THESIS ON ECONOMICS H30

Developments and Determinants of Intra-Industry Trade in the Baltic States

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Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for any academic degree.

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MAJANDUS H30

Majandusharusisene kaubandus Balti riikides: areng ja mõjutegurid

ALEKSEI NETŠUNAJEV

TTÜ KIRJASTUS

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ABBREVIATIONS

ADF test	Augmented Dickey-Fuller test
CEE	Central and Eastern Europe
CIS	Commonwealth of Independent States
EU	European Union
FDI	Foreign Direct Investment
FE	Fixed Effects
GDP	Gross Domestic Product
GHM approach	D. Greenaway, R. Hine and C. Milner approach
GL index	Grubel-Lloyd index
GMM	Generalized Method of Moments
HIIT	Horizontal Intra Industry Trade
H-O model	Heckscher-Ohlin model
HS	Harmonized System
IIT	Intra Industry Trade
RCA	Revealed Comparative Advantage
RE	Random Effects
TC	Trade Coverage
TIIT	Total Intra Industry Trade
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UV	Unite Value
VIIT	Vertical Intra Industry Trade
WTO	World Trade Organization

INTRODUCTION

Intra-industry trade (IIT) refers to the simulataneous import and export of similar products belonging to the same industry. Intra-industry trade plays a very important role in trade patterns, particularly in relation to transition countries mainly for two reasons. First, it is often considered a measure of product integration between markets and provides evidence on the level of integration into the world economy. Second, it is a proxy for the intensity of possible factor adjustments fostered by trade expansion. If as the results of trade integration countries exchange different varieties of the same type of good, then capital and labour should not be reallocated from a struggling import-competing sector to an expanding export sector, but simply reshuffled within a given sector. Hence adjustment costs for the economy are usually lower in the latter case (Grubel and Lloyd, 1975). For that reasons understanding IIT dynamics is of practical use.

It should be pointed out that classical Ricardian models provide no explanation of intra-industry trade. Under the assumptions of Ricardian models countries with identical factor endowments would only produce goods domestically. Therefore intra-industry trade is described by a number of so called new trade theories which are based on assumptions different from the classical trade models. Intra-industry trade of two types usually occurs: trade of horizontally differentiated goods and trade of vertically differentiated goods. Horizontal IIT (HIIT) is the exchange of commodities differentiated by attributes other than quality. The models of HIIT are considered of greater relevance to trade among the developed countries. The models of vertical IIT (VIIT) are considered to reflect trade flows between developed and developing countries. VIIT occurs according to Hechsher-Ohlin model logic, based on comparative advantages and depending on resource endowments and factor proportions. Models explaining HIIT are very different from the Ricardian and Heckscher-Ohlin (H-O) type models and are based on an imperfectly competitive market structure. Krugman (1979) and Lancaster (1980) made major contributions to the development of the new trade theories, and they related IIT to imperfect competition and economies of scale. Krugman (1979) argues that intra-industry trade allows countries to specialise in limited varieties of final goods without reducing the varieties available to consumers. Therefore, different country characteristics are important as the determinants of either vertical or horizontal IIT.

The aim of the thesis is to study IIT dynamics and econometrically assess its determinants for the Baltic countries. In the present thesis, the author limits the analysis with a homogeneous region of the Baltic countries, which were transition countries in the recent past. The Baltic countries appear to be a group with a unique economic background that makes them an interesting research subject in the field of international trade for the following reasons.

The Baltic countries are unique in the sense that during Soviet times trade flows were almost completely orientated to the East. Other Central and Eastern

European (CEE) countries during the so-called Iron Curtain period had some foreign trade activities with Western countries. After the fall of the Soviet Union, the Baltic countries experienced a rapid structural reorientation of trade flows from Eastern to Western countries, while the reorientation was not as dramatic in the other CEE countries. The region experienced the highest gross domestic product (GDP) growth in 2004-6, compared to the other new members of the European Union.

Although the Baltic States have much in common, but there are some important differences. Estonia positions itself as a part of Northern Europe, whereas Latvia and Lithuania tend to look towards Central Europe more. Therefore, although at first glance a homogeneous region, the Baltic States may have heterogeneity in IIT.

