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THE GRAVITY MODEL FOR ASSESSING TRADE PATTERNS: THE CASE OF BALTIC STATES

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Abstract. *International trade is the key element of globalisation and closer economic and political cooperation between countries. Regional integration is an important driver of closer trade ties among countries. In this context, the article focuses on analysing the factors, influencing the dynamics of trade patterns of the Baltic States. The research method used in the article is the gravity model of trade, which rests on the key assumption that trade between countries is defined by the size of the economies and the distance between the countries. The gravity equation estimates showed that the membership of the Baltic States in the EU had a positive effect on the export levels of the Baltic States to other EU members. On the other hand, the membership in the EU is not the main trade stimulating factor. The more important factor for the Baltic States' exports is the former economic ties with Russia. An analysis also revealed that the Baltic States have many important trade partners with different levels of income. This finding does not support the Linder hypothesis which states that the main trading partners should have a rather similar level of income.*

Keywords*: gravity model of trade, trade patterns, international trade, Linder hypothesis*

1. Introduction

International trade is the key element of globalisation and closer cooperation between world countries, both economic and political. A country's active participation in the global trade is also a path to economic growth and prosperity. There are many factors that exert influence on how effectively a country participates in international trade. Some factors, such as trade openness and participation in free trade agreements, are creating opportunities for trade and other factors, such as high trade tariffs, a fluctuating exchange rate and the geographical distance act as barriers to trade.

The liberalisation of world trade has come a long way over the past hundred years. An important recent trend is the emergence of numerous regional trade agreements, what is currently high on the political agenda of many countries and global businesses, who are analysing the effects of the regional integration on their business prospects.

In this context, the aim of this article is to find out what are the main factors influencing the trade patterns of the Baltic States. Estonia, Latvia and Lithuania (the Baltic States) have undergone unique economic and political developments in the past decades.

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Lessons learned from the Baltic States' experience are unique and valuable for other countries and regions undergoing similar economic and policy transformations, in particular in Central and Eastern Europe.

Thus, the purpose of this article is to identify the main factors impacting the trade directions of the Baltic States. The most common tool, found in the relevant literature, is to analyse the trade patterns of those countries and the effects of various trade agreements as the gravity model of trade, which is also used as the main research tool in this article.

2. Literature Review

It has been known since the 1960s that the size of bilateral trade flows between any two countries can be approximated by the same law of gravity, an analogy with the Newtonian theory of gravitation. Tinbergen (1962) was the first to outline this phenomenon. Just as planets are mutually attracted in proportion to their sizes and proximity, countries trade in proportion to their respective GDPs and proximity (Bacchetta et al., 2013).

In the basic form of the gravity model, the amount of trade between two countries is assumed to increase in proportion to their size as measured by their national income (or GDP), and decrease in proportion to the cost of transport between them, as measured by the distance between their economic centers. Later researches have suggested to include population in the model as an additional measure of the size of the country and its economy. This model is sometimes called the augmented gravity model. It is also common to specify the augmented gravity model using per capita income (or per capita GDP) instead of the overall national income. Per capita income expresses the level of economic development. Thus, the size of the economy and the level of economic development are the main attractive forces – the stimulating or pull factors – of bilateral trade flows, while the main push or resisting factor is the distance between the trading countries. The distance expresses the impact of transaction costs on the intensity of trade relations. These pull and push factors are the traditional gravitational forces that influence bilateral trade flows (Pass & Tafenau, 2004).

Over the last half-century, the gravity model has become the workhorse of the applied international trade literature, and has given rise to literally thousands of publications and working papers, covering a wide variety of regions, time periods, and sectors. For example, Disdier and Head (2008), in their meta-analysis of the effect of distance on trade, cover 1,052 separate estimates in 78 papers. By linking trade flows directly with economic size, and inversely with trade costs, usually proxied by geographical distance as an indicator of transport costs, the gravity model captures some deep regularities in the pattern of international trade and production. In this way, the gravity model has produced some of the clearest and most robust findings in empirical economics (Shepherd, 2012), and, therefore, have been commonly used to investigate trade flows and related policies.

However the gravity model of trade is the model itself and therefore has certain approximations and is not entirely able to capture certain factors, such as cultural and different policy effects on trade. Some authors have been also exploring econometric limitations of the model (for example, Anderson, 2011; Mele & Baistrocchi, 2012).

Many of the studies, using the gravity model of trade, analyse the general question of the trade flows between one country and its trade partners or the region with an attempt to determine the key factors to that trade (Kristjánsdóttir, 2005; Papazoglou, 2007; Lampe, 2008; Pietrzak & Lapinska, 2014). Other studies look more specifically to the trade flows of certain products (Pelletiere & Reinert, 2004; Sarker & Jayasinghe, 2007). Studies also focus on different policy implications and factors that affect the trade flows between countries, for example, the effects of common currency (Bun & Klaassen, 2007), foreign direct investments (Gopinath & Echeverria, 2004), natural border effects (Nitsch, 2000), and transportation costs (Martinez & Suarez, 2005; Egger, 2008). Other studies focus on researching the different trade policy effects on the trade flows between countries (Nowak-Lehmann et al., 2007; Grant & Lambert, 2008; Park & Park, 2008). Also, a number of researches have attempted to provide improvements of the performance of the gravity model by introducing methodological adjustments (Kalirajan, 2007; Baier & Bergstrand, 2009).

