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Gravity Approach for Exploring Baltic Sea Regional Integration in the Field of International Trade

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Abstract

The paper is inviting a reader to think to what extent we can use the knowledge resulting from laws of nature for exploring economic processes. In order to look for the answers on this question, the paper is going to explore international trade flows between the Baltic Sea region countries using a gravity approach. Attention is paid to analyzing forces that attract foreign trade flows and to exploring the influence of distance as an indicator that expresses both transportation costs and cultural proximity of the countries. The results of modeling support the statement that the size of economy has statistically significant and positive influence on the bilateral trade relations of the region. The influence of economic development level that is expressed by GDP per capita is statistically insignificant. In the case of the Baltic regional integration, distance is expressing most significantly cultural proximity and historical relationship between the countries. The regional integration effect in trade is inherently larger for small countries. Small economies in transition have to look for a regional niche to penetrate into the international market.

Keywords: International trade, gravity models, Baltic Sea region
JEL classification: F10; C10

1 INTRODUCTION

The paper is inviting a reader to think to what extent we can (and whether we can at all) use the knowledge resulting from laws of nature for exploring economic processes. Do the principles known from the law of gravitation also appear in social and particularly economic processes? Do we apply the principles of gravitation for analyzing regional integration in the field of foreign trade? In order to look for the answers on these questions, this paper is going to explore international trade flows of the Baltic Sea region countries using a gravity approach.

The Baltic Sea region (Denmark, Germany, Sweden, Finland, Norway, Poland, Estonia, Latvia, Lithuania and Russia) has become one of the most important economic regions in Europe due to its favorable location between East and West and the dynamic interdependence between transition and integration. The development of the Baltic economies is positively influenced by the processes of regional integration and economic cooperation between the countries around the Baltic Sea. These countries have historical and cultural traditions for developing trade relations. The Scandinavian countries and Germany focused their special attention toward the Baltic economies in transition already from the beginning of the transition processes.

International trade is one of the most expedient economic factors in pushing economies to transition and integration. Significant changes in international trade pattern have attracted economists to pay more attention to the development of theoretical considerations and empirical approaches that enable to explore international trade flows and the role of regional integration in developing bilateral trade relations between countries.

In recent years, gravity models have been used in empirical studies of changes in international trade pattern and reintegration of economies in transition in international division of labor *(Wang and Winters* 1991 and 1994, *Baldwin* 1993, 1994 and 1997, *Gros* and *Gonciarz* 1996, *Iversen* 1998, *Cornett* and *Iversen* 1998, *Fidrmuc* 1998 and 1999, *Laaser* and *Schrader* 2002). Using gravity equation for exploring international trade flows has more than forty years of history and this equation is still at the center of applied research on international trade. Gravity equation fits the data remarkably well.

Theoretical considerations for using gravity models to explore international trade flows have been widely discussed and developed (*Tinbergen* 1962, *Linnemann* 1966, *Ander-*

son 1979, *Bergstrand* 1985, 1989 and 1990, *Deadorff* 1984, 1995 and 1998, *Evenett* and *Keller* 1998, *Anderson* and *Wincoop* 2001, *Harrigan* 2001). Despite of continuing discussions and uncertainty about the foundations of the gravity model, it is possible to say, that these theoretical considerations, which are mostly based on microeconomic foundations and trade theories, are also valid when exploring the changes in international trade patterns during transition and integration processes.

The paper is organized in four main parts. The first part of the paper (Section 2) presents a short overview of the Baltic Sea region integration idea and the importance of regional integration in developing international trade flows. In the second part, the possibilities of using the gravity approach for modeling international trade flows are described and analyzed laying emphasis on the theoretical foundations of this approach in economics (Section 3). The third part of the paper presents the results of modeling trade flows between Estonia (the smallest transitional economy of the region with very liberal and open economy) and its main trade partners (Section 4), paying attention to the role of the Baltic Sea region in developing Estonian foreign trade relations and supporting quick changes of Estonian geographical trade pattern. The fourth part of the paper presents the main empirical results of estimating the gravity equation for analyzing international trade flows between the Baltic Sea region countries (Section 5). The gravity models exploring trade flows between the Baltic Sea region countries have been developed distinguishing two separate groups in foreign trade relations according to the mode of transport: sea and air, and two groups of attraction forces: size of economy and the level of economic development.

2 DEVELOPMENT OF THE BALTIC REGIONAL INTEGRATION IDEA

Geopolitical classification and analysis of the development of the countries around the Baltic Sea has been a field of scientific research already for a century. The regional similarity of the Baltic Sea region countries has particularly attracted researchers from Scandinavia and Germany. An attempt to develop a classification for the Baltic Sea region countries was made by *Haltenberger* in 1925. According to Haltenberger, Estonia and Latvia form the so-called small Baltics (das kleinere Baltikum) and in geopolitical sense they must be treated together with Scandinavian countries as Baltoscandia. Lithuania was grouped together with Poland and some other European countries as the

Central-East European countries. *Wood* (1932) developed the idea that the geopolitical, socio-cultural and economic characteristics of the Baltic Sea region consist of three subgroups: 1) Baltic Fennoscandia, 2) Dano-German, 3) South-East Baltic States.

Proposed by Wood's approach, the Baltic's co-operation idea was developed further by the Estonian economist and geographer Eduard Kant. *Kant* (1934 and 1935) stressed the idea that there is a striking similarity between the Netherlands, Belgium and Luxembourg with the Baltic Sea region countries, particularly with the three Baltic states Estonia, Latvia and Lithuania:

1) The three Baltic states are located to each other in the same way as the Benelux countries.
2) On the East border of these states is a big neighbor.
3) The Nordic Sea is located to the Benelux countries in almost the same way as the Baltic Sea to the Baltic states.
4) There are important transportation links with the big eastern neighbor.

According to Kant's opinion, the Baltic countries will become more competitive on the world market if they can intensify economic co-operation between themselves and develop common infra-structural networks. These ideas were rather revolutionary and in many ways contradictory to the real developments of economic co-operation between the Baltic states in 1930s.

The Second World War and the Iron Curtain separated the two world systems and broke the traditional economic and political relations between the Baltic Sea region countries, which were established already during the Middle Ages (Hanseatic League). Economic co-operation between the Baltic Sea region countries was practically stopped until the end of the 1980s. Political changes that have taken place during the recent decade have significantly influenced the economic co-operation of the countries around the Baltic Sea. In the Scandinavian countries and Germany, the idea of the Nordic economic area, the Baltic Sea region, has become prominent. Meanwhile, many organizations and co-operative institutions have been established, for example the Council of the Baltic States in 1992.

The integration of the Baltic Sea region countries into the EU has more than twenty-five years of history starting from January 1, 1973 when Denmark became a member of the

EU. The collapse of the Berlin Wall and the German unification moved the EU border to the east and Germany became the biggest Baltic Sea region country. After several years of negotiations and preparations, Sweden and Finland joined the EU in January 1, 1995. This marked the next stage of the EU enlargement (the northern enlargement). As the Baltic Sea region countries with developed market economies strove for the EU membership, transitional countries of the region (Poland, Estonia, Latvia, Lithuania) created a network for integration first of all in the field of international trade: free trade areas with EFTA countries, the Baltic Free Trade Area (covering Estonia, Latvia and Lithuania), CEFTA, etc. These four Baltic Sea region countries are also candidates for the EU eastward enlargement.

