	***RE***
lnGDP_exp	1,13*** (0,006)	0,682*** (0,046)	0,999***(0,019)
lnGDP_imp	0,873*** (0,006)	1,345*** (0,046)	0,952*** (0,019)
lnDIST	-1,483***(0,032)		-1,245*** (0,069)
CONTIG	1,192*** (0,076)		0,897*** (0,199)
COMLANG	1,152*** (0,079)		1,146*** (0,234)
COLONY	0,093 (0,094)		0,422* (0,256)
COMCUR	0,467*** (0,05)		0,803*** (0,171)
LANDLOCKED_exp	12,794***(1,744)		52,872***(3,258)
LANDLOCKED_imp	15,391***(0,835)		6,595*** (2,342)
lnREMOTE_exp	0,604*** (0,033)	-3,898*** (0,26)	-0,071 (0,099)
lnREMOTE_imp	0,619*** (0,03)	-0,87*** (0,213)	0,161* (0,088)
RTA	2,714***(0,228)	0,634** (0,298)	1,486*** (0,28)
CUSTone	0,306***(0,045)	-0,01 (0,029)	-0,026 (0,029)
CUSTboth	1,52***(0,165)	0,17*** (0,098)	0,043 (0,099)
EXPdiv	0,444* (0,046)	0,119*** (0,029)	-0,021 (0,029)
constant	-46,373*** (0,786)	54,392 (4,933)	-25,162*** (2,304)
R2	0,262	0,195	0,760
Interaction terms	yes	yes	yes
Year dummies	yes	yes	yes

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

One of such methods is Heckman two-stage estimation, which includes zero trade export flows into the analysis. The coefficients of the majority of independent variables in column 5 are significant and are of expected sign. The coefficient for GDPs are positive which indicates that with the growth in GDP of the country both the export supply and import demand are increased. The coefficient for distance just reflects the fact that the far away the countries are the less trade is observed between them. The coefficients for variables which account for shared history or culture are of expected signs too. Particularly, if countries experienced common colonial past the degree of trade between them is expected to be higher due to the fact that they may already had some trade relations within the colony. The coefficient of RTA and CURRENCY dummies state that if countries are members of the same trade agreement or make transactions in the same currency their trade costs are decreased, thus leading to higher amount of goods exported/imported. Whether the country is landlocked or not is estimated to have a reasonable negative effect as well. Variables accounting for the remoteness have expected sign too, indicating the fact that the far away the country is located from the rest of the world, the higher degree of trade is between the partners.

The variables which indicate whether pair of countries have the same language, common colonial past are the most commonly used as the identification restriction in Heckman model, since the countries which have shared past or cultural similarities are assumed to have lower fixed costs of exporting/importing goods from each other (Felipe and Kumar, 2012). However, the dummies for common language and colony are already included in the main regression and have the significant and positive effect on bilateral exports, so there is no opportunity to use them as exclusion variables. On the other hand, the variable for having common religion is rarely used as the controlling factor in the gravity model. Since there is no stable relationship between religion and trade flows, Helpman et al (2008) argue that it can serve as a good restriction variable. According to Shepotylo (2009) another factor that is suitable for Heckman selection method is the governance indicators of the regulatory quality since they reflect the effectiveness of the measures implemented by the government that can promote free trade and fasten private sector growth. Hence, there is likely to be positive correlation between the level of regulatory quality and probability of the country to export. Initially, we should test whether either common religion or regulatory quality variables are good exclusion restrictions. For the variable to be used in the first step of Heckman it should affect the propensity of the partners to trade, but not the current trade volumes. So, we estimate the Probit and the original model including common religion dummy and variable controlling for regulatory quality of the exporter country into the set of regressors. The coefficients of the interest are presented in the Table 4.

Table 4. Test for the significance of the exclusion variables

	ln(EX)	**(Probit) EX**	**ln(EX)**	**(Probit) EX**
religion	0,008	1,427***		
	(0,025)	(0,096)		
reg_quality_exp			9,05e-08	0,557***
			(1,19e-07)	(0,136)

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

As we can see, both common religion and regulatory quality variables are significant in Probit model, while there is no evidence of these factors to be directly influencing the current export flows between two countries. Thus, the variables could be used as the restrictions in Heckman model.

Table 5. Heckman two-step estimation results

	Heckman (1)	***Heckman (2)***
lnGDP_exp	1,105*** (0,007)	1,112*** (0,007)
lnGDP_imp	0,847*** (0,007)	0,854*** (0,007)
lnDIST	-1,457*** (0,035)	-1,462*** (0,032)
CONTIG	1,27*** (0,084)	1,233*** (0,076)
COMLANG	1,082*** (0,089)	1,104*** (0,08)
COLONY	0,14 (0,105)	0,13 (0,095)
COMCUR	0,503*** (0,056)	0,492*** (0,05)
LANDLOCKED_exp	9,303*** (1,948)	10,659*** (1,76)
LANDLOCKED_imp	15,141*** (0,927)	15,158*** (0,838)
lnREMOTE_exp	0,626*** (0,037)	0,619*** (0,033)
lnREMOTE_imp	0,647*** (0,033)	0,637*** (0,03)
RTA	2,778*** (0,255)	2,78*** (0,23)
CUSTone	0,273*** (0,05)	0,284*** (0,045)
CUSTboth	1,364*** (0,185)	1,416*** (0,166)
EXPdiv	0,384***(0,051)	0,404***(0,046)
lambda	-1,829*** (0,134)	-1,290*** (0,132)
rho	-1	-0,782
Interaction terms	yes	yes
Year dummies	yes	yes