The research carried out in this article falls within the group of research studies that analyse the question of trade flows in the region and its determinants with specific focus on the Baltic States.

3. Research Methodology and Data

The gravity model of trade will be the main tool to carry out an empirical analysis of trade patterns of the Baltic States. The gravity model specification for calculating trade volumes is typically of the following form:

$$TRADE_{ij}^{t} = \beta_0 + \beta_1 GDP_i^t + \beta_2 GDP_j^t + \beta_3 DIST_{ij} + \beta_4 GDPPC_i^t + \beta_5 GDPPC_j^t + \sum_{g=1}^{G} \gamma_g Z_{ij} + \sum_{k=1}^{K} \alpha_k X_{ij}^t + \varepsilon_{ij}^t \quad (1)$$

Variables of the equation are explained in Table No. 1.

TABLE No. 1. The list of Variables of the Gravity Equation 1

Variable	Explanation
$TRADE^t_{ij}$	Bilateral trade flows between country *i* and country *j* [1]
$GDP^t_{i,j}$	Country *i* and country *j* GDPs
$DIST_{ij}$	Country *i* and country *j* GDP per capita
$GDPPC^t_{i,j}$	Geographical distance between economic centers of country *i* and country *j*
Z_{ij}	Time-invariant explanatory variables
Z^t_{ij}	Time-varying explanatory variables
$\beta_0, \beta_1, \ldots, \beta_5$	Parameters of the model
ε^t_{ij}	Error term

Source: Ravishankar & Stack (2014)

[1] Many studies use the sum of exports and imports as the dependent variable; however, exports is the most commonly used dependent variable found in the trade flows gravity models (Kepaptsoglou et al., 2010)

The basic gravity equation consists of an independent variable of trade flows between the countries and other dependent variables relating to the economic size of trading partners and the geographical distances between their economic centers.

The separate role of $GDPPC_{i,j}^{t}$ (i.e., per capita income) in the gravity equation is to indirectly test the Linder hypothesis. Although the Linder hypothesis presents no empirical model, the theory suggests that if an importing country's aggregated preferences for goods are similar to an exporting country's consumption patterns, the country *j* will develop industries similar to the country *i*. In other words, the Linder hypothesis is concerned with income similarities (Fajgelbaum et al., 2011). However, it has to be noted that the similarity of GDP per capita might not necessarily lead to the similar structure of the consumption, since income inequality, often represented by the Gini coefficient, might produce a different consumption structure. For the purposes of simplicity and in order to remain in line with other researchers' methodologies, the consumption structure in this article is approximated by GDP per capita similarity.

The gravity equation also includes a vector of time-invariant explanatory variables, Z_{ij}; a vector of time-varying trade-stimulating (pull) and trade resisting (push) variables, X_{ij}^{t}; and the error term, ε_{ij}^{t}. The vector of time-invariant explanatory variables Z_{ij} comprises dummy variables, such as landlocked countries, common colonial ties, or an indicator for institutional proximity. The vector of time-varying explanatory variables X_{ij}^{t} refers to the time sensitive variables, such as exchange rates and accession to the trade blocs.

Some dummy variables (either an island, a landlocked country or common borders) are used to reflect the hypotheses that the transport costs increase with distance, and that they are higher for landlocked countries and islands but are lower for neighboring countries. Dummies for common language, adjacency or other relevant cultural features such as common colonial history are used to capture information costs. Tariff barriers are generally included in the form of dummies for the existence of regional trade agreements.

The full gravity equation of trade determinants between Baltic States and their trade partners, used in the research, is specified as follows:

$$lnEXP_{ij}^{t} = \beta_0 + \beta_1 \ln(GDP)_i^t + \beta_2 \ln(GDP)_j^t + \beta_3 \ln(DIST)_{ij} + \beta_4 \ln(GDPPC)_{ij}^t + \beta_5 \ln(RER)_i^t + \beta_6 \ln(RER)_j^t + \beta_7 \ln(D\_CBO)_{ij} + \beta_8 \ln(D\_CCO)_{ij} + \beta_9 \ln(C\_EU)_{ij}^t + \beta_{10} \ln(D\_CCU)_{ij}^t + \varepsilon_{ij}^t \quad (2)$$

The gravity equation was log-linearised to give an empirical version of the model. Variables of the equation are explained in Table No. 2.