In 1995 the Baltic Sea was declared as an inland sea of the EU. This event was of strategic importance for the integration of the countries around the Baltic Sea – Scandinavian countries integrating with Central and Southern Europe and the Mediterranean; countries in transition associated with the EU pursuing the process of adjustment on macro, meso and micro scale at the same time (*Kisiel-Łowczyc* 2000, *Raagma* 1997, *Kuklinski* 1997). The strong feeling of the Baltic identity and responsibility for the sea have brought people together already for centuries.

Table 1: The share of the Baltic Sea region in total export and import of the countries around the Baltic Sea in 1995-2000, %

Country	Export 1995	Import 1995	Export 2000	Import 2000
Denmark	45.2	46.3	44.2	46.0
Finland	38.7	44.7	37.1	51.4
Germany	9.4	10.9	9.6	11.5
Norway	31.4	43.8	25.4	43.5
Sweden	34.5	42.6	32.6	43.0
Estonia	75.1	74.5	74.8	58.2
Latvia	66.5	71.7	55.2	72.4
Lithuania	54.8	65.2	55.9	60.4
Poland	52.8	42.2	47.6	41.2
Russia	17.6	26.2	23.9	20.3

Sources: Central Statistical Bureau of Latvia (2000); International Monetary Fund (2001); Authors calculations

Economically and politically highly integrated area is characterized by strong mutual relationships among the countries belonging to this area. Foreign trade is one of the

most important fields of regional integration that forms a remarkable source of income and economic welfare. It is evident that regional trade is of different importance for the countries around the Baltic Sea (Table 1).

The role of the Baltic Sea region trade is of special importance for the three Baltic states, the transitional countries with small open economies. More than 50% of the export and import flows of these states are developed with the Baltic Sea region countries. The main trading partners for the Baltic states are capital abundant countries around the Baltic Sea: Germany, Sweden and Finland (Table 2).

The Baltic states have cultural and historical traditions for developing trade relations with the Baltic Sea region countries and this region has been used as a starting point to gain experience and to penetrate into international markets. The development of trade relations within the Baltic Sea region is also important for admittance into the European Union and to establish an institutional base for integration.

The integration and transition processes of the countries around the Baltic Sea are also influenced by economic and political development of Russia. This influence is particularly evident in the case of the Baltic states. Russia is their biggest neighbor with the most unpredictable economic and political development. The Baltic states have developed comparatively active trade relations with Russia but the share of Russia in the Baltic states export is declining rapidly after Russian crisis in 1998. For instance, the share of Russia in Estonian general export was 13.3 % in 1998, and only 6.8 % in 2000 (*Statistical Office of Estonia* 2001, p. 34).

The transmission of the Russian crisis in 1998 to the Baltic economies mainly took place through lower exports. In the aftermath of the Russian crisis in August 1998, the experience of the three Baltic states has been similar in many respects: 1) exports declined; 2) economic growth turned negative; 3) the budgetary positions weakened. The adjustment processes with the recent Russian economic crisis could be also treated as an example how small transitional countries with open and liberal economies could react on asymmetric shocks. The lessons of the Russian crisis are twofold for the Baltic Sea region: 1) the Baltic states learned a lesson indicating the need to diversify risks and

Table 2: The share of the Baltic Sea region countries in exports and import of the Baltic states in 1999, %

Baltic Sea region country	Estonia		Latvia		Lithuania	
	Export	Import	Export	Import	Export	Import
Germany	7.5	9.3	12.8	13.4	16.0	16.5
Sweden	18.8	9.3	6.6	5.4	4.2	3.4
Finland	19.4	22.8	1.5	6.0	1.0	3.1
Denmark	3.9	2.5	5.4	3.0	6.2	3.9
Norway	2.4	1.1	0.8	1.1	1.1	0.7
Poland	0.6	1.9	2.6	4.8	4.5	5.7
Estonia	–	–	5.7	6.7	2.4	1.5
Latvia	8.7	2.2	–	–	12.8	2.0
Lithuania	3.9	1.6	8.3	6.9	–	–
Russia	9.2	13.5	12.4	18.2	7.0	20.1
Total	74.4	64.2	56.1	65.5	55.2	56.9

Source: Department of Statistics to the Government of the Republic of Lithuania (1999), pp. 16-18

to develop more actively economic co-operation and trade relations with other Baltic Sea region countries; 2) market forces could be strengthened by political factors that support the EU eastward enlargement processes and the real integration of economies in the transition to the world economic system.

3 THEORETICAL FOUNDATIONS OF USING GRAVITY APPROACH IN EXPLORING INTERNATIONAL TRADE FLOWS

From a methodological point of view, gravity theory can be considered as a relational theory, which describes the degree of spatial interaction between two or more points in a manner analogous to physical phenomena (*Nijkamp* and *Reggiani* 1992). Classical gravity theory states that the attraction force a_{ij} between two entities i and j is proportional to their respective masses m_i and m_j and inversely proportional to the squared distance d_{ij}^2 between these entities ($a_{ij} = \gamma m_i m_j d_{ij}^{-2}$; γ is a constant proportionality factor).

As early as in the middle of the nineteenth century *Carey* (1858-1859) observed the presence of gravitational force in social phenomena, stating that the force was in direct ratio to mass and inverse to distance (*Isard* 1960). Gravity theory has primarily been centered on in the fields where a distance plays a significant role. Gravity theory has

proven to be useful in describing social phenomena in space such as population migration, flow of goods, money, and information, traffic movement and tourist travel. One can specify gravity theory for such uses as follows (*Nijkamp*, 1975, p. 204):

(1) $t_{ij} = K\, O_i^{b1} Dj^{b2} f(S_{ij})$.

Where:
t_{ij} - the volume of flows between two points,
K - a constant,
O_i - volume of flows from the points of origin,
D_j - volume of flows at the point of destination,
b_1, b_2 - weighted geometric averages of O_i and D_j respectively,
$f(S_{ij})$ - distance friction, a decreasing function of S_{ij}.

The utility specification of the gravity model has been analyzed by *Niedercorn* and *Bechdolt* (1969), *Golob* and *Beckmann* (1971), and *Nijkamp* (1975). The theory of consumer behavior assumes that, subject to budget constraint, the available income will be spent on several alternatives so as to maximize utility. An optimal allocation of the given budget can be obtained by postulating a utility function for the decision-maker that reflects relative preferences. Niedercorn and Bechdolt as well as Nijkamp have shown that, assuming the budget constraint is linear, the volume of transactions between two points can be stated as a utility maximizing problem. They proved that a model using gravity theory could be derived from a utility maximizing function, either in a specified form as in equation (1) or in logarithmic form.