In empirical trade literature, one can find a substantial bulk of research on the determinants of intra-industry trade. Authors are mainly interested in the analysis of IIT in developing countries. The vast majority of papers are based on panel data analysis (Veeramani, 2002; Kandogan, 2003; Fertö, 2005a). Those papers concentrate on testing trade theory-based hypotheses related to country-specific factors and IIT. These factors include cross-country differences in income distribution, market size, and physical and human capital endowments (Krugman, 1979; Flam and Helpman, 1987; Falvey and Kierzkowski, 1987; Shaked and Sutton, 1984).

The author's research of the dynamics and determinants of the IIT of the Baltic countries using different estimation techniques is summarized in the following three published papers:

1. Fainštein, G. and Netšunajev, A. 2010. Foreign Trade Patterns between Estonia and the EU. – *International Advances in Economic Research*. 16(3): 311-324.
2. Fainštein, G. and Netšunajev, A. 2011. Intra-Industry Trade Development in the Baltic States. – *Emerging Markets Finance and Trade*. 47(04S3): 95-110.
3. Netšunajev, A. 2012. Intra-Industry Trade in the Baltic States: Long run Analysis. – *Journal of Business and Economics*. 3 (2): 107-116.

The three papers can be though of a step by step deepening analysis of IIT in the region. In **the first paper**, the focus is on the development of the foreign trade flows between Estonia and the EU. The paper gives a brief overview of the recent economic history of the region and of Estonia particularly, analyzes dynamics of its trade flows and dynamics of IIT. **The second paper** investigates intra-industry trade dynamics for Estonia, Latvia, and Lithuania in 1999-2007. IIT indices are computed and decomposed into its vertical and horizontal components. Using conventional panel data analysis, three static models and a dynamic model of IIT determinants are estimated. In fact, the standard panel data estimates could be subject to criticism for a number of reasons. For example, problems with the estimation and its interpretation can arise due to some properties of the data and homogeneity restrictions. Therefore in **the third paper** the author relaxes some of previously used econometric assumptions. That allows investigating intra-industry trade long run homogeneous dynamics in the Baltic countries. Five possible theory-based long run relationships are estimated and discussed.

The contribution of the papers and hence the thesis to the existing literature **is empirical** and can be shortly summarized as follows.

- Constructed IIT indices quantify the extent to which bilateral imports and exports are matched within sectors for the Baltic countries and their five main trading partners.
- Standard econometric analysis reveals that differences in human capital are significant in explaining IIT.
- IIT is shown to be a persistent process for the Baltic States.
- There is evidence in favour of long run effects, particularly of factor endowments and market size on various forms of IIT.

A number of **policy oriented conclusions** can be drawn from the analysis. The share of IIT in the Baltic countries is somewhat higher then on average in the world, but lower then the high income countries usually enjoy. Therefore there is a place for improvement and governmental support for the industries with high IIT potential. Different support channels can be considered, for example governmental educational decisions, e.g. development of professional education and university curricula and educational orders should take into account possibilities to contribute to the development of the industries with IIT potential. Also promotion of business and entrepreneurship on the state level must not neglect possible contribution of the industries to the IIT.

The first and second papers are written in collaboration with Grigori Fainštein. Contribution of the author to the first paper is in the section on IIT, the computations in that section are entirely done by the author of the thesis. The author also contributes to the computations of the second paper. Particularly, the author was in charge of obtaining IIT for the countries as well as for the section on dynamic panel estimation. The texts for both papers were written jointly.

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FOREIGN TRADE PATTERNS BETWEEN ESTONIA AND THE EU

The extremely open Estonian economy very much depends on the foreign trade. Hence, understanding the main factors behind the structural development of Estonian trade is an important condition for effective macroeconomic and industrial policy.

The important factors in Estonian economic openness are its advantageous geographical location and remarkably liberal trade regime. In the early 1990s, the ratification of bilateral free trade agreements formed the legislative basis for the development of trade with both EU members and, at that time, the potential EU members. Estonia signed The European Agreement (Association Agreement) in June of 1995, which came into force in February 1998. The economic sense of the agreement was to abolish all trade barriers (if there were any) to industrial products and to create a formal free trade area between Estonia and the EU. The transition period for the agreement was not implemented because Estonia already operated with a liberal trade policy and had very marginal import taxes. Estonia has been a member of the WTO since 1999 and a member of the EU since 2004 – in both roles helping to implement common foreign trade policies.

Reorientation in trade flows from the former Soviet to European partners took place very quickly in the early 1990s. The shares of European exports and imports are quite stable, but the volume of trade has exploded. In 1995, European imports amounted to 21.5 billion Estonian kroons[1], and in 2007, this reached 140.5 billion Estonian kroons. Estonian exports to European partners amounted to 13.4 billion Estonian kroons in 1995 and reached 87.9 billion Estonian kroons in 2007.