TABLE No. 2. **The list of Variables to be used in the Research**

Variable	Name	Explanation
EXP^t_{ij}	Exports	Exports (goods and services, FOB) from country *i* to country *j* in USD producer prices (year 2010 = 100[*])
GDP^t_i	Exporter GDP	Exporter GDP in USD producer prices (year 2010 = 100)
GDP^t_j	Importer GDP	Importer GDP in USD producer prices (year 2010 = 100)
$GDPPC^t_{ij}$	GDP per capita difference	Exporter and importer GDP per capita difference in USD producer prices (year 2010 = 100)
RER^t_i	Exporter real exchange rate	Exporter real exchange rate, in local currency units per USD in consumer prices (year 2010 = 100)[**]
RER^t_j	Importer real exchange rate	Importer real exchange rate, in local currency units per USD in consumer prices (year 2010 = 100)
$DIST_{ij}$	Distance	Distance in kilometers between the capitals of the trading partners
D_CBO_{ij}	Common border	Common border; = 1 if the countries share a dry land border, = 0 if not
D_CCO_{ij}	Common coloniser	Common coloniser; = 1 if both of the countries were part of the Soviet union, = 0 if not
$C\_EU^t_{ij}$	Common currency	EU membership; =1 if both of the countries belong to the EU in the year *t*, = 0 if not
$D\_CCU^t_{ij}$	EU membership	Common currency; = 1 if both of the countries have common currency in the year *t*, = 0 if not
$\beta_0, \beta_1, \ldots, \beta_{10}$	Parameters	Parameters of the model
ε^t_{ij}	Error term	Error term

Source: Created by author, based on Ravishankar & Stack (2014)

The variables of an island, a landlocked state or a land area are not used in the gravity equation because, from the perspective of the Baltic States, all the countries have similar geographical positions, and this aspect is not considered as being important. As countries do not share a common language, this variable is also not relevant. Institutional proximity, being difficult to quantify, is also omitted from the gravity equation of this research.

Panel data is often used for gravity model calculations. For this research, the panel data set consists of bilateral export flows from the Baltic States to their main export markets. The export markets were selected following the rule that the export to these countries should cumulatively constitute at least 90% of any of the Baltic States exports. Accordingly, there are 30 countries included in the set of panel data. Country *i* means the Baltic State and country *j* means its trade partner. The full list of pairs of the Baltic States and its trade partners are provided in Table No. 1 of the Appendix.

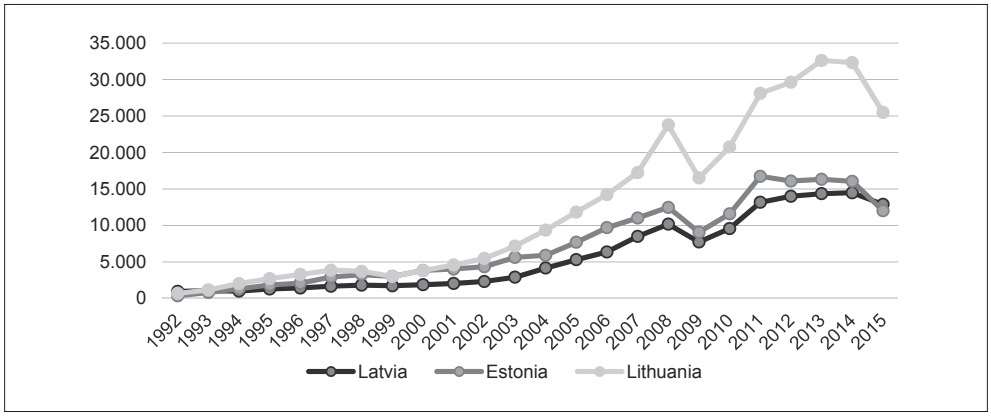
[2] The year 2010 is used as a reference year to adjust data for inflation using consumer price index.

[3] The exchange rates for the countries that adopted common currency (euro) were chain- linked with the euro exchange rate upon entry into the European Monetary Union/

The sample period covers the period of 1994–2015. The nominal exports data in USD at constant producer prices (year 2010 = 100) is sourced from the Directions of Trade Statistics (DOT) and the International Monetary Fund (IMF) (Directions, 2016). The USD producer prices were sourced from the International Financial Statistics (IFS) and the IMF (International, 2016). Data on GDP and GDP per capita were taken from the World Development Indicators (WDI) and the World Bank (World, 2016). The geographical distance between the trading partner countries was taken from the Center for Prospective Studies and International Information (CEPII) (Center, 2016). Data for calculating the real exchange rate was taken from the WDI and the World Bank (World, 2016). The data used to chain-link the national exchange rates with the euro upon its adoption were taken from the European Commission (Converting, 2016). The US consumer prices (year 2010 = 100) were used to express the nominal exchange rate into real exchange rate, sourced from the IFS and IMF (International, 2016).

4. Analysis of Results

The Baltic States economies and the trade flows were growing almost during the whole period of 1992–2015 (see Picture No. 1).