The gravity model to examine international trade flow is also analogous to Newton's law, relating the gravity between two objects to their masses and the distance between them. According to the gravity approach, bilateral trade between two regions (countries) is directly related to their incomes (GDP, GNP) and inversely related to the distance between them. The antecedents for using the gravity approach to model international trade flow date back to *Tinbergen* (1962), *Poyhonen* (1963) and *Linnemann* (1966). Linnemann added more variables and went further toward a theoretical justification in terms of Walrasian general equilibrium system. He pointed out that, when considering the theoretical aspects of a gravity model for trade, there are three main factors to be considered: 1) the total potential supply (or exports) of a country to the world market; 2) the total potential demand (or imports) of a country to the world market; 3) those factors

that create resistance to trade and thus affect the degree of trade intensity. These include ordinarily tariff barriers and transportation costs. The first and second factors are expected to be equal to one another if one disregards the international flow of capital, services or land transfers. The basic form of the gravity model for the examination of international trade flow is as follows:

(2) $X_{ij} = b_0 Y_i^{b1} Y_j^{b2} N_i^{b3} N_j^{b4} D_{ij}^{-b5} P_{ij}^{-b6}$.

Where:
X_{ij} - the trade flow between country *i* and *j*,
$b_0, b_1, b_2, b_3, b_4, b_5, b_6$ - coefficients,
Y_i and Y_j - domestic expenditures per capita in country *i* and *j*, respectively,
N_i and N_j - population in country *i* and *j*, respectively,
D_{ij} - trade resistance due to geographic distance between countries i and j,
P_{ij} - dummy variable to take into account preferential trade factors between *i* and *j*.

Trade is assumed to occur when domestic production is not equivalent to domestic demand. Essentially, certain fields of production have an advantage in certain regions or countries, which results in specialization of production and a division of labor. In trade theory this specialization of production explains why trade occurs in terms of comparative advantage in production.

According to *Harrigan* (2001, p. 2), economists are ordinarily proud of the theory of comparative advantage, seeing of both beautiful and profound: beautiful because of its simplicity and elegance, profound because it is surprising and has deep implications for economic policy and our understanding of real economies. But at the same time Harrigan also rightly stresses that the most fundamental problem about comparative advantage is that it relates observables (trade flows and specialization patterns) to things, which are by their nature almost unobservable (autarky prices) (ibid).

Despite of wide discussions about theory of comparative advantage and significant progress that has been made in this field, economists are still far from fully understanding the determinants and empirical significance of comparative advantage. Empirical research on comparative advantage is still an underdeveloped field and there are lots of opportunities to develop good empirical work in this field in order to understand also the basic trade models better. Gravity approach is evidently one of the most widely used

empirical researches on international trade, which also has a lot of uncertainty and discussions about the theoretical foundations so far. These discussions are important for both for better understanding theoretical foundations of empirical studies as well as for developing these theoretical foundations.

In fact there are several theoretical foundations of the gravity model (*Niedercorn* and *Bechdolt* 1969, *Golob* and *Beckmann* 1971, *Nijkamp* 1975, *Anderson* 1979, *Bergstrand* 1985, 1989 and 1990, *Helpman* and *Krugman* 1985, *Helpman* 1987, *Deadorff* 1995 and 1998, *McCallum* 1995, *Evenett* and *Keller* 1998). Additionally to the utility specification of the gravity model, *Anderson* (1979) presented a theoretical foundation of the gravity model based on constant elasticity of substitution (CES) preferences and goods that are differentiated by region of origin. Subsequent extensions (see *Bergstrand* 1989 and 1990; *Deadorff* 1998) have preserved the CES preference structure and added monopolistic competition and/or a Hecksher-Ohlin structure to explain specialization. Based on these extensions, *Anderson* and *Wincoop* (2001,) derived an operational gravity model with an rather simple form. They derived the decomposition of trade resistance into three intuitive components: 1) the bilateral trade barrier between region *i* and *j*, 2) *i*'s resistance to trade with all regions, and 3) *j*'s resistance to trade with all regions.

Analyzing various approaches to theoretical foundations of gravity equations, *Evenett* and *Keller* (1998, p. 1) summarized three types of trade models, which differ in the way product specialization is obtained in equilibrium):

1) Technology differences across countries in the Ricardian model.
2) Variations in terms of countries' differing factor endowments in the Hecksher-Ohlin (H-O) model.
3) Increasing returns at the firm level in the increasing returns to scale (IRS) models.

In reality, though, technologies and factor endowments are not the same around the world; they change over time and can be transferred between countries. Trade theory, as a rule explains why countries may trade in different products but does not explain why some countries' trade links are stronger than others and why the level of trade between countries tends to increase over time. This emphasizes the limited applicability of trade theory in explaining the size of trade flows. Therefore, while trade theory can explain why trade occurs, it cannot explain the extent of trade, whereas the gravity model allows to take into

account more factors for explaining the extent of trade as an aspect of international trade flows.

Gravity equations ordinarily have strong empirical explanatory power with R^2 ranging from 70% to 95%. *Eichengreen* and *Irwin* (1998, pp. 33-34) aptly summarized the state of theoretical foundations for the gravity model: "Where there is no close correspondence between the leading theoretical models of trade and the variables appearing in the gravity equation, a number of authors have suggested that the gravity-model framework is compatible both with the Hecksher-Ohlin model and with theories of trade in the presence of imperfect competition. The attraction of the gravity model (no pun intended) is not simply lack of theoretical incompatibility, of course, but its ability to explain the variation in bilateral trade flows across a wide variety of countries and periods. Few aggregate economic relationships are as robust."

To sum up, despite of many discussions about theoretical foundations of gravity models, they are widely used for exploring international trade flows. The development of using gravity equations for modeling economic processes including also international trade flows bases on various theoretical considerations, which could be explained by:

1) Regional science and new economic geography.
2) Microeconomic foundations.
3) Trade theories.

The theoretical foundations and main concepts of using gravity law in social science and economics are summarized in the table 3. It is possible to suggest that these theoretical considerations are also valid when modeling trade flows of economies in transition.

Since the beginning of 1990s, gravity models have also been widely used to estimate trade flows between East and West Europe. Special attention has been given to estimating potential trade flows between the EFTA, European Union, Central and East European and Baltic countries (*Winters* and *Wang* 1991 and 1994, *Baldwin* 1993, 1994 and 1997, *Hamilton* and *Winters* 1992, *Gros* and *Dautrebande* 1992 and 1996, *Eltetö* and *Szemler* 1996, *van Beers* and *Biessen* 1996, *Iversen* 1998, *Cornett* and *Iversen* 1998, *Paas* 1996, 1998 and 2000, *Fidrmuc* 1998 and 1999, *Laaser* and *Schrader* 2002). In the mid and late 1990s a lot of attention was paid to the CEE and Baltic countries

integration into the European Union laying emphasis on the regional integration's effect on the development of trade relations.