It is necessary to specify the ways in which the geographical reorientation of foreign trade occurred. One should distinguish between trade diversion and trade creation. The terms were first introduced by Jacob Viner (Viner, 1950). Trade diversion is defined as a shift in trade from a more efficient supplier outside the customs union towards a less efficient supplier within the union. On the other hand, trade creation means that a customs union creates trade that would not have existed otherwise.

To study the actual trade diversion at a disaggregated level, the Finger-Kreinin coefficient is calculated. One can observe a decreasing similarity of exports meaning that no essential trade diversion occurred in export flows in 1993-2002. This can partly be explained by the trade creation with the western countries based on FDI inflow, which made the structure of exports to the EU diverge from that of CIS countries. The import similarity also declined. This indicates that the main import articles from Eastern markets have remained unchanged, and the

[1] Estonia has euro as the official currency from January 1, 2011. Exchange rate 1 euro = 15.6466 Estonian kroons

growth of imports from the West has occurred due to the expansion in other commodity groups.

Comparative advantage is the central concept in explaining the foreign trade patterns. Recent empirical works in this field are concentrated on measuring comparative advantage (see Hoen and Oosterhaven 2004; Moenius 2006), analyzing its dynamics (see Young, 1991; Fertö, 2007), and factor endowments as a main determinant according to Heckscher-Ohlin model (Findlay, 1970). The most common measure of a country's comparative advantage is the Balassa index of revealed comparative advantage (RCA) (Balassa, 1965).

The RCA index is calculated for Estonian trade data. The commodity groups with the highest comparative advantage on the EU market are wood and articles of wood, furniture, bedding, mattresses, etc., electrical machinery, dairy products, other made-up textile articles, cotton and articles thereof, articles of iron or steel, articles of apparel and clothing accessories, etc. In 1995-2007, comparative advantage in the EU market for most of the commodity groups decreased. The RCA increased for such groups as oil seeds and oleaginous fruits, explosives, pyrotechnic products, wood pulp, printed books, carpets and other textile floor coverings, glass and glassware, and furniture.

Another indicator of a country's comparative advantage is the trade coverage ratio (TC). It is defined as a ratio of a country's exports of a given commodity group to the country's imports of the same commodity group. According to the distribution of Estonian exports by TC and RCA values, the following biggest commodity groups have both an internal and external comparative advantage on the EU market: fish and crustaceans, dairy products, wood and articles of wood, articles of apparel and clothing accessories etc., other fabricated textile articles, other base metals; cermet; articles thereof and furniture, bedding, mattresses, etc. There is strong export growth potential for the following groups: cereals, preparations of meat, fish, or crustaceans, tanning or dyeing extracts, ships, boats, and floating structures.

To analyze the factor intensity of Estonian trade flows with the EU, the approach developed in UNCTAD (2002) is used. According to this approach, commodities are grouped into six categories: primary commodities, labour-intensive and resource based manufactures, manufacturing with low skill and technology intensity, manufacturing with medium skill and technology intensity, manufacturing with high skill and technology intensity, and unclassified products. Results show that the specialization is mainly located in primary commodities and manufacturing with medium skill and technology intensity. Specialization increased in primary commodities and decreased in manufacturing with medium skill and technology intensity.

Next, intra-industry trade is analyzed. Intra-industry trade plays a very important role in the trade patterns, especially in that of transition countries and is often considered as a measure of product integration between the markets. Horizontal IIT is the exchange of commodities differentiated by attributes other than quality. The models of horizontal IIT are considered to be of greater relevance to trade among developed countries. The models of vertical IIT are considered to reflect trade flows between developed and developing countries.

The models explaining horizontal IIT are very different from the Ricardian and Heckscher-Ohlin type models and are based on an imperfectly competitive market structure. Vertical IIT occurs, according to the H-O model, based on comparative advantages and depends on resource endowments and factor proportions.

The common measure of the level of intra-industry trade is Grubel-Lloyd (GL) index (Grubel and Lloyd 1975). The methodology to disentangle horizontal and vertical components was introduced by D. Greenaway, R. Hine and C. Milner (1994, 1995). Therefore, it is referred to in literature as the GHM approach. It is based on the assumption that the gap between the unit value (UV) of imports, and the UV of exports for each commodity reveals the type of trade, as relative prices reflect relative quality (Stiglitz, 1987). The distinction between vertical and horizontal IIT in the empirical work is based on a dispersion factor (Greenaway et al., 1994). After testing for different dispersion factors the authors adhere to $\alpha=0.15$.