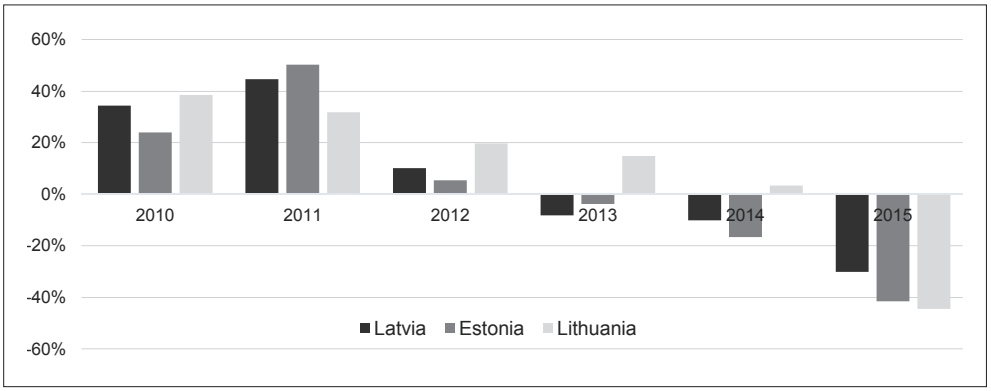


PICTURE No. 1. **Baltic States Export Trends 1992–2015, in million USD**

Source: Direction of Trade Statistics, International Monetary Fund (2016)

The volume of exports of Latvia, Estonia and Lithuania have grown in double digits in the past decade. On absolute terms, Lithuania's export is twice as high as that of Latvia's and Estonia's because Lithuania is a larger economy. The growth trend of the Baltic States exports was strong up until the current crisis of 2008, when exports dropped in all the three countries. However, the export volumes reached the previous levels in just three years, and continued to grow up until 2013.

The export levels of Baltic States in 2014–2015 have been hampered by the economic slowdown in the EU as well as by the economic and political developments in Russia. Russia's conflict with Ukraine, which began in late February 2014, prompted a number of governments to apply sanctions against individuals, businesses and officials from Russia and Ukraine. These sanctions were approved by the US, the EU and other countries and international organisations. Russia has responded with sanctions against a number of countries, including a total ban on food imports from the EU, US, Norway, Canada and Australia. The sanctions have contributed to the collapse of the Russian currency and the 2014–2015 Russian financial crisis. They have also caused economic damage to a number of EU countries, with the total losses estimated at €100 billion (Sharkov, 2015). Additionally, Russia's economy has been hardly hit by low oil prices. In turn, the Baltic States economies have sustained the strongest hit by the negative political and economic developments in Russia.



PICTURE No. 2. **Changes of Baltic States Exports to Russia 2010–2015, %**
Source: Direction of Trade Statistics, International Monetary Fund (2016)

As seen in Picture No. 2, Baltic States exports to Russia started to fall dramatically in 2014 with -3% from Lithuania and up to -17% from Estonia. In the year 2015, the already low levels of exports to Russia declined even further by -30%, -42% and -44% in Latvia, Estonia and Lithuania, respectively.

Table No. 3 provides the summary statistics on the panel data, used in the gravity equation for this research.

The number of observations N for all except one variable is 1914, which means that the panel is nearly balanced, and is also large enough to produce statistically reliable results. Since the VIF (variance inflation factor) for none of the independent variables is greater than 2.01, the correlation between the variables and multicollinearity of the regression is not high.

TABLE No. 3. **Summary Statistics**

Variable[4]	N	VIF	Mean	Median	Min	Max	St Dev
EXP^t_{ij} *(Exports)*	1905	-	18.30	18.59	6.64	22.53	1.99
GDP^t_i *(Exporter GDP)*	1914	1.38	23.82	23.83	23.01	24.51	0.38
GDP^t_j *(Importer GDP)*	1914	1.63	26.67	26.72	23.01	30.44	1.62
$GDPPC^t_{ij}$ *(GDP per capita difference)*	1914	1.54	9.33	9.86	-2.49	11.27	1.45
RER^t_i *(Exporter real exchange rate)*	1914	1.01	1.17	1.15	-0.72	3.07	1.32
RER^t_j *(Importer real exchange rate)*	1914	1.07	2.31	1.89	-3.13	9.59	2.27
$DIST_{ij}$ *(Distance)*	1914	1.72	7.25	7.32	4.68	8.90	0.93
D_CBO_{ij} *(Common border)*	1914	1.90	0.10	0	0	1	0.30
D_CCO_{ij} *(Common coloniser)*	1914	2.01	0.21	0	0	1	0.41
$D\_CCU^t_{ij}$ *(Common currency)*	1914	1.09	0.04	0	0	1	0.20
$C\_EU^t_{ij}$ *(EU membership)*	1914	1.53	0.32	0	0	1	0.47

Source: Author's calculations

The mean of the numerical variables is, in general, very close to the median values, which implies that there are not many outlying values and the panel data is quite symmetric. Five out of seven variables are slightly skewed to the left as their medians are more than the mean values. The standard deviation of the exports is small, despite the rather big difference between minimum and maximum values (6.64 and 22.53). This suggests that export observations are relatively close to the mean value. The exporter and importer real exchange rate is relatively higher than the median deviation from the mean, and the higher standard deviation suggests that exchange rates of the analysed trading partners have been fluctuating significantly during the analysed period, and, in this way, have impacted the competitiveness of the trading partners. A rather high standard deviation of GDP per capita difference suggests that the Baltic States have many important trade partners with different levels of income. This does not support the Linder hypothesis, which states that the main trading partners should have a rather similar level of income.