Table 3: The theoretical foundations and main concepts of using gravity law in social science and economics

Theoretical background	Main concepts	Authors
Regional science, economic geography	The measurement of intra-regional relationships and their influence on the behavior of individual units. Regions are conceived as a mass.	*Reilly* (1929), *Steawart* (1948), *Isard* (1960), *Krugman* (1991a, 1991b, 1998), *Fujita* et al. (1999)
Microeconomics (utility maximization, general equilibrium theory, constant elasticity of substitution preferences)	A model using gravity theory could be derived from a utility maximizing function.	*Tinbergen* (1962), *Linnemann* (1966), *Niedercorn* and *Bechdolt* (1969), *Golob* and *Beckman* (1971), *Nijkamp* (1975), *Anderson* (1979), *Bergstrand* (1985, 1989, 1990), *Nijkamp* and *Reggiani* (1992)
Trade theories	Trade theories differ in the way product specialisation is obtained in equilibrium: 1) Technology differences (Ricardian model). 2) Factor endowments differences (Hecksher-Ohlin model); H-O model). 3) Increasing returns to scale models (IRS).	*Tinbergen* (1962), *Poyhonen* (1963), *Linnemann* (1966), *Anderson* (1979), *Bergstrand* (1985), *Helpman* (1987 and 1989), *Krugman*, (1979), *Helpman* and *Krugman* (1985), *McCallum* (1995), *Deadorff* (1995), *Evenett* and *Keller* (1998), *Eichengreen* and *Irwin* (1998), *Harrigan* (2001), *Anderson* and *Wincoop* (2001)

The main directions of developing the gravity approach for modeling international trade pattern of economies in transition and their integration into the world trade system could be summarized as follows:

1) Estimating the trade potential of Central and Eastern Europe and development of East-West trade.
2) Exploring regional integration and trade flows in the framework of international organizations (OECD, EU, EFTA, Baltic Sea region, etc.).
3) Estimating bilateral trade flows between a country in transition and its main trade partners.

Using gravity approach for exploring bilateral trade flows between the East and West countries, *Baldwin* (1994, p. 82) also focused on problems of theoretical foundations for the gravity model, "The gravity model used to have a poor reputation among reputable economists. Starting with *Wang* and *Winters* (1991), it has come into fashion. One problem that lowered its respectability was its oft-asserted lack of theoretical foundations. In contrast of popular belief, it does have such foundations."

To sum up, empirical results of the using gravity approach in exploring international trade pattern allow us to conclude that despite its simplicity, the gravity model explains the actual pattern of trade flows remarkably well. The advantage of the gravity model is that it needs comparatively little data, and internationally comparable data for the construction of a gravity model are usually available. These advantages are particularly of interest when modeling trade flows and developing trade scenarios of economies in transition and exploring integration processes of transitional and industrialized economies. Developments of empirical studies using gravity models also help to understand and develop theoretical foundations of these models.

4 MODELING FOREIGN TRADE FLOWS BETWEEN ESTONIA AND THE MAIN TRADING PARTNERS

Estonia is the smallest Baltic Sea region country with very liberal and open transitional economy. The country started its trade policy reform in 1990 and moved rapidly towards very liberal trade system, one with virtually no tariffs or quantitative restrictions at all. During 1990-1998, Estonian geographical trade pattern changed remarkably. In 1990 the share of intra-regional (trade within the USSR and East and Central European socialist countries) was 95.5% in export and 88.9% in import (*Michalopolous*, *Tarr* 1994, p. 6). In 2000 the respective numbers were 70.2% and 58.5% (*Statistical Office of Estonia* 2001a, No. 1).

Estonia has been intent on the rapid liberalization of trade among the three Baltic countries and advocated of the establishment of the Baltic Free Trade Agreement. In 1994 the agreement was signed and during 1996, this co-operation reached the next level: Baltic Customs Union, which covered not only industrial but also agricultural products. Both of these agreements, Baltic Free Trade Agreement and Baltic Customs Union, have improved the competitiveness of Baltic countries in the long run. In 1996, the Free Trade Agreement

between Estonia and Ukraine came into force. In 1997 a major task of Estonian trade policy was to develop trade relations with Russia. The Ministry of Economic Affairs of Estonia considered co-operation with a number of regions of Russia through the participation in various professional associations and enterprises. Special priority was given to the regions of St. Peterburg, Moscow, Yekaterinburg and Pskov. Thought was also given to the establishment of regional trade representations in Russia by Estonian professional associations and enterprises. It was planned to conclude an Investment Protection Agreement as well as an Agreement on the Avoidance of Double Taxation. Before the crisis in Russia in autumn 1998, most of these agreements were only on a level of preparation and negotiation stage. Under the conditions of Russia's economic crisis, development of tight bilateral trade relations was too risky for Estonia.

Estonia also has Free Trade Agreements with the most of CEE countries (Czech and Slovak Republics in April and May 1996, with Slovenia in November 1996, with Poland and Hungary in November 1998, etc). Estonia has agreements on Investment Promotion and Mutual Protection with Germany (signed in November 1992, implemented in January 1997) and Unites States (signed in April 1994 and implemented in February 1997). Estonia signed with the EU a Free Trade Agreement in July 1994 and it took into force on January 1, 1995. The Association Agreement was signed in June 1995 and was ratified in 1997. The Free Trade Agreement set up a free trade area with the EU within the transition period. Estonia is also a member of the World Trade Organization (WTO) and one of the leading candidates for membership of the European Union. The process of negotiation to join the EU is long and complex and revising of Estonian trade policy system is necessary. The liberal trade and customs policy reform facilitated Estonia's comparative success in moving towards market economy during the first stages of transition processes and the necessary rapid restructuring of economy will now have to be substantially revised according to the requirements of the WTO and EU.

Taking into account various agreements between Estonia and its trade partners, the following specification of the gravity model is used in this study:

$$(3) \qquad Y_i = A\, X_{i1}^{B_1}\, X_{i2}^{B_2}\, D_{i1}^{B_3}\, D_{i2}^{B_4}\, D_{i3}^{B_5}\, D_{i4}^{B_6}\, u_i.$$

Where:

Y_i - trade flows (exports or imports) between Estonia and country *"i"*,

X_{i1} - total GDP of country *"i"* (GDP_i),

X_{i2} - distance between Estonia and country *"i"*: $(DISTANCE)_i$,
$A, B_1, B_2, B_3, B_4, B_5, B_6$ - coefficients,
u_i - error term.

Dummy variable (D_{ij}) indicate to which group or trading area a given country belongs: $D_{i1} = 1$, - transitional countries, new candidates for the EU membership (Poland, Hungary, Czech Republic, Slovakia, Slovenia, Latvia, Lithuania, Bulgaria, Romania, Estonia); $D_{i1} = 0$ - other,

$D_{i2} = 1$ - member of the EU, $D_{i2} = 0$ - other,
$D_{i3} = 1$ - member of CIS, $D_{i3} = 0$ - other,
$D_{i4} = 1$ - belongs to the Baltic Sea region, $D_{i4} = 0$ - other.

Based on the specification of the gravity model (3), the following export and import equations are estimated:

(4) $$ln(EXPORT)_i = B_0+B_1ln(GDP)_i+B_2ln(DISTANCE)_i+B_{3\text{-}6}(DUMMIES)+u_i$$

and

(5) $$ln(IMPORT)_i = B_0+B_1ln(GDP)_i+B_2ln(DISTANCE)_i+B_{3\text{-}6}(DUMMIES)+u_i.$$

It could be presumed that Estonia has different conditions for exporting goods to various countries or group of countries as well as for importing goods from these countries (transitional, EU, CIS, Baltic Sea region countries, etc). In the conditions of Estonian liberal trade policy, Estonian trade partners do not have any restrictions or customs duties for exporting their goods to Estonia. It could be assumed that CIS and the Baltic Sea region countries have developed their trading relations with Estonia also as a result of historical conditions. Hence, dummy 3 and dummy 4 could be treated as dummies that characterize some historical and also cultural (particularly dummy 4) conditions for developing bilateral trade relations between countries. Estonia has experiences of developing trade relations with CIS countries and it is possible to suggest that Estonia has some advantage to develop export to CIS countries than for instance to the EU countries. Due to common historical and cultural background of Estonia and the Baltic Sea region countries Estonia could also develop more active trade relations with the countries of this region than with other countries. Hence, Estonia has a certain regional niche

to penetrate into international market after about 50 years of socialist period. This hypothesis will be tested in the next part of the paper.