A disaggregated Harmonized System (HS) 8-digit level set of data on the trade flows between Estonia and EU countries for the period 1999-2007 is used. Data originates from the Eurostat e-database. The GL indices are computed for the entire set of commodities, further, the indices are aggregated. The highest level of aggregation is 21 sections of Harmonized System. Total IIT dynamics show minor fluctuations in the years 1999-2003. In the period 2004-2007, total IIT increased. Vertical IIT shows similar dynamics as a total IIT. In general, it experiences a period of growth, although it falls once in 2006. Horizontal IIT is around 0.1 before 2004 and afterwards stabilizes at around 0.14. In general, the share of vertical IIT is significantly higher than the share of horizontal IIT. That is consistent with the findings of other contributors (c.f. Fertö 2005b, Fontagné et al. 2006). Vertical IIT experienced greater growth (33.3%) than horizontal IIT (27.7%), if comparing relevant shares in 1999 and 2007. Within this period, the common year for the increase in IIT to start is 2004.

Next, the commodity composition of IIT is presented. Within the analyzed period, the share of IIT has decreased for the whole set of commodities: products of the chemical or allied industries (section 6), wood pulp or of other fibrous cellulosic material, paper (section 10), optical, photographic, cinematographic, measuring, checking, precision, medical, or surgical instruments, and apparatus, clocks and watches, musical instruments (section 18), works of art (section 21). For other sections, a share of IIT increased.

INTRA-INDUSTRY TRADE DETERMINANTS IN THE BALTIC COUNTRIES

The idea of IIT was first introduced in the 1960s. Simultaneous import and export within an industry was initially observed for Belgium, the Netherlands, and Luxembourg (Benelux) by Verdoorn (1960). Since then, the concept of IIT has made enormous steps forward and is known to be very important in contemporary trade studies. Recent data show that 27-44 percent of global trade, depending on the level of aggregation used in estimations, is intra-industry (Brühlart, 2008). Previous studies show that nine of the top-ten bilateral IIT flows exist in the European Union (Fontagné et al., 2006, p. 467).

Returning to established papers on IIT, Grubel and Lloyd (1975) in their empirical study of trade flows showed that among major industrialized countries trade flows exist within the same industries, which trade theories of that time, such as Ricardian and Heckscher-Ohlin (H-O), could not explain. This fact resulted in the development of new formal trade theories to explain the nature of IIT.

Horizontal IIT is the exchange of commodities differentiated by attributes other than quality. The models of HIIT are considered of greater relevance to trade among the developed countries. The models of vertical IIT are considered to reflect trade flows between developed and developing countries. Models explaining HIIT are very different from the Ricardian and H-O-type models and are based on an imperfectly competitive market structure. VIIT occurs according to H-O model logic, based on comparative advantages and depending on resource endowments and factor proportions. Therefore, different country characteristics are important as the determinants of IIT in the two types of models.

Krugman (1979) and Lancaster (1980) made major contribution to the development of the new trade theories, and they related IIT to imperfect competition and economies of scale. They focused on the simultaneous export and import of products of the same type and similar quality, which is what now called HIIT. In Krugman's (1979) model the supply side consists of a large number of firms, each producing a particular variety of the product under increasing returns. On the demand side, individuals consume varieties of goods, and any new differentiated good available on the market enters the consumer's basket. International trade in this model creates a larger integrated market in which intra-industry specialization between countries may enable firms to reduce unit costs and access to a larger number of varieties increases consumer welfare. Krugman demonstrates that the interaction between economies of scale and horizontal product differentiation may cause international trade between countries with the same technology and factor endowments.

Other influential contributions are made by Falvey (1981) and Falvey and Kierzkowski (1987). The latter developed a model in which intra-industry trade was driven by vertical product differentiation, import and export of similar products were distinguished by quality differences. Their models differ from the standard H-O model in the way that differences in factor endowments explain intra-industry rather than inter-industry specialization.

Flam and Helpman (1987) introduce a similar model of intra-industry trade in vertically differentiated products. In the model they operate with North and South countries that are different in technology, income and income distribution. The main difference from Falvey and Kierzkowski (1987) is that they use labor as a single factor of production. Resources are used to produce two goods, one good is homogenous and the other is differentiated. Higher quality commodities are characterized by relatively higher input of labor used in their production. On the demand side consumers with higher labor endowments demand a higher quality differentiated commodity. The pattern of VIIT reflects differences in technology and in income distribution.