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

Application of Heckman method generated significant coefficients of the expected signs. However, the fact needed to be taken into account is the estimate of the parameter rho, which measures the correlation between the error terms of the selection and the outcome equations and has a range [-1;1]. In our case the estimate of rho in absolute value is quite large in both cases and indicates that there is significant correlation between two equations, which doubts the reliability of the results since as was mentioned by Marchenko and Genton (2012) Heckman estimation performs poorly when the error terms are correlated. Heckman method is more applicable for the analysis of the cross-section data sets, since at the second stage OLS estimation is performed which may lead to biased estimates for the panel data samples. Moreover, the method relies on the log-linearization of the gravity equation, the drawbacks of which was discussed earlier.

Another method which accounts for the zero trade flows is Poisson Pseudo Maximum likelihood estimation, which considers the initial multiplicative version of the gravity equation and treats actual value of export as dependent variable, rather than logarithm of it. The majority of the coefficients obtained as a result of PPML method are of expected sign. However, the landlockedness factor of the countries is supposed to negatively affect the trade between them, and this is indeed observed in the literature, while in this regression the coefficients are positive. This issue is resolved when the interaction of landlockedness of the country and the distance between

the partners is added to the regression. The variable controls for the effect of the landlockedness on the export as a function of distance. The outcome of the equation's modification is presented in Table 6.

Table 6. PPML estimation results with addition of the interaction terms

	PPML (no interaction)	***PPML (interaction with landlocked)***	***PPML (all interactions)***
lnGDP_exp	0,832*** (2.96e-06)	0,829*** (2,90e-06)	0,821***(3,04e-06)
lnGDP_imp	0,809*** (2.92e-06)	0,805*** (2,86e-06)	0,804***(2,99e-06)
lnDIST	-1,019*** (4.22e-06)	-1,001*** (4,34e-06)	-0,661***(7,62e-06)
contiguity	0,284*** (7,88e-06)	0,278*** (7,87e-06)	0,332***(2,34e-05)
common language	0,430*** (8,14e-06)	0,416*** (8,12e-06)	-0,056***(1,83e-05)
colony	-0,026*** (1,12e-05)	-0,029*** (1,11e-05)	0,138***(1,64e-05)
common currency	0,399*** (8,80e-06)	0,419*** (8,81e-06)	0,569***(1,21e-05)
landlocked_exp	0,058*** (1,16e-06)	0,314*** (6,96e-05)	27,48***(1,39e-03)
landlocked_imp	0,031*** (1,16e-06)	1,268*** (7,32e-05)	5,88***(6,48e-04)
dist*landlocked_exp		-0,040*** (9,74e-06)	
dist*landlocked_imp		-0,178*** (1,04e-05)	
RTA	0,139*** (8,42e-06)	0,136*** (8,38e-06)	4,685***(8,01e-05)
lnRemote_exp	0,319*** (7,25e-06)	0,336*** (7,27e-06)	0,419***(7,70e-06)
lnRemote_imp	0,404*** (7,21e-06)	0,402*** (7,23e-06)	0,447***(7,60e-06)
CUSTone	-0,406*** (2,22e-05)	-0,375*** (2,21e-05)	-0,291***(2,31e-05)
CUSTboth	0,738*** (4,85e-05)	0,822*** (4,87e-05)	0,567***(6,22e-05)
EXPdiv	0,013*** (1,82e-05)	0,029*** (1,81e-05)	0,169***(1,92e-05)
Constant	-36,341*** (1,43e-04)	-36,462*** (1,41e-04)	-41,695*** (1,76e-04)
R-squared	0,8782	0,8788	0,8894
Interaction terms	No	No	Yes
Year dummies	Yes	Yes	Yes

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

The landlockedness coefficients are still positive, but in order to estimate the true effect the interaction term needs to be taken into account. If the mean value of the distance (7,874) is considered the effect of whether the exporter is landlocked or not on the export flows is estimated to be negative. More precisely, the landlocked country is expected to export 6,1% less than the one that has the access to sea (ocean), conditioning on the distance. The effect for the importer is similarly negative.

Moreover, the interaction terms with other variables including RTA, contiguity, colony common language, common currency were generated in order to control for the partial effects which might influence the ECU's trade creation or diversion. The results of such procedure are displayed in the Appendix (TableA7, TableA8, TableA9, TableA10). The inclusion of the interaction between RTA and distance made it possible to conclude that while the effect of the distance on trade flows is negative it is lower for the pair of same union member-countries (Table A7). Partners which share not only the common border but also the common official language are likely to trade more than those that are similar only in one parameter (Table A8). Hence, the inclusion of the interaction variables just confirmed the previously estimated relationship between export flows and other factors. The coefficients of the variables of our interest, reflecting the

participation in the ECU (CUSTone, CUSTbot, EXPdiv) did not change much as well. While there are some differences in the magnitude of these variables, the signs and the significance in all specifications are the same as those presented in Table6. Even when all the significant interaction terms are included in the model (column 3), the overall effect of the ECU didn't change.