Estimation of the export and import equations (4) and (5) bases on:

- The exports and imports data of the *Statistical Office of Estonia* (1997b, 1998a).
- GDP data of 1997 (*IMF* 1998).
- A matrix of distance between the countries.

All estimations base on the data of 46 Estonian main trading partners. The trade flows between Estonia and these trading partners (countries) form more than 95% of Estonian total foreign trade volume. The measure of the geographical distance between countries is defined as the distance between capital cities. For neighboring countries this distance is defined as the distance between their capital city and geographical center of Estonia.

According to the basic assumptions of the gravity model, the following hypotheses could be tested:

1) Estonia has developed more active foreign trade relations with countries where total GDP is higher.
2) Distance negatively influences trade flows. Estonia has developed more active foreign trade relations with nearby countries.
3) Belonging to EU, CIS, Baltic Sea region and transitional countries (the new candidates for the EU) influences Estonian exports and imports flows.

As a matter of fact, in cross-sectional data involving heterogeneous units, heteroscedasticity may be a rule rather than an exception. If the true variance (σ_i^2) is known, we can use the WLS method to obtain BLUE estimators. If true σ_i^2 is not known, it is possible to proceed in two steps: first to run the usual OLS regression and obtain estimated Y_i^{est}, and second to use Y_i^{est} as a weight. These transformations are called WLS estimations in this paper.

The WLS estimators of export and import equations (4) and (5) are included in the tables 4 and 5.

Table 4: WLS estimators of exports equation (4)

	Coefficients (B_i)	Std. Error (*se*)	*t*-statistic	Significance (*p*)
Constant	8.781	2.892	3.037	0.004
LnGDP	0.883	0.146	6.065	0.000
LnDIST	-1.931	0.321	-6.022	0.000
Dummy 1	-0.846	0.771	-1.097	0.279
Dummy 2	-0.332	0.558	-0.594	0.556
Dummy 3	2.289	0.768	2.979	0.005
Dummy 4	1.085	0.663	1.636	0.110

$R^2 = 0.793$, adj. $R^2 = 0.761$, $F = 24.855$, $p = 0.000$

Table 5: WLS estimators of imports equation (5)

	Coefficient (B_i)	Std. Error (*se*)	*t*-statistic	Significance (*p*)
Constant	1.685	2.580	0.653	0.517
LnGDP	0.854	0.130	6.573	0.000
LnDIST	-0.851	0.286	-2.973	0.005
Dummy 1	0.418	0.688	0.607	0.547
Dummy 2	0.009	0.498	0.181	0.853
Dummy 3	1.278	0.685	1.864	0.070
Dummy 4	1.349	0.592	2.280	0.028

$R^2 = 0.764$, adj. $R^2 = 0.727$, $F = 21.008$, $p = 0.000$

The results of regression analysis show that the independent variables explain more than 70% of the variation in the dependent variables in all gravity equations describing Estonian export and import relations with the main trading partners. The coefficients of the independent variable *lnGDP* are positive and the coefficients of independent variable *lnDIST*, as expected, are negative in both equations. The coefficient signs of dummies 3 and 4 also correspond to expectations. The hypothesis that being a member or a candidate to EU (dummies 1 and 2) influences trade flow has not been statistically accepted in this study.

It is possible to summarize that in the conditions of Estonian liberal trade policy, some historical conditions and comparatively close economic relations within the Baltic Sea

region and also CIS countries have influenced Estonian export and import flows and geographical international trade pattern in 1997. Similar results were obtained from running the econometric analysis based on the data of 1995 and 1996 as well as using data of Wealth of nations instead of GDP (*Paas* 1996 and 1998). The results of analysis allow us to conclude that parameters for different gravity equations constructed for exploring trade flows between Estonia and the main trading partners are comparatively stable, and consequently, the results of analysis of trade scenarios do not remarkably depend on the year of data used for estimating gravity equations.

Hence, the following hypotheses were accepted in estimating the export and import equations of the gravity model based on data of *Statistical Office of Estonia* (1997b, 1998a) (export and import data) and IMF (GDP data) in 1997:

1) Estonia tends to have trade relations with countries where total GDP is higher.
2) Distance influences foreign trade flows. The larger the distance between Estonia and the trading partners, the smaller the trade flow.
3) Belonging a trade partner to the CIS or Baltic Sea region countries had positive impact on trade flows between Estonia and a trade partner.

The results from the gravity model seem to support the notion that the existing trade relations between Estonia and the Baltic Sea region countries are most favorable for developing Estonian foreign trade. Russia as the major representative of CIS trade partners belongs also to Baltic Sea region (the North West part of Russia).

On the basis of the gravity model (3) and WLS estimators of the export and import equations (4) and (5) two scenarios for Estonian export and import pattern are elaborated: an optimistic and a pessimistic scenario. Following the optimistic scenario (Scenario 1), we expected that transitional economies have average GDP growth rate 5% in year, industrialized countries 3% and Russia 1%. According to pessimistic scenario (Scenario 2), the average GDP growth rate is suggested 2% in all partner countries, except CIS countries, where a negative growth rate is predicted (-2%). According to the both scenarios, the share of Baltic Sea region countries will increase in Estonian export and import, and the share of CIS countries decline (Tables 6, 7 and 8).

Table 6: Actual and potential share of the Baltic Sea region trade in Estonian export 1997 and 2000[a], %

Country	Export 1997	Export 2000, Scenario 1	Export 2000, Scenario 2	Export 2000	Actual share to potential in 2000
Norway	1.60	0.89	0.93	2.4	+
Sweden	16.76	9.42	9.79	20.6	+
Germany	5.68	12.73	13.23	8.6	+
Finland	16.01	36.52	37.95	32.5	–
Denmark	3.29	2.48	2.58	3.4	+
Lithuania	6.23	0.75	0.68	2.8	+
Latvia	8.83	1.93	1.76	7.1	+
Poland	0.93	2.28	2.08	0.6	–
Russia	19.08	18.47	16.72	2.0	–
Total	74.71	85.47	85.72	80.0	–

[a] The shares are calculated on the base of 46 Estonian main trading partners.