In the empirical studies, one did not distinguish between vertical and horizontal components of IIT over time but, instead, used the total share of IIT. Greenaway et al. (1994, 1995) were among the first to separate IIT into its vertical and horizontal components empirically. Recent studies show that VIIT plays a very important role in the trade flows of countries (Crespo and Fontoura, 2004; Fertö, 2005b; Fontagné and Freudenberg, 1997; Greenaway et al. 1994, 1995). The common measure of the level of IIT is the Grubel–Lloyd index (Grubel and Lloyd 1975):

The methodology to disentangle horizontal and vertical components was first introduced by Greenaway et al. (1994, 1995) and is therefore known in literature as the *GHM* approach. It is based on the assumption that the gap between the unit value of import and the UV of export for each commodity reveals the type of trade, as relative prices reflect relative quality (Stiglitz, 1987). At first, Greenaway et al. calculate overall IIT for the UK using an unadjusted *GL* index and then divided it into horizontal and vertical components based on the relative unit values of export and import.

According to Crespo and Fontoura (2004), the general unit value approach has some shortcomings. First, consumers may buy expensive products for reasons other than quality, at least in the short run. Second, values of two bundles may differ if the mix of products differs, so that one bundle contains a higher proportion of high unit value items than the other. Another problem often mentioned is some possible randomness in the choice of the dispersion factor. (Kandogan, 2003). Nevertheless, the unit value approach is widely accepted and used in the contemporary empirical literature.

Taking into account the structural reforms and the fact that Baltic countries are at a lower economic development level than the majority of the main trading and FDI inflow partners, IIT for the Baltic States is expected to increase and VIIT is expected to have a higher share than HIIT. Two sets of trade data on the Baltic States' trade flows is used. The first one is disaggregated data at the HS eight-digit level on the Baltic States' total imports and exports for the period 1999-2007. The second set of data covers disaggregated trade at the HS eight-digit level between the Baltic States and their relevant top-five export partners. This set of data is used to compute shares of IIT, VIIT, and HIIT for pairs of trading partners. Data are obtained from the Eurostat database. The *GL* indexes are computed for the whole set of commodities of the Baltic States. The highest level of aggregation is based on HS sections.

In Estonia, VIIT increased from 0.19 to 0.24 and HIIT from 0.10 to 0.14 during the observed period. Estonia had the highest share of TIIT in 2007. In Latvia, VIIT increased from 0.14 to 0.25, while HIIT increased from 0.07 to 0.09. In Lithuania, VIIT increased from 0.16 to 0.18, while HIIT increased from 0.07 to 0.14. In Estonia and Latvia, growth of VIIT mainly contributed to the growth of TIIT, while in Lithuania HIIT was the main engine behind the increase in TIIT. Therefore, the economic mechanism of the process is different. On the one hand, the increase in IIT in Estonia and Latvia was due mainly to comparative advantage and depended on factor endowments of these two Baltic countries. On the other hand, in Lithuania scale economies and increasing returns drove IIT through its horizontal component. In 2007, the gap between VIIT and HIIT was lowest in Lithuania.

The commodity decomposition and therefore IIT oriented sectors of economies are different in the Baltic states. This could be due to historical reasons, geopolitical reasons and other reasons that affect the development of economic connections between the countries.

A number of testable hypotheses relating to country-specific factors and IIT can be drawn from theoretical models. These factors include cross-country differences in per capita income, income distribution, market size, physical and human capital endowment. The determinants of total IIT and its vertical and horizontal components using different econometric models are analyzed. As a dependent variable, previously computed shares of IIT are used.

Data for the analysis are from www.nationmaster.com for GDP, GDP per capita, and electricity consumption; www.indo.com for distance calculation; United Nations University data on Gini coefficients; UNESCO Institute for Statistics and UN data on education expenditure; Estonian, Latvian, and Lithuanian Statistics Office data for GDP and GDP per capita for the last year of our estimations. In the empirical literature, cross-section and panel data analysis are primarily used. In the estimations, panel data and dynamic panel data analysis are used to capture cross-country and time-dependent effects.

A panel of trade flow between the Baltic States and five main trading partners for 1999-2007 is utilized for the analysis. Three static panel data models using fixed effects (FE) and random effects (RE) and a dynamic panel data model have been estimated. Considering static panel data models, in order to choose between either FE or RE estimates, Hausman tests were conducted. The test did not provide convincing evidence for or against one of the models. The FE results are not appealing, and are hard to explain economically. Therefore, the RE models are used.