Table No. 4 gives the empirical results of the gravity model, capturing export flows from the Baltic States to their main 30 trading partners over the period of 1994–2015.

TABLE 4. **Gravity Model Results**

Variable	Coefficient	SE Coefficient	T-Value	P-Value
Intercept	-30.96	1.66	-18.62	<0.0001
GDP^t_i *(Exporter GDP)*	1.59	0.07	22.52	<0.0001
GDP^t_j *(Importer GDP)*	0.72	0.02	40.19	<0.0001
$GDPPC^t_{ij}$ *(GDP per capita difference)*	0.16	0.02	8.58	<0.0001
RER^t_i *(Exporter real exchange rate)*	0.19	0.02	10.27	<0.0001
RER^t_j *(Importer real exchange rate)*	-0.13	0.01	-12.15	<0.0001
$DIST_{ij}$ *(Distance)*	-1.36	0.03	-45.17	<0.0001
D_CBO_{ij} *(Common border)*	2.13	0.07	28.52	<0.0001
$C\_EU^t_{ij}$ *(EU membership)*	0.67	0.06	11.38	<0.0001

Source: Author's calculations

[4] For definitions of variables see Table 2.

The initial regression analysis showed that the dummies of common border and common currency are statistically insignificant (with P-values more than 0.05 for both). The insignificance of a common border can be explained, since the Baltic States are rather small in size and are considered small, open economies with an easy access to the most of the neighboring countries. The common currency dummy insignificance was most likely a result of the Baltic States having euro as their currency for a relatively short period (Estonia introduced euro in 2011, Latvia in 2014, and Lithuania in 2015). All the rest of the variables are significant with the 95%, and also with the 99% confidence level.

The R-Square of the regression is 74.86%, which is rather high, meaning that the gravity model variables explain most of the export levels between the analysed countries.

The gravity model results suggest that the most important factors influencing the trade between the Baltic States countries and their trade partners are a common coloniser, exporter GDP, and distance between the countries. Membership in the EU is a positive factor, but not as important as the latter ones. The least important factors are exporter and importer real exchange rates and the GDP per capita difference.

The core gravity model variables are the GDP of trading partners and the distance between the countries. In the case of Baltic States, both of the core parameters are significant; however, their importance is second to the previous economic ties with Russia and other former Soviet Union countries (i.e., the common coloniser variable). The augmented gravity model also includes the GDP per capita variable as a reflection of the Linder hypothesis. According to the hypothesis, countries with the similar level of income should trade more. However, the Linder hypothesis does not hold true in the case of the Baltic States, as the parameter of GDP per capita difference is positive, suggesting that the bigger the difference between the GDPs, the more trade should there be. On the other hand, the coefficient for GDP per capita difference is one of the smallest; therefore, the importance of this variable is rather limited. The distance coefficient is negative, thus supporting the core gravity model of trade assumption that trade related costs reduce the trade volumes between the countries.

The importance of variables of real exchange rate is rather limited, thus meaning that the exchange rate movements are not the key drivers of the trade volumes of the Baltic States, even though exchange rate movements affect the competitiveness of the countries. All of the Baltic States at the end of the analysis period had the euro as their currency. Despite all the three countries introducing euro only in the recent years, all of them had been preparing to join the Eurozone by pegging their currencies to euro soon after the euro was introduced in the EU. Therefore, for the Baltic States, the euro and US dollar exchange rates proximate the national currency movements against the dollar. The gravity equation estimates suggest that the euro depreciation against the US dollar had a positive effect on the Baltic States' export levels. On the other hand, the trade partner real exchange rate coefficient is negative, meaning that the partner currency's depreciation against the US dollar has reduced the receptiveness for Baltic States' exports.

The analysis of the economic significance of the regression parameter estimates shows that a 10% increase in a Baltic State's GDP would result in a 15.9% increase in the export levels of that Baltic State to its trade partners, while a 10% increase of a given Baltic State trade partner GDP would increase the export volumes from the Baltic State to the said trade partner by around 7.2%. In case the Baltic State trade partner joined the EU, the export levels of the Baltic State to that country should increase by 6.7%. The 10% increase in the GDP per capita difference between Baltic State and its trade partner would lead to the 1.6% export increase to that trade partner.