Source: Central Statistical Bureau of Latvia (1998), Statistical Office of Estonia (2001a); Authors calculations

Table 7: Actual and potential share of Baltic Sea region trade in Estonian import 1997 and 2000[a], %

Country	Import 1997[a]	Import 2000 Scenario 1	Import 2000 Scenario 2	Import 2000	Actual share to potential in 2000
Norway	1.13	1.40	1.44	1.4	=
Sweden	9.57	9.63	9.87	9.8	=
Germany	10.61	20.75	21.27	9.5	–
Finland	24.70	20.25	20.76	27.4	+
Denmark	2.73	3.65	3.74	2.5	–
Lithuania	1.60	0.82	0.74	1.6	+
Latvia	1.84	1.34	1.31	2.6	+
Poland	1.19	3.35	3.03	1.8	–
Russia	15.22	9.85	8.83	8.5	–
Total	68.59	71.04	70.89	65.1	–

[a] The shares are calculated on the base of 46 Estonian main trading partners.

Source: Central Statistical Bureau of Latvia (1998), Statistical Office of Estonia (2001a); Authors calculations

Table 8: Actual and potential share of CIS trade in Estonian export and import 1997 (actual) and 2000 (according to trade scenarios), %

Country	Export 1997[a]	Export Scenario 1 2000	Export Scenario 2 2000	Import 1997[a]	Import Scenario 1 2000	Import Scenario 2
Armenia	0.01	0.04	0.03	0.00	0.04	0.04
Aserbaid.	0.04	0.04	0.04	0-04	0.05	0.04
Georgia	0.03	0.03	0.03	0.01	0.03	0.03
Kazahstan	0.40	0.09	0.09	0.52	0.12	0.11
Kyrgystan	0.05	0.02	0.02	0.02	0.03	0.02
Moldova	0.18	0.13	0.12	0.04	0.10	0.09
Tajiki	0.06	0.02	0.01	0.26	0.02	0.02
Turkmenis.	0.02	0.04	0.04	0.08	0.05	0.05
Ukraine	5.02	3.06	2.77	1.07	1.92	1.72
Uzbekistan	0.44	0.12	0.11	0.74	0.15	0.14
Belarus	1.40	1.94	1.75	0.39	0.96	0.86
Russia	19.08	18.47	16.72	15.22	9.85	8.83
Total	26.73	23.98	21.70	18.39	13.32	11.93

[a] The shares are calculated on the base of 46 Estonian main trading partners.
Source: Central Statistical Bureau of Latvia (1998); Authors calculations

It is possible to compare the elaborated trade scenarios with the actual geographical trade pattern of Estonia in 2000. We could summarize that the share of the Baltic Sea region countries in Estonian export has increased during the research period 1997-2000. But there are also some differences between expected and actual trade flows of Estonia. Geographical trade pattern changed significantly during this period. The changes were mainly due to remarkable decline of Estonian-Russian trade relations after the Russian crisis in 1998. In 1999 and 2000 foreign trade flows between Estonia and Russia declined tremendously, and the Russia's share in Estonian actual exports and imports was significantly smaller than potential in 2000. Some increase of trade flows between Estonia and Russia is predictable in the near future, particularly between Estonia and North West (or Baltic) part of Russia.

Russia is also a dominating CIS trading partner for Estonia. The total share of CIS in Estonian foreign trade flows was less than 20% in 1998 (20.9% in export and 14.2%). Recent financial crisis (1998) in Russia and widened currency exchange corridor have had a negative effect on bilateral trade relations between Estonia and also other CIS countries. Ukraine and Belarus have sometimes been considered to be counterweights to foreign trade problems with Russia, in particular due to favorite foreign trade regimes in these countries. On the other hand, recent market reforms and several problems that Estonian

companies emerged during trade relations with these countries have made bilateral trade between Estonia and Ukraine as well as Belarus more complicated. Resulting from this, the share of both Ukraine and Belarus has declined in Estonian export and import in recent years. For instance, the actual share of Ukraine in the Estonian special export was only 1.0% and import 0.6%, and the share of Belarus respectively 0.3% and 0.8% in 2000 (*Statistical Office of Estonia* 2001a). These shares are smaller than calculated according to the both scenarios.

The results of using gravity approach to explore Estonian international trade patterns support the statement that Estonia has excellent potential to develop trade relations with capital abundant countries of the Baltic Sea region, especially Finland, Germany and Sweden. Russia's share in Estonian trade relations is declining but according to both scenarios, Russia's share in Estonian export will be significant also in the long run. Estonia has good potential to develop trade relations with Poland – the biggest economy in transition among the Central and East European (CEE) countries.

To sum up, significant changes in Estonian economic development and geographical trade pattern could be looked in a broader context of development of the Baltic Sea region. Trade growth in this region is above the average growth ratio in the EU. Estonia has cultural and historical traditions to develop trade relations with Baltic Sea region countries and this region can be used as a starting point to gain experience and to penetrate into international markets. Regional integration improves competitiveness of the country and makes Estonia more attractive for foreign direct investment by multinational companies. Development of trade relations within the Baltic Sea region is also important for admittance into the EU and to establish an institutional base for integration. The results of the study also allow us to conclude that small economies in transition should look for a regional niche to penetrate into the international market. Ordinarily, the regional integration effect (also border effect) is inherently larger for small countries. This statement got also acceptance in the case of Estonia as the smallest country of the Baltic Sea region.

5 MODELING BILATERAL TRADE FLOWS OF THE BALTIC SEA REGION COUNTRIES

The aim of this part of the paper is twofold:

1) To test the hypothesis that the bilateral trade flows of the Baltic Sea region countries are influenced by the size of economy and the level of economic development of trade partners´ countries, the distance between the countries and the possible barriers or advantages of belonging to international unions, organizations or groups of countries.
2) To estimate trade flows between the Baltic Sea region countries and to analyze their trade potential.

Based on the stated aims of this part of the paper and according to the basic assumptions of the gravity model, the following hypothesis could be tested:

1) The Baltic Sea region countries have developed more active intra Baltic foreign trade relations with neighbor countries where total GDP (expresses the size of economy) and GDP per capita (expresses the level of economic development) are higher.
2) Distance influences foreign trade flows negatively: the larger the distance between countries, the smaller the expected level of trade.
3) Belonging to certain groups of countries (the EU countries, the EU enlargement candidate countries, the Former Soviet Union (FSU) countries) influences foreign trade flows.

One category of trade flow restrictions is man-made impediments. These barriers or disincentives are created and maintained by governments or their agencies as well as by groups of private individuals or firms. Tariffs, quotas, subsidies, export taxes, exchange controls, and different marketing restrictions are the means by which governments or their agencies can create trade barriers. There are also economic and political unions that create trade preferences to selected countries.

To analyze the effects of regionalism, investigators typically add dummy variables for participation in regional arrangements. According to the previous empirical studies (see for instance *Whalley* 1998), the benefits from this form of market assurance may in fact be quite large, particularly in the case of a small country. Regional trade arrangements

include the traditional welfare gains from preferential tariff reductions, the market-power benefits of forming a larger unit for tariff setting and bargaining, and strategic benefits from integrating markets and committing to preferential arrangements. This statement also got acceptance in exploring trade flows between Estonia and its main trading partners in 1997 (and also in 1995 and 1996).