Overall, comparing the estimation results across applied different methods it is obvious that some of them suffer significant drawbacks: performed Hausman test recommends fixed effect estimation rather than the random effect, so the RE estimation results are not reliable. However, the FE disregards the effects of time indifferent dummies which are likely to reflect the trade costs necessary to be included for, otherwise the omitted variable bias may be present. The application of the Heckman two-stage technique for the analysis of the panel data sets is the rare phenomenon in the literature, so it is less likely to deliver reliable results. On the other hand, PPML has proven to have strong performance even with different data distribution and large fraction of zeros in the dependent variable (Shepherd, 2013). That's why PPML is one of the most widespread techniques when it comes to estimating the gravity model of trade with panel data sample. In this study the application of the method also has delivered stable and significant results across different specifications. Hence, for the interpretation of the ECU's effect on the trade dynamics of its partners the coefficients estimated by the PPML method will be used in the further analysis.

The coefficients of our interest are CUSTboth, CUSTone and EXPDIV. The negative sign of CUSTone (-0,291) indicates the existence of import trade diversion effects of the ECU, particularly that non-ECU members exported less to ECU participants than predicted by the hypothetical trade level. In particular, ECU members are estimated to import from the rest of the world by 25,2% less than anticipated.

But this import trade diversion effect, which is considered to have negative impact on the countries' economies, is compensated by the presence of trade creation within the ECU: the mutual trade within the ECU is 76,3% higher than the hypothetical level. Such estimation is not surprising due to the provided analysis in the Section 3, where the increase in the trade within the ECU was observed. The coefficient of CUSTboth is positive and larger in absolute value than the coefficient of CUSTone (0,567-0,291=0,276). Thus, the loss of import from more efficient out-of-union suppliers is not a problem due to the larger increase in the internal trade of the ECU.

Moreover, the positive coefficient of EXPDIV (0,169) shows that ECU participants' export to other countries is higher than expected by the traditional gravity equation (by 18,4%). This fact refers to "negative export trade diversion" effect, which is also beneficial for the economies.

At this stage of analysis, we can safely conclude that ECU contributes significantly to the development of the trade relations not only within the Union, but also positively affects the bilateral export flows from non-member countries. However, it is crucial to observe the effects of the Union formation on each participant in order to dispel the myth or on the contrary suggest an evidence of the prevailing benefits of ECU for Russia. The estimation results of the gravity equation including ECU's trade effects for every member is presented in the Table 7. And again, we will rely on the estimated coefficients obtained by PPML method, since it is increasingly likely to deliver unbiased and consistent outcome.

Table 7. Estimation results for each ECU participant

	FE	RE	Heckman1	Heckman2	PPML
lngdpexp	0,727***(0,047)	1,002***(0,019)	1,095***(0,007)	1,087***(0,007)	0,82***(3,05e-06)
lngdpimp	1,337***(0,047)	0,949***(0,019)	0,854***(0,007)	0,846***(0,007)	0,804***(3,00e-06)
lndist		-1,251***(0,069)	-1,47***(0,032)	-1,464***(0,034)	-0,665***(7,64e-06)
contig		0,894***(0,198)	1,203***(0,076)	1,236***(0,08)	0,313***(2,35e-05)
comlang		1,146***(0,232)	1,109***(0,08)	1,086***(0,084)	0,131***(1,64e-05)
colony		0,418*(0,254)	0,11 (0,095)	0,12 (0,1)	-0,035***(1,83e-05)
comcur		0,797*** (0,17)	0,501*** (0,05)	0,512***(0,053)	0,569***(1,21e-05)
landlocked_exp		58,423***(3,335)	19,028***(1,915)	17,606***(2,015)	38,295***(1,58e-03)
landlocked_imp		7,114***(2,335)	14,717***(0,837)	14,683***(0,881)	5,801***(6,61e-04)
lnremote_exp	-4,23***(0,263)	-0,071 (0,099)	0,667***(0,033)	0,675***(0,035)	4,644***(8,04e-05)
lnremote_imp	-0,764***(0,222)	0,191** (0,088)	0,64*** (0,03)	0,65***(0,032)	0,415***(7,75e-06)
rta	0,654**(0,297)	1,511***(0,279)	2,734***(0,23)	2,736***(0,242)	0,449***(7,65e-06)
armone	-0,022 (0,069)	-0,07 (0,07)	0,061 (0,125)	0,035 (0,132)	-1,04***(3,94e-04)
armboth	-0,262 (0,227)	-0,419* (0,23)	0,45 (0,412)	0,381 (0,435)	1,046***(5,13e-04)
armexp	0,443*** (0,069)	0,211*** (0,07)	-0,943***(0,126)	-0,982***(0,133)	-1,619***(4,56e-04)
blrone	0,07 (0,059)	0,085 (0,059)	-0,176***(0,085)	-0,196** (0,09)	-0,558***(9,92e-05)
blrboth	0,149 (0,211)	0,09 (0,212)	1,801***(0,325)	1,74*** (0,343)	1,06***(9,13e-05)
blrexp	-0,342***(0,059)	-0,387*** (0,059)	0,096 (0,086)	0,068 (0,091)	-0,552***(8,67e-05)
kazone	-0,154***(0,06)	-0,147**(0,059)	0,471***(0,084)	0,456*** (0,088)	-0,557***(7,08e-05)
kazboth	0,097 (0,211)	0,004 (0,212)	1,285***(0,329)	1,249*** (0,348)	0,078***(1,06e-04)
kazexp	0,613***(0,06)	0,424***(0,06)	1,429***(0,088)	1,385*** (0,092)	0,834***(5,45e-05)
kgzone	-0,081 (0,07)	-0,13* (0,07)	0,368***(0,126)	0,376*** (0,133)	0,421***(2,02e-04)
kgzboth	0,567** (0,227)	0,421* (0,23)	1,832***(0,414)	1,774*** (0,437)	1,077***(3,61e-04)
kgzexp	0,041 (0,072)	-0,226*** (0,073)	-0,578***(0,131)	-0,584***(0,137)	-0,715***(4,85e-04)
rusone	0,091 (0,058)	0,084 (0,058)	0,595***(0,084)	0,594*** (0,089)	-0,238***(2,5e-05)
rusboth	0,308 (0,21)	0,131 (0,212)	1,586***(0,335)	1,54*** (0,354)	0,472***(8,95e-05)
rusexp	-0,04 (0,058)	-0,106* (0,058)	0,754*** (0,084)	0,757*** (0,089)	0,158***(2,11e-05)
constant	59,651*** (5,082)	-25,689*** (2,303)	-46,564*** (0,791)	-46,522*** (0,835)	-41,614*** (1,78e-04)
Lamda			-1,156***(0,133)	-1,731***(0,127)	
Rho			-0,706	-1	
R2	0,1919	0,7601			0,8900
Interaction terms	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