5. Additional Gravity Model Estimates

The previous section provided an analysis of gravity model variables that have an impact on the volumes of the Baltic States' exports. In addition to the chosen variables, looking through the analysis period of 1994–2015, few important events should be identified and analysed separately: the 1998 Russian crisis, the start of Baltic States accession into the EU in 2002 and the 2008 financial crisis. To separately analyse the effects of these events on the Baltic States' trade, the panel data was accordingly divided into pre- and post- 1998, pre- and post-2002 and pre- and post-2008 years. The gravity model estimations for separate periods are provided in Table No. 2 of the Appendix. The variable of EU membership was excluded from these estimates, as EU membership dummy has only the value of zero in pre-1998/2002 data sets.

The ***1998 Russian crisis*** was the first major Russian crisis after the collapse of the Soviet Union. The crisis dramatically affected Russia and its neighboring countries, including the Baltic States. The crisis, among other things, was a first push for the Baltic States to start reorienting their economies and exports to more competitive Western European countries.

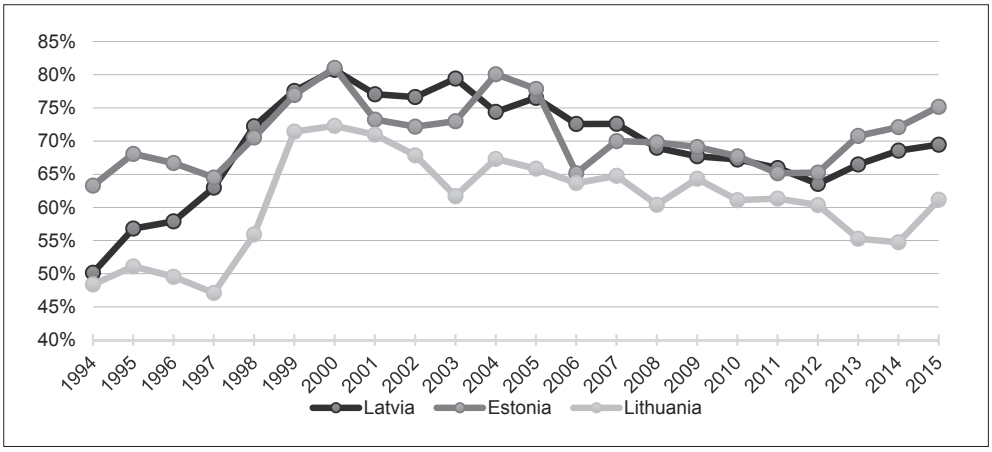
The post-1998 gravity model estimates show that the growing levels of GDPs of the Baltic States were more significantly increasing the export levels of the countries, compared to the pre-1998 period. The rest of the variables were less important in defining the volumes of exports after 1998. Another interesting observation to be made is that the importance of a common coloniser after 1998 dropped significantly (its coefficient declined from 3.05 to 1.60). This supports the assumption that the Baltic States made significant export direction adjustments after the Russian crisis. The importance of GDP per capita difference after 1998 declined, as the export levels of the Baltic States were growing in any case. The variable of the exchange rates continued to be relatively unimportant in defining the dependent variable.

The ***start of accession into the EU in 2002*** was a critical moment in time for the Baltic States. In that year, the negotiations on the accession into the EU were finalised. This *de facto* meant that Baltic States were going to become the official members of the EU in 2004. In addition, the euro was introduced in the circulation in 2002, and Lithuania

and Estonia have pegged their currencies to euro in the same year (Latvia's currency was pegged to euro in 2004). These important events highlight the significant increase of the economic ties between Baltic States and other EU members in 2002.

The pre- and post-2002 gravity estimates suggest that the same tendencies as before and after the 1998 Russian crisis were prevailing. The higher GDP levels were fueling higher export levels and the trade ties to the former Soviet Union countries were diminishing. In addition, the GDP per capita difference between the Baltic States and their trading partners became even less important after 2002.

On the other hand, an analysis of the Baltic States exports dynamics to the EU suggests additional conclusions.



PICTURE No. 3. **Share of Baltic States exports to the EU, 1994–2015, %**

Source: Direction of Trade Statistics, International Monetary Fund (2016)

As seen from the Picture No. 3, the considerable hike of the Baltic States export share to the EU appeared between 1997 and 2000, just after the 1998 Russian crisis. However, starting from 2004, the share of exports to the EU started to decrease up until the countries employed post-2008 crisis export oriented growth policies, introduced the euro as their currency and exports to Russia dropped dramatically. Hence, the strongest effect of the integration to the EU on the Baltic States exports was before and during the EU accession period.

The ***2008 financial crisis*** was another important factor, significantly affecting many economies of the world. The crisis also strongly affected the Baltic States as their GDPs shrunk significantly, the worst being the year 2009 when Baltic States' economies plummeted by 14–15% (World, 2016). Having in mind that the export was seen by all the three countries as the main path to the recovery, the effect of the 2008 crisis is worth analysing separately.