In order to test the stated hypotheses and to explore trade flows between the Baltic Sea region countries the following gravity equation has been estimated:

(6) $$lnY_{ij} = B_0 + B_1 ln(GDP)_i + B_2 ln(GDP)_j + B_3 ln(GDPPC)_i + B_4 (GDPPC)_j + B_5 ln(DISTANCE)_{ij} + B_k (DUMMIES) + u_{ij} \quad ,$$

where:

Y_{ij} - export from country *i* to country *j* (or import from country *j* to country *i*);
$(GDP)_i$ and $(GDP)_j$ - gross domestic product of exporting *(i)* and importing *(j)* countries respectively;
$(GDPPC)_i$ and $(GDPPC)_j$ - gross domestic product per capita of exporting *(i)* and importing *(j)* countries respectively;
$(DISTANCE)_{ij}$ - the distance in kilometers between the countries *i* and *j*;
DUMMY 1 - designating that exporting country *(i)* belongs to the EU;
DUMMY 2 - designating that exporting country *(i)* is a candidate of the EU eastward enlargement;
DUMMY 3 - designating that exporting country *(i)* belongs to the FSU;
u_{ij} - error term.

The estimation of the gravity equation (6) bases on:

1) Exports and imports data of IMF, 1998 (*International Monetary Fund* 2000a).
2) GDP data, 1998. The GDP data are in market exchange rates (MER) and in purchasing power parities (PPP) (*International Monetary Fund* 2000a, 2000b, *World Bank* 2000).
3) A matrix of distances between the countries. The measure of the geographical distance is defined as (a) flight distance between the capital cities, (b) shipping distance between the main ports of the countries (www.indo.com/distance).

Analyzing trade flows between Estonia and the main trading partners, the statement that distance is expressing not only transportation cost but also cultural proximity and historical relationship between countries got acceptance (see Section 4). It is possible to assume that flight distance should have more significant influence on the bilateral trade flows than shipping distance.

Several authors have discussed how to use the GDP data for estimating gravity equations (the GDP (MER) *versus* GDP (PPP)) (*Gros* and *Consiarz* 1996, *Baldwin* 1994 and 1997, *Cornett* and *Iversen* 1998, *Iversen* 1998). According to *Gros* and *Consiarz* (1996, pp. 715), it is not recommendable to use PPP-converted GDP for estimating gravity equations. Estimates of trade potential should be made on the base of the international value of goods and services a country produces, not how well off inhabitants are. Iversen argues that the proper measure of the transition economies' incomes (GDP(MER) or (GDP)PPP) lies somewhere between the two approaches, and it is impossible to settle this matter on a purely theoretical basis (*Iversen* 1998, p. 273). Based on these considerations, both GDP indicators (MER and PPP) are used in this paper in order to estimate the gravity equation (6).

Based on the gravity equation (6), four models are estimated for exploring trade flows between the Baltic Sea region countries:

- *Model 1:* explanatory variables are natural logarithms of total GDP(MER) (ln GDPM), GDP(MER) per capita (*lnGDPMPC*), flight distance (*lnDISTPL*), and dummies D_1, D_2 and D_3.

- *Model 2:* explanatory variables are natural logarithms of GDP(MER) (*ln GDPM*), GDP(MER) per capita (*lnGDPMPC*), shipping distance (*lnDISTSH*), and dummies D_1, D_2 and D_3.

- *Model 3:* explanatory variables are natural logarithms of GDP(PPP) (*lnGDPP*), GDP(PPP) per capita (*lnGDPPPC*), flight distance (*lnDISTPL*), and dummies D_1, D_2 and D_3.

- *Model 4:* explanatory variables are natural logarithms of GDP(PPP) (*lnGDPP*), GDP(PPP) per capita (*lnGDPPPC*), shipping distance (*lnDISTSH*), and dummies D_1, D_2 and D_3.

The main statistical characteristics of the estimated models 1–4 are presented in table 9. Based on the results of the four gravity models' estimations, it is possible to conclude that model 3 fits the best. The results of the WLS estimation of the parameters of the model 3 are presented in table10.[1]

Table 9: Statistical characteristics of the estimated gravity models 1-4

Models	Coefficient of determination (R^2)	Adjusted coefficient of determination ($R^2_{adjusted}$)	*F*-statistic	Significance (*p*)
Model 1	0.700	0.671	23.643	0.000
Model 2	0.650	0.615	18.766	0.000
Model 3	0.785	0.764	36.932	0.000
Model 4	0.671	0.638	20.616	0.000

Source: Author's estimations using statistical package SPSS

To sum up, the following hypotheses were accepted in estimating the gravity equation (6) for exploring the trade flows between the Baltic Sea region countries:

1) The Baltic Sea region countries tend to have trade relations with countries with higher GDP. Hence, the size of economy of exporting and importing countries, which is expressed by the total GDP, influences bilateral trade flows positively. The level of economic development that is expressed by GDP per capita does not have a statistically significant influence on bilateral trade flows. Statistical estimators are the best in the cases of using GDP (PPP).

2) Distance influences international trade flows: the larger the distance between the trading countries, the smaller the trade flows. Statistical estimators are the best in the cases of using flight distance.

3) Being a trading partner, a EU country has a positive impact on the bilateral trade flows. Being a trading partner, a candidate of the EU enlargement, or a FSU country does not have statistically significant influence on bilateral trade flows.

1 Similar results are obtained using White's heteroskedasticity-consistent co-variance matrix estimator.

The gravity models have strong power in explaining trade pattern and testing hypotheses, but the modeling results are not very reliable if we want to estimate the level of trade flows in absolute terms. This statement is also expressed by *Gros* and *Conciarz* (1996). Hence, it is not reasonable to use gravity equations to forecast bilateral trade flows. Based on the modeling results, it is first of all recommendable to pay attention to the cases where bilateral trade has good potential for development.

Table 10: WLS estimators of the gravity model 3

Variables	Coefficients (B_i)	Standard error (*se*)	*t*-statistic	Significance (*p*)
Constant	0.749	6.042	0.124	0.902
$Ln(GDPP)_I$	0.572	0.103	5.563	0.000
$Ln(GDPP)_j$	0.633	0.067	9.478	0.000
$Ln(GDPPPC)_i$	-0.007	0.489	-0.014	0.989
$Ln(GDPPPC)_j$	0.105	0.162	0.646	0.520
$Ln(DISTPL)_{ij}$	-1.457	0.187	-7.792	0.000
Dummy 1 (D_1)	0.641	0.279	2.295	0.024
Dummy 2 (D_2)	-0.309	0.484	-0.638	0.525
Dummy 3 (D_3)	-0.061	0.483	-0.126	0.900

Source: Author's estimations using statistical package SPSS

The estimated trade flows (based on the model 6) between the Baltic Sea region countries are presented in Table 11.

If we look of the results of modeling, it is possible to summarize that transitional countries have good potential for developing their export first of all to the industrialized countries of the region. All five transitional countries of the region (Estonia, Latvia, Lithuania, Poland, Russia) have good potential to develop export relations with the Scandinavian countries. The industrialized countries of the region have already established good bilateral trade relations, and they have good potential to develop their export mostly to the transitional countries. Hence, the results of modeling international trade flows between the Baltic Sea region countries based on the data 1998 enable us to conclude that industrialized countries and countries in transition have good potential for developing bilateral trade relations. This conclusion is in accordance with the general trend in the development of international trade that has been expressed by the rapid growth of the East-West trade relations in recent years.