The estimation of the effects that ECU might have on each member's trade flows delivers less optimistic results. The overall ECU participation effect for Armenia is estimated to be negative, since the country has experienced the lower import from non-member countries by 67,86% (ARMone=-1,04) simultaneously decreasing its own export to those countries by 78% (ARMexp=-1,619). The positive coefficient of ARMboth is an indicator of the intensification of the trade with other Union members, but this effect is just not large enough to compensate the deformation of the relations with the rest of the world.

The effect of becoming an ECU member for Kyrgyzstan is much more positive. Having both KGZone and KGZboth positive in sign and statistically significant reflect the absolute import trade creation for Kyrgyzstan: import from non-member and ECU member countries is higher by 52,3% and 193,6% respectively. But there is a decrease in the export from Kyrgyzstan to other countries (by 104,4%), which may be explained by the preference of trading within the ECU due to the lower costs border crossing.

When the effects for Belarus are considered, one would expect to see more promising results since it has been 10 years of Belarus participation in ECU. However, it is not the case since the estimation suggests that Belarus is experiencing the lower levels of import from non-ECU countries: the amount of goods imported is 42,7% less than expected from normal trade relations. Moreover, Belarus' export to other countries is lower than anticipated by 42,4% (BLRexp = -0,552). Even though the decrease in the volume of import from the rest of the world is compensated by trade creation within the Union: BLRone+BLRboth>0, the profitability of Belarus's participation in ECU is doubtful.

The same proposition can be applied to describe the effect for Kazakhstan. While the export to non-member countries is anticipated to be higher by 130,2%, the import from those nations is 42,7% lower than the hypothetical level. The trade flows of Kazakhstan with ECU partners are increased by 8,1%. However, it is not enough to overcome the negative effect of the import trade diversion. Hence, despite Kazakhstan and Belarus being among the first countries to participate in ECU, there is no evidence of the absolute positive effects for their economies.

The pattern of the whole ECU trade effects described earlier coincides with the possible ECU participation consequences only for Russia. The loss of import from non-member countries by 21,1% is fully compensated by the intra-bloc trade creation (RUSboth+RUSone>0). Moreover, Russia has expanded the scope of its export not only within ECU but also to the nations outside the Union by 17,1%.

Based on these observations we can state that while there are positive effects of ECU participation for some members, the advantages for Russia totally outweigh those for other ECU countries.

Conclusion

Since the first implementation of the gravity model for analyzing bilateral trade, the usage of equation was criticized for lacking the theoretical basis, thus increasing the probability of resulting in inconsistent estimation. However, authors have found the way to establish similar relations between trade and distance through economic theories. The development of the model has reached such a level that it is now applied not only to explain trade flows but also migration dynamics and investment stocks.

It is often the issue of applying the proper gravity model estimation method to obtain reliable results. While in the earlier studies more common techniques for estimation of the data were used (OLS, FE, RE), authors now are more in favor of methods which account for the specific characteristics of the trade data (presence of zero export flows), so application of PPML or Heckman two-stage can be vastly observed among researches.

The gravity model is extensively used for checking the effectiveness of various trade agreements through estimating the trade creation and diversion effects for their members. While it certainly takes time for these effects to appear, the attempt to evaluate the impact of ECU formation on each union member was made in this research.

The analysis of trade creation and trade diversion effects of ECU as a whole showed that ECU had been efficient in promoting internal trade and increasing the net export of its members to non-union countries, which is certainly beneficial for the economies of nations. Despite the presence of the import trade diversion, the scope of intra-bloc trade creation effect is larger, so that the Union can be considered as a net trade creator.