The first model considers the simplest gravitation model approach and follows Kandogan (2003). Regression results reveal that all variables are statistically significant for TIIT and HIIT. The GDP of the partner country has an unexpected sign. One possible explanation could be the lower economic growth of partner countries compared to the growth rate of Baltic States. GDP and distance are the most important factors in HIIT development. GDP captures the market size of a country and therefore shows the importance of scale effect in HIIT. Distance is also more important in explaining HIIT than VIIT, as VIIT includes technological cooperation.

In the next model, additional variables to capture factor endowment according to the H-O approach are included. For HIIT, factors of increasing returns dominate, and therefore, a negative sign of factor endowment variables is expected. The similarity and product differentiation of countries are the main factors of this type of trade. In this specification, a high significance of difference in human capital for TIIT and HIIT, with the expected sign, is observed. The differences in physical capital and income distribution variables have the expected sign for VIIT, but are not statistically significant. The dummy variable for the EU country is statistically significant for VIIT but has an unexpected sign. The market size and distance variables are significant and have the same signs as in the previous model.

In the third specification, following Brühlart (2008), GDP variables are replaced with variables of average GDP and absolute difference in per capita GDP between trading partners. The first one captures the market size and the second the factor endowment difference. The results suggest that the market size variables have the expected sign and are significant for TIIT and HIIT. The variable of the difference in per capita GDP between trading partners is statistically insignificant.

Finally, a dynamic panel data model is estimated to check the persistence of the IIT process and analyze whether there could be some uncaptured effect of factor endowment variables. The tests reveal some possible problems with the approach. For instance, tests for second-order autocorrelation show that it could be present in the TIIT specification. But, in general, the estimates seem appealing and economically sensible. It is quite difficult to determine the exact effect of factor endowment variables on IIT, though a positive effect of difference in educational spending per capita is certain. The effect is of a higher magnitude for HIIT than for VIIT. The process of IIT and TIIT is highly persistent. A positive effect of difference in the Gini indexes could be plausible for HIIT and a positive effect of differences in physical capital and income distribution could be plausible for TIIT.

Admittedly, some weaknesses of the study may be pointed out. First, the *GHM* approach for computing the IIT and decomposing it into HIIT and VIIT is subject to criticism. The approach builds upon the comparison of import and export unit values, where the threshold for a trade flow to be HIIT or VIIT might be said to suffer from randomness. Second, there may be an identification problem, as the GDP of the trading partner has an unexpected sign in all the static panel data models. Some specifications of dynamic panel data suffer from second-order correlation, and there is some evidence against the validity of the instruments used.

LONG RUN ANALYSIS OF THE INTRA-INDUSTRY TRADE

In the empirical trade literature, one could find a substantial bulk of research on the determinants of intra-industry trade. Authors are mainly interested in the analysis of IIT in developing countries. The vast majority of the papers are based on panel data analysis (Fertö, 2005a; Kandogan, 2003; Veeramani, 2002). Those papers concentrate on testing trade theory-based hypotheses related to country-specific factors and IIT.

In the above-mentioned empirical papers, the conventional static panel data models are used. As an outcome of the estimation, one could obtain standard pool estimates, fixed and random effects estimates where only intercepts could be allowed to differ across groups (see e.g. Green (2011) for a textbook exposition). In fact, these pooled models could be subject to criticism for a number of reasons. For example, problems with the pooled estimation and its interpretation could arise due to some properties of the data and homogeneity restrictions.

Suppose one is interested in the dynamics of economic relations in the panel data context. That may complicate estimation substantially, as the data may be subject to a serial correlation, heteroskedasticity and endogeneity of explanatory variables. The solution to the majority of the aforementioned complications was found by Arellano and Bond (1991), who developed the consistent estimator based on the generalized method of moments (GMM).

GMM estimation methods for the dynamic panels proposed by Blundell and Bond (2000) could be used to eliminate the unobserved, say industry specific effects through the equations in first-differences. The GMM estimator also controls the endogeneity of the explanatory variables using the lags of those variables as valid instruments in the case of an absence of serial correlation. Some recent empirical IIT papers took advantage of the methods and used the dynamic properties of the panel data (Faustino and Leitao, 2006; and Fainštein and Netšunajev, 2011). These papers suggest that IIT is a persistent process and