The comparison of pre- and post-2008 financial crisis period highlights the diminished importance of levels of GDP on the volumes of exports. Indeed, as mentioned before, GDPs of the Baltic States were falling dramatically during the crisis, while export was seen as the only way to recovery. After the crisis, the Baltic States focused on stimulating their exports, and this is reflected in the gravity model results. Another distinguishing aspect of pre- and post- 2008 analysis is the insignificance of the GDP per capita difference variable. This suggests that the Baltic States have built their competitive advantages in international trade and are exporting products and services that they are able to produce best.

The gravity model estimates for different periods suggest that the core gravity model parameters – GDP and distance – remain very significant drivers of the volumes of the exports of the Baltic States. However, the importance of distance is diminishing. This is an effect of globalisation and deeper integration not only among the partners of separate free trade agreements, but all the countries of the world. The importance of many other variables, in particular, the former common coloniser and GDP per capita difference, diminishes over time, too.

6. Conclusions

The gravity model of trade rests on the presumption that the size of the economy is the main trade stimulating factor, and the main resisting factor is the distance between the trading countries. In case of the Baltic States, both of the core parameters are significant; however, their importance is second to the previous economic ties with Russia and other former Soviet Union countries. The findings support the gravity model assumption, but the results also underline the significance of the other factors, influencing the trade flows between the countries. The analysis revealed that the economic ties with former Soviet Union members are diminishing over time, in particular after certain strong economic and geopolitical shocks.

The dramatic changes of the trade composition of the Baltic States occurred in the past couple of years, when exports to Russia shrunk in double digits. This mainly happened because of geopolitical tensions raising from Russia's conflict with Ukraine in 2014. Thus, dramatic political factors can affect trade patterns significantly and in a very short time.

The Baltic States have many important trade partners with different levels of income. This finding does not support the Linder hypothesis, which states that the main trading partners should have a rather similar level of income.

The gravity equation estimates show that the Baltic States membership in the EU has a positive effect on the export levels of the Baltic States to other EU members. The findings are consistent with other researchers' conclusions, because many other researchers also found that free trade agreements have a positive effect on trade between their mem-

bers via a trade creation effect. However, the strongest effect of integration in the EU on the Baltic States exports was before and during the EU accession period.

The data analysis showed that the existence of a common border and a common currency are not significant factors influencing the Baltic States' trade flows. The existence of common border is insignificant, because the Baltic States are rather small in size, and are considered as small, open economies, with an easy access to the most of the neighboring countries. The common currency insignificance might be the result of the Baltic States having euro as their currency for a relatively short time at the time of research. On the other hand, some other researchers also found that euro's effect on the trade creation is not as large as commonly thought (Bun & Klaassen, 2007).

The importance of variables of real exchange rate is rather limited, thus meaning that exchange rate movements are not the key drivers of the trade volumes of the Baltic States, even though exchange rate movements affect the competitiveness of countries.

The growing levels of GDPs of the Baltic States was an increasingly important factor influencing the higher export levels of the countries from 1994 up until the financial crisis of 2008. However, the data comparison of pre- and post-2008 financial crisis period highlighted the diminished importance of levels of GDP on the volumes of exports. The GDPs of Baltic States were falling dramatically during the financial crisis of 2008, while export was seen as the main path to the recovery. Thus, analysis suggests that the Baltic States adopted successful policies to stimulate their exports as the main path leading to the economic recovery.

The core gravity model parameters – GDP and distance – remain very significant drivers of the volumes of the exports of the Baltic States. The distance coefficient in the gravity equation is negative, thus supporting the core gravity model assumption that trade related costs reduce the trade volumes between the countries. However, the importance of distance for the trade volumes of the Baltic States has been diminishing over time. The diminishing importance of distance in trade relations is the direct effect of globalisation and deeper integration among all the countries in the world.

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TABLE No. 1. **The Main Export (EX) Partners of the Baltic States 1992-2015**