However, there are members for which the effectiveness of participation in ECU is questionable. The analysis has shown that due to the ECU membership Armenia is likely to suffer from decrease of the import from the rest of the world that is not compensated by the within ECU trade creation effects, which obviously results in the decrease of country's welfare. Moreover, there is an evidence of the fall in the level of volumes of products exported by Armenia to the rest of the world. This fact allows us to state that for Armenia the participation in ECU is likely to be irrational in terms of trade benefits.

In the case of another relatively newly joined member – Kyrgyzstan – the benefits of participation outweigh the costs. Namely, the trade creation effects are observed, meaning more import from non-member countries as well as from ECU economies, with a low degree of export trade diversion.

The economic effects of participation in ECU are controversial for Kazakhstan and Belarus. Russia is the only member to have experienced economic benefits since joining the Union without incurring any losses. And it is not surprising that the trade effects generated by ECU for Russia are dominant and determine the effects of the trade agreement as a whole because as was mentioned earlier Russia has the highest GDP among members, so the country has more influence in determining the functioning of ECU.

The hypothesis stating that it is only Russia that is likely to experience economic benefits as a result of ECU formation is partially accepted, since for other members the advantages of participation in the ECU still exist as well as drawbacks. But in the case of Russia, all costs are being compensated possibly at the expense of others. For newly joined members the trade effects are not straightforward. We may assume that three years is the short time period for positive dynamics to occur, but the case of Belarus and Kazakhstan who were the participants since ECU functioning detects that it is not the number of years being an ECU member, but rather the economic or political status of the country.

Overall, gravity model estimation results suggest that Eurasian Custom Union as an integrative project might have positive effects on the economies of its members. However, such positive outcome is mostly driven by the effects ECU generated for Russia. The analysis of ECU's possible trade effects for each participant showed that for some countries joining the Union may bring more disadvantages than benefits in terms of significant trade diversion and comparatively low degree of trade creation. So, the effectiveness of ECU functioning is quite controversial issue.

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Appendix A

Table A1. Basic information and data on the member states (2018)

	Territory	*Population*		*GDP*		*GDP per capita*
	square km	*million*	*% of EEU*	*USD billion*	*% of EEU*	*USD*
Armenia	29 473	3,0	1,6%	12,4	0,7%	4212,1
Belarus	207 600	9,5	5,2%	59,7	3,1%	6289,9
Kazakhstan	2 724 900	18,3	10,1%	170,5	8,9%	9331,0
Kyrgyzstan	199 900	6,3	3,5%	8,1	0,4%	1281,4
Russia	17 075 400	144,5	79,6%	1657,6	86,9%	11288,9

Source: The World Bank: https://data.worldbank.org

Table A2. Distances between the members of ECU

	Armenia	*Belarus*	*Kazakhstan*	*Kyrgyzstan*	*Russia*
Armenia	1	1943,6	2377,8	2479,7	2080,5
Belarus	1943,6	1	3095,1	3605,1	1495,4
Kazakhstan	2377,8	3095,1	1	884,7	2152,8
Kyrgyzstan	2479,7	3605,1	884,7	1	2650,5
Russia	2080,5	1495,4	2152,8	2650,5	1

Source: CEPII database: http://www.cepii.fr

Table A3. Export shares of ECU members

	Armenia	*Belarus*	*Kazakhstan*	*Kyrgyzstan*
% of export to Russia	26,93%	38,19%	8,64%	19,43%
% of export to other member countries	0,94%	2,79%	1,25%	15,39%

Source: UN Comtrade Database: https://comtrade.un.org/data/

Table A4. Countries included in the sample

Armenia	Cyprus	Greece	Korea	Portugal	Turkmenistan
Austria	Czech Republic	Hungary	Latvia	Romania	Turkey
Azerbaijan	Denmark	India	Lithuania	Russia	Ukraine
Belgium	Egypt	Ireland	Luxembourg	Slovak Republic	USA
Bulgaria	Estonia	Iran	Moldova	Slovenia	United Kingdom
Belarus	Finland	Italy	Mexico	Sweden	Uzbekistan
Canada	France	Japan	Malta	Switzerland	
China	Georgia	Kazakhstan	Netherlands	Spain	
Croatia	Germany	Kyrgyzstan	Poland	Tajikistan	

Table A5. Summary statistics

Variable	Mean	Std. Dev.	Min	Max
lnex	18,679	3,228	6,908	26,896
lnGDP_exp	26,467	1,821	23,018	30,746
lnGDP_imp	26,467	1,821	23,018	30,746
lnDIST	7,874	0,875	5,081	9,621
lnRemote_exp	18,893	0,450	18,372	20,344
lnRemote_imp	18,893	0,450	18,372	20,344
contiguity	0,067	0,251	0	1
common language	0,033	0,178	0	1
colony	0,033	0,178	0	1
common currency	0,052	0,222	0	1
landlocked_exp	0,294	0,456	0	1
landlocked_imp	0,294	0,456	0	1
RTA	0,480	0,500	0	1
CUSTone	0,040	0,196	0	1
CUSTboth	0,003	0,052	0	1
EXPdiv	0,040	0,196	0	1

Table A6. Average Unconditional marginal effects (Tobit)