Table 11: Estimated trade flows between the Baltic Sea region countries in 1998, millions USD

From To	Est.	Latv.	Lith.	Pol.	Den.	Norw.	Swed.	Finl.	Rus.	Germ.
Estonia		78 (--)	42 (--)	72 (*)	156 (+)	109 (+)	602 (+)	4111 (++)	228 (--)	522 (+)
Latvia	77 (--)		134 (-)	199 (*)	217 (+)	116 (+)	533 (++)	522 (+)	280 (--)	805 (+)
Lithuania	44 (--)	101 (--)		504 (+)	260 (*)	118 (++)	413 (+)	351 (+)	418 (--)	1205 (+)
Poland	82 (-)	47 (--)	82 (-)		1701 (+)	578 (+)	1610 (+)	1000 (+)	1258 (-)	11993 (-)
Denmark	75 (-)	182 (+)	42 (--)	711 (*)		1160 (-)	1975 (--)	699 (-)	515 (++)	12192 (+)
Norway	103 (+)	88 (++)	147 (++)	473 (++)	2274 (-)		3804 (-)	704 (-)	614 (++)	4739 (*)
Sweden	289 (-)	260 (+)	154 (+)	673 (*)	1977 (--)	1942 (--)		2765 (-)	881 (+)	4902 (--)
Finland	1924 (++)	340 (++)	221 (++)	407 (+)	681 (--)	526 (-)	2695 (-)		4075 (+)	8708 (-)
Russia	214 (--)	69 (--)	136 (--)	1028 (-)	1008 (+)	612 (++)	1723 (++)	2126 (-)		7241 (-)
Germany	292 (-)	294 (-)	110 (--)	5833 (-)	14201 (+)	2815 (-)	5705 (-)	2705 (-)	2730 (--)	

(++) - the estimated trade flows are at least two times higher than the real trade flows
(+) - the estimated trade flows are less than two times higher than the real trade flows
(*) - the estimated trade flows are almost in accordance with the real trade flows
(--) - the estimated trade flows are at least two times or more lower than the real trade flows
(-) - the estimated trade flows are less than two times lower than the real trade flows

Source: Author's estimations

In order to evaluate the reliability of modeling results, it is important to analyze how stable the results in time and also in specification of the models are. Based on the main assumption of the gravity approach for exploring bilateral trade flows and on the use of trade flows and GDP data of the year 2000 (IMF data) the equation (6) is estimated with two following dummies:

- *DUMMY 1* – trade partners are both EU countries ($D_1=1$; EU dummy).
- *DUMMY 2* – trade flows are between the industrialized and transitional countries of the region, ($D_2=1$; East-West dummy).

Dummies are selected in order to test the hypothesis that the Baltic Sea region countries' East-West trade relations have been actively developed in 2000, two years after

Russian crisis 1998. This hypothesis is set based on the modeling results presented in the Table 11. The results of estimations that base on the data of 2000 are presented in table 12 (White's heteroskedasticity-consistent covariance matrix estimators).

Table 12: Estimators of the gravity equation (6) based on IMF data 2000

Variables	Coefficients (*B*)	Standard error (*se*)	*t*-statistic	Significance (*p*)
Constant	25.725	4.690	5.491	0.000
$Ln(GDP)_I$	0.213	0.022	9.495	0.000
$Ln(GDP)_j$	0.164	0.023	7.265	0.000
$Ln(GDPPC)_I$	-0.377	0.160	-2.362	0.021
$Ln(GDPPC)_j$	-0.107	0.159	-0.672	0.503
$Ln(DISTPL)_{ij}$	-1.101	0.213	-5.180	0.000
Dummy 1 (D_1)	0.025	0.106	0.237	0.814
Dummy 2 (D_2)	-0.589	0.210	-2.799	0.006

R^2=0.697, $R^2_{adjusted}$ = 0.671, F=26.915, p=0.000
Source: Author's estimations using statistical package Eviews

The results of estimating are stable but also a bit surprising regarding the sign of the dummy 2. It is possible to summarize that despite of quick orientation of the Baltic Sea region transitional countries to development of their trade relations with the industrialized countries of the region (particularly during the recent two years after Russian crisis 1998), the East-West trade relations are still less developed than trade relations between the EU countries of the region. Analyzing estimated trade flows and comparing predictions with the actual trade flows in 2000, it can be concluded that there is still good potential for developing future trade relations between the industrialized and transitional countries of the region. Most of the Baltic Sea region countries have good potential for developing trade relations also with Russia.

To sum up, based on modeling results exploring bilateral trade relations of the Baltic Sea region countries in 1998 and 2000, it can be summarized that the modeling results are rather stable and in accordance with the modeling Estonian trade flows between its main trading partners in 1997. The modeling results also support the statement that regional integration effect is particularly significant for small countries, but it also plays a remarkable role in integrating transitional and industrialized countries of the region. During the last two years after the Russian crisis, the Baltic states and Poland actively developed their trade relations with the industrialized countries of the region, but the

East-West trade relations are still less developed than trade relations between the EU countries (and Norway) of the region.

6 CONCLUDING REMARKS

Empirical results of using gravity approach for exploring changes in the international trade pattern allow us to summarize that the knowledge resulting from some laws of nature are also applicable for exploring economic processes. The principles of gravitation could be used for estimating bilateral trade flows and analyzing regional integration in the field of foreign trade. Despite its simplicity, the gravity model explains the actual pattern of trade flows empirically remarkably well. The advantages of using gravity models to examine the international trade pattern are 1) data needed for the model are easily accessible and reliable, 2) theoretical considerations of using these models to explore the international trade flows have been widely discussed and they are still developing. There is a lot of literature about theoretical foundations of gravity models to explore foreign trade flows; and empirical studies certainly support better understanding and development of these theoretical foundations, particularly in conditions of interdependence between transition and integration processes of countries with different economic and political background. The latter is a typical feature of the Baltic Sea region.

The gravity models for analyzing the trade flows between the Baltic Sea region countries have been elaborated paying special attention to exploring the attraction forces of the bilateral trade flows and the influence of distance as an indicator that expresses both transportation costs and cultural proximity of the countries. The results of the study support the statement that the size of economy, which is expressed by the total GDP of the trade partners' countries, has statistically significant and positive influence on the bilateral trade flows of the region. The influence of economic development level that is expressed by GDP per capita is statistically insignificant. Distance has a negative impact on trade flows. The Baltic Sea countries have actively developed foreign trade relations with the nearby countries. In the case of the Baltic regional integration, distance is expressing most significantly cultural proximity and historical relationship between the countries of the region.

The processes of regional integration between the transitional and industrialized countries have positively influenced the development of the Baltic Sea region trade. The

development of mutually beneficial economic co-operation with the capital-abundant industrialized countries of the region has positively influenced the economic environment of the Baltic economies in transition and has created conditions that support their economic restructuring and rise of competitiveness. The development of economic co-operation within the Baltic Sea region is also important for their admittance into the European Union and for establishing the institutional base for integration.

The industrialized countries of the region have got the experience of how to penetrate new markets and how to develop economic co-operation with Russia and other former socialist countries and to adjust with the EU eastward enlargement processes. The results of the study support the statement that the favorable location of the Baltic Sea region between East and West and the dynamic interdependence between transition and integration processes will have an important role in the future development of the region.

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