LATVIA				ESTONIA				LITHUANIA			
Partner	Volume (USD, mn)	Share in EX	Share in EX (cumulative)	Partner	Volume (USD, m)	Share in EX	Share in EX (cumulative)	Partner	Volume (USD, m)	Share in EX	Share in EX (cumulative)
Russia	18,262	14%	14%	**Finland**	30,198	18%	18%	**Russia**	45,059	16%	16%
Lithuania	17,705	14%	28%	**Sweden**	24,668	15%	33%	**Latvia**	28,806	10%	27%
Estonia	13,875	11%	39%	**Russia**	17,123	10%	43%	**Germany**	25,237	9%	36%
Germany	11,408	9%	48%	**Latvia**	15,228	9%	53%	**Poland**	17,764	6%	42%
Sweden	8,102	6%	54%	**Germany**	9,241	6%	58%	**Estonia**	15,255	5%	48%
United Kingdom	7,518	6%	60%	**Lithuania**	8,292	5%	63%	**United Kingdom**	14,157	5%	53%
Poland	5,588	4%	65%	**United States**	6,533	4%	67%	**Belarus**	13,216	5%	57%
Denmark	5,045	4%	68%	**Norway**	5,177	3%	70%	**Netherlands**	12,641	5%	62%
Finland	3,252	3%	71%	**Denmark**	4,727	3%	73%	**France**	10,144	4%	66%
Netherlands	3,031	2%	73%	**United Kingdom**	4,500	3%	76%	**Sweden**	10,107	4%	69%
Norway	2,754	2%	76%	**Netherlands**	4,375	3%	78%	**Ukraine**	9,601	3%	73%
Belarus	2,682	2%	78%	**France**	2,681	2%	80%	**Denmark**	8,995	3%	76%
United States	2,020	2%	79%	**Ukraine**	2,620	2%	82%	**United States**	8,286	3%	79%
Ukraine	2,008	2%	81%	**Belgium**	2,384	1%	83%	**Norway**	5,533	2%	81%
France	1,981	2%	82%	**Poland**	2,344	1%	84%	**Italy**	5,494	2%	83%
Italy	1,879	1%	84%	**Italy**	1,842	1%	85%	**Belgium**	3,993	1%	84%
Belgium	1,312	1%	85%	**Turkey**	1,674	1%	87%	**Kazakhstan**	3,954	1%	86%
Spain	1,104	1%	86%	**China**	1,543	1%	87%	**Finland**	3,502	1%	87%
Algeria	1,037	1%	86%	**Nigeria**	1,473	1%	88%	**Spain**	3,446	1%	88%
Czech Republic	1,001	1%	87%	**Spain**	1,301	1%	89%	**Switzerland**	2,570	1%	89%
Turkey	845	1%	88%	**Hungary**	1,019	1%	90%	**Canada**	2,292	1%	90%
Kazakhstan	843	1%	89%	**Canada**	966	1%	90%	**World**	277,868	100%	100%
Ireland	785	1%	89%	**World**	166,017	100%	100%				
Switzerland	712	1%	90%								
Cyprus	640	1%	90%								
World	127,829	100%	100%								

Source: Direction of Trade Statistics, International Monetary Fund, author's calculations

TABLE 2. **Gravity Model Estimates for Pre- and Post- Years of 1998, 2002 and 2008**

	Pre- and post- 1998				Pre- and post- 2002				Pre- and post- 2008			
Variable	Coefficient	SE Coefficient	T-Value	P-Value	Coefficient	SE Coefficient	T-Value	P-Value	Coefficient	SE Coefficient	T-Value	P-Value
Intercept	-26.35	5.01	-5.26	<0.0001	-25.55	3.69	-6.93	<0.0001	-33.08	2.16	-15.34	<0.0001
	-30.79	2.01	-15.34	<0.0001	-25.36	2.43	-10.44	<0.0001	-19.06	2.99	-6.36	<0.0001
GDP_i^t *(Exporter GDP)*	1.35	0.21	6.47	<0.0001	1.36	0.15	8.88	<0.0001	1.71	0.09	19.18	<0.0001
	1.67	0.08	20.40	<0.0001	1.46	0.10	14.78	<0.0001	1.25	0.12	10.32	<0.0001
GDP_j^t *(Importer GDP)*	0.77	0.04	17.93	<0.0001	0.74	0.03	22.93	<0.0001	0.73	0.02	30.65	<0.0001
	0.69	0.02	35.51	<0.0001	0.68	0.02	32.44	<0.0001	0.65	0.03	25.51	<0.0001
$GDPPC_{ij}^t$ *(GDP per capita difference)*	0.33	0.05	6.92	<0.0001	0.29	0.03	8.39	<0.0001	0.23	0.02	9.30	<0.0001
	0.11	0.02	5.50	<0.0001	0.07	0.02	3.29	0.001	0.00	0.03	-0.13	0.8997
RER_i^t *(Exporter real exchange rate)*	0.22	0.04	5.00	<0.0001	0.23	0.03	7.09	<0.0001	0.22	0.02	9.30	<0.0001
	0.18	0.02	8.95	<0.0001	0.16	0.02	7.54	<0.0001	0.14	0.03	5.36	<0.0001
RER_j^t *(Importer real exchange rate)*	-0.14	0.03	-5.14	<0.0001	-0.14	0.02	-7.18	<0.0001	-0.16	0.01	-11.34	<0.0001
	-0.13	0.01	-12.10	<0.0001	-0.13	0.01	-10.97	<0.0001	-0.10	0.01	-6.79	<0.0001
$DIST_{ij}$ *(Distance)*	-1.65	0.07	-23.92	<0.0001	-1.62	0.05	-31.18	<0.0001	-1.56	0.04	-40.98	<0.0001
	-1.41	0.03	-45.49	<0.0001	-1.38	0.03	-40.99	<0.0001	-1.29	0.04	-31.85	<0.0001
D_CBO_{ij} *(Common border)*	3.05	0.19	16.39	<0.0001	2.57	0.14	18.64	<0.0001	2.14	0.10	21.93	<0.0001
	1.60	0.08	20.92	<0.0001	1.54	0.08	18.78	<0.0001	1.44	0.10	14.58	<0.0001

Source: Author's calculations
Note: above are the pre-estimates; below are post-estimates