	AMEs
lnGDP_exp	1,159*** (0,006)
lnGDP_imp	0,862*** (0,006)
lnDIST	-1,663*** (0,019)
CONTIG	0,253*** (0,040)
COMLANG	0,528*** (0,050)
COLONY	0,124*** (0,050)
COMCUR	0,124*** (0,040)
LANDLOCKED_EXP	-0,206*** (0,021)
LANDLOCKED_IMP	-0,308*** (0,021)
lnREMOTE_exp	0,398*** (0,028)
lnREMOTE_imp	0,682*** (0,028)
RTA	0,882*** (0,022)
CUSTone	0,395*** (0,045)
CUSTboth	1,780*** (0,162)
EXPdiv	0,294*** (0,045)

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

Table A7. PPML estimation including interaction terms (RTA)

Interaction variable (Z)	DIST	COMLANG	COLONY
RTA	4,351*** (7,31e-05)	0,146*** (8,33e-06)	0,124*** (8,52e-06)
Z*RTA	-0,511*** (8,76e-06)	0,329*** (2,05e-05)	0,310*** (2,23e-05)
Z	-0,706*** (7,10e-06)	0,183*** (1,77e-05)	-0,155*** (1,49e-05)
CUSTone	-0,238*** (2,22e-05)	-0,403*** (2,21e-05)	-0,398*** (2,21e-05)
CUSTboth	0,732*** (4,84e-05)	0,524*** (4,86e-05)	0,458*** (4,93e-05)
EXPdiv	0,180*** (1,82e-05)	0,016*** (1,8e-05)	0,021*** (1,8-05)
R^2 (adj)	0,8815	0,8760	0,8758

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

Table A8. PPML estimation including interaction terms (CONTIG)

Interaction variable (Z)	COMLANG	RTA	COLONY
CONTIG	0,237*** (8,30e-06)	0,250*** (2,25e-05)	0,211*** (8,26e-06)
Z*CONTIG	0,364*** (1,96e-05)	0,037*** (2,4e-05)	0,660*** (2,27e-06)
Z	0,170*** (1,65e-05)	0,144*** (8,56e-06)	-0,259*** (1,45e-05)
CUSTone	-0,399*** (2,21e05)	-0,386*** (2,25e-05)	-0,399*** (2,22e-05)
CUSTboth	0,501*** (4,87e-05)	0,603*** (4,84e-05)	0,262*** (4,95e-05)
EXPdiv	0,020*** (1,8e-05)	0,034*** (1,85e-05)	0,020*** (1,8e-05)
R^2 (adj)	0,8761	0,8755	0,8769

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

Table A9. PPML estimation including interaction terms (LANDLOCKED_exp)

Interaction variable (Z)	RTA	DIST	REMOTE_exp
landlocked_exp	-0,131*** (2,17e-05)	0,323*** (6,96e-05)	26,487*** (1,32e-03)
Z*landlocked_exp	0,249*** (2,37e-05)	-0,049*** (9.74e-06)	-1,414*** (7,09e-05)
Z	0,108*** (8,59e-06)	-1,001*** (4,34e-06)	0,324*** (7,23e-06)
CUSTone	-0,349*** (2,22e-05)	-0,360*** (2,21e-05)	-0,373*** (2,21e-05)
CUSTboth	0,559*** (4,84e-05)	0,694*** (4,87e-05)	0,768*** (4,87e-05)
EXPdiv	0,054*** (1,81e-05)	0,045*** (1,81e-05)	0,051*** (1,8e-05)
R^2 (adj)	0,8762	0,8761	0,8765

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

Table A10. PPML estimation including interaction terms (LANDLOCKED_imp)

Interaction variable (Z)	RTA	DIST	REMOTE_imp
landlocked_imp	-0,294*** (2,36e-05)	1,278*** (7,32e-05)	21,189*** (1,35e-03)
Z*landlocked_imp	0,416*** (2,53e-05)	-0,179*** (1,04e-05)	-1,132*** (7,09e-05)
Z	0,108*** (8,59e-06)	-1,001*** (4,34e-06)	0,406*** (7,19e-06)
CUSTone	-0,349*** (2,22e-05)	-0,360*** (2,21e-05)	-0,373*** (2,21e-05)
CUSTboth	0,559*** (4,84e-05)	0,694*** (4,87e-05)	0,768*** (4,87e-05)
EXPdiv	0,054*** (1,81e-05)	0,045*** (1,81e-05)	0,051*** (1,8e-05)
R^2 (adj)	0,8762	0,8761	0,8765

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets.

Table A11. Year dummies estimates

	OLS	**Tobit**	**FE**	**RE**	**PPML**	**Heckman**
y2003		-0,113** (0,048)	0,36*** (0,063)	-0,164*** (0,034)	-0,213*** (1,76e-05)	-0,129*** (0,049)
y2004	0,129*** (0,047)	0,017 (0,048)	0,457*** (0,057)	-0,012 (0,032)	-0,083*** (1,66e-05)	-0,009 (0,049)
y2005	0,231*** (0,047)	0,12** (0,048)	0,446*** (0,05)	0,053 (0,03)	-0,023*** (1,6e-05)	0,103** (0,048)
y2006	0,285*** (0,047)	0,173*** (0,048)	0,444*** (0,044)	0,11*** (0,028)	0,051*** (1,53e-05)	0,149*** (0,048)
y2007	0,382*** (0,047)	0,269*** (0,048)	0,416*** (0,036)	0,19*** (0,026)	0,13*** (1,47e-05)	0,247*** (0,048)
y2008	0,575*** (0,047)	0,463*** (0,048)	0,449*** (0,03)	0,334*** (0,024)	0,236*** (1,42e-05)	0,448*** (0,048)
y2009	0,306*** (0,047)	0,194*** (0,048)	-0,334*** (0,036)	-0,112*** (0,026)	-0,014*** (1,53e-05)	-0,171*** (0,048)
y2010	0,33*** (0,047)	0,218*** (0,047)	0,507*** (0,038)	0,214*** (0,026)	0,082*** (1,46e-05)	0,192*** (0,048)
y2011	0,433*** (0,047)	0,321*** (0,047)	0,564*** (0,035)	0,309*** (0,025)	0,194*** (1,39e-05)	0,308*** (0,048)
y2012	0,401*** (0,047)	0,289*** (0,047)	0,577*** (0,035)	0,292*** (0,026)	0,145*** (1,4e-05)	0,276*** (0,048)
y2013	0,383*** (0,047)	0,271*** (0,047)	0,484*** (0,032)	0,255*** (0,025)	0,145*** (1,39e-05)	0,255*** (0,048)
y2014	0,447*** (0,056)	0,335*** (0,056)	0,4*** (0,033)	0,219*** (0,028)	0,137*** (1,99e-05)	0,321*** (0,057)
y2015	0,19*** (0,056)	0,077 (0,056)	0,124*** (0,03)	-0,004 (0,028)	-0,04*** (2,09e-05)	0,07 (0,057)
y2016	0,135** (0,056)	0,023 (0,056)	0,037 (0,028)	-0,058** (0,027)	-0,054*** (2,08e-05)	0,007 (0,057)
y2017	0,077 (0,048)	-0,036 (0,047)	0,02 (0,023)	-0,024 (0,023)	-0,056*** (1,39e-05)	-0,037 (0,047)
y2018	0,112** (0,048)					
oil2014	-0,254*** (0,068)	-0,254*** (0,068)	0,028 (0,033)	0,002 (0,033)	-0,024*** (2,14e-05)	-0,254*** (0,068)
oil2015	-0,28*** (0,067)	-0,279*** (0,067)	-0,009 (0,033)	-0,042 (0,033)	-0,007*** (2,28e-05)	-0,287*** (0,068)
oil2016	-0,267*** (0,067)	-0,266*** (0,067)	0,001 (0,033)	-0,033 (0,033)	-0,064*** (2,27e-05)	-0,268*** (0,068)

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets

Table A12. Estimated coefficients for the interaction terms (Table3 and Table5 continued)

	Tobit	***FE***	***RE***	***Heckman (1)***	***Heckman (2)***
Lndist*landlocked_exp	-0,052*** (0,029)		-0,417*** (0,082)	-0,066** (0,032)	-0,059** (0,029)
Lndist*landlocked_imp	0,138*** (0,034)		-0,052 (0,092)	0,113*** (0,038)	0,125*** (0,034)
Rta*lndist	-0,237*** (0,027)	-0,032 (0,035)	-0,127*** (0,033)	-0,25*** (0,031)	-0,248*** (0,028)
Rta*comlang	-0,906*** (0,115)	-0,342** (0,147)	-0,401*** (0,137)	-0,834*** (0,129)	-0,856*** (0,116)
Rta*colony	-0,029 (0,106)	-0,087 (0,225)	-0,145 (0,19)	-0,054 (0,118)	-0,052 (0,106)
Contig*comlang	-0,109 (0,116)		0,103 (0,384)	-0,126 (0,13)	-0,115 (0,117)
Contig*rta	-1,045*** (0,087)	-0,056 (0,216)	-0,311* (0,172)	-1,105*** (0,097)	-1,072*** (0,088)
Contig*colony	-0,243** (0,104)		-0,637* (0,358)	-0,235** (0,115)	-0,234** (0,104)
Rta*landlocked_exp	0,72*** (0,048)	-0,095 (0,065)	-0,004 (0,061)	0,63*** (0,054)	0,66*** (0,049)
Rta*landlocked_imp	-0,178*** (0,049)	-0,209*** (0,065)	-0,253*** (0,061)	-0,227*** (0,054)	-0,207*** (0,049)
Lnremote*landlocked_exp	-0,689*** (0,096)	-1,061*** (0,235)	-2,685** (0,176)	-0,493*** (0,107)	-0,57*** (0,097)
Lnremote*landlocked_imp	-0,882*** (0,051)	1,072*** (0,237)	-0,338* (0,137)	-0,858*** (0,056)	-0,864*** (0,051)
Contig*comcur	-0,662*** (0,124)		-0,806* (0,427)	-0,626*** (0,139)	-0,639*** (0,125)
Comlang*comcur	0,214 (0,162)		-0,356 (0,545)	0,206 (0,181)	0,206 (0,163)
Comcur*landlocked_exp	-0,671*** (0,106)		-0,35 (0,368)	-0,706*** (0,119)	-0,693*** (0,107)
Comcur*landlocked_imp	-0,255** (0,107)		-0,207 (0,369)	-0,284** (0,119)	-0,274** (0,107)

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets

Table A13. PPML estimation with interaction terms

	PPML	**AME**
lngdpo	0,821***(3,04e-06)	2747661***(12,594)
lngdpd	0,804***(2,99e-06)	2691694***(12,387)
lndist	-0,661***(7,62e-06)	-2212859***(26,213)
contig	0,332***(2,34e-05)	1111147***(78,384)
comlang	-0,056***(1,83e-05)	-188030,1***(61,195)
comcur	0,569***(1,21e-05)	1905674***(40,962)
colony	0,138***(1,64e-05)	461326,5***(54,983)
landlocked_exp	27,484***(1,39e-03)	92000000***(4660,854)
landlocked_imp	5,88***(6,48e-04)	19700000***(2168,918)
lnremote_exp	0,419***(7,70e-06)	1403187***(26,065)
lnremote_imp	0,447***(7,60e-06)	1495958***(25,745)
rta	4,685***(8,01e-05)	15700000***(271,506)
Lndist*landlocked_exp	0,138***(1,54e-05)	462967,9***(51,591)
Lndist*landlocked_imp	-0,034***(2,04e-05)	-114189,7***(68,386)
custone	-0,291***(2,31e-05)	-974504,2***(77,357)
custboth	0,567***(6,22e-05)	1898056***(208,373)
expdiv	0,169***(1,92e-05)	567072,5***(64,363)
Rta*lndist	-0,56***(9,63e-06)	-1873623***(32,615)
Rta*comlang	0,654***(3,96e-05)	2187747***(132,741)
Rta*colony	-0,905***(3,8e-05)	-3028997***(127,467)
Contig*comlang	-0,031***(3,75e-05)	-103398,3***(125,367)
Contig*rta	-0,103***(2,56e-05)	-345736,6***(85,668)
Contig*colony	0,925***(3,74e-05)	3094490***(125,501)
Rta*landlocked_exp	0,418***(3,71e-05)	1397555***(124,232)
Rta*landlocked_imp	-0,074***(4,00e-05)	-246281,6***(134,02)
Lnremote*landlocked_exp	-1,535***(7,4e-05)	-5137559***(248,029)
Lnremote*landlocked_imp	-0,296***(3,75e-05)	-989783,9***(125,633)
Contig*comcur	-0,239***(1,86e-05)	-800425,7***(62,305)
Comlang*comcur	-0,262***(2,02e-05)	-876351,9***(67,545)
Comcur*landlocked_exp	-0,442***(3,21e-05)	-1479475***(107,616)
Comcur*landlocked_imp	-0,033***(2,9e-05)	-110035,1***(96,97)
constant	-41,695***(1,76e-04)	

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets

Table A14. Estimated coefficients for the interaction terms (Table7 continued)

	FE	***RE***	***Heckman (1)***	***Heckman (2)***	***PPML***
Lndist*landlocked_exp		-0,422*** (0,081)	-0,061** (0,029)	-0,068** (0,03)	0,107*** (1,6e-05)
Lndist*landlocked_imp		-0,029 (0,091)	0,075** (0,035)	0,062* (0,037)	-0,017*** (2,06e-05)
Rta*lndist	-0,034 (0,035)	-0,13*** (0,033)	-0,242*** (0,028)	-0,244*** (0,029)	-0,555*** (9,66e-06)
Rta*comlang	-0,342** (0,147)	-0,402*** (0,137)	-0,84*** (0,116)	-0,816*** (0,122)	0,557*** (4,28e-05)
Rta*colony	-0,09 (0,225)	-0,143 (0,189)	-0,063 (0,106)	-0,067 (0,112)	-0,899*** (3,84e-05)
Contig*comlang		0,002 (0,38)	-0,119 (0,117)	-0,13 (0,124)	0,066*** (4,05e-05)
Contig*rta	-0,041 (0,215)	-0,306* (0,172)	-1,052*** (0,087)	-1,08*** (0,092)	-0,092*** (2,57e-05)
Contig*colony		-0,643* (0,355)	-0,267*** (0,104)	-0,268** (0,11)	0,92*** (3,78e-05)
Rta*landlocked_exp	-0,13** (0,065)	-0,024 (0,061)	0,626*** (0,049)	0,594*** (0,052)	0,366*** (3,97e-05)
Rta*landlocked_imp	-0,208*** (0,065)	-0,252*** (0,061)	-0,27*** (0,049)	-0,291*** (0,052)	-0,083*** (4,25e-05)
Lnremote*landlocked_exp	-1,396*** (0,237)	-2,98*** (0,18)	-1,016*** (0,105)	-0,936*** (0,11)	-2,1*** (8,38e-05)
Lnremote*landlocked_imp	1,036*** (0,238)	-0,374*** (0,137)	-0,818*** (0,051)	-0,81*** (0,054)	-0,297*** (3,8e-05)
Contig*comcur		-0,816* (0,423)	-0,62*** (0,124)	-0,607*** (0,131)	-0,233*** (1,86e-05)
Comlang*comcur		-0,355 (0,54)	0,181 (0,162)	0,18 (0,172)	-0,28*** (2,02e-05)
Comcur*landlocked_exp		-0,329 (0,364)	-0,673*** (0,106)	-0,687*** (0,112)	-0,44*** (3,21e-05)
Comcur*landlocked_imp		-0,195 (0,366)	-0,296*** (0,107)	-0,306*** (0,113)	-0,019*** (2,9e-05)

Note: ***, **, * indicate the 1%, 5% and 10% significance respectively, standard errors are listed in the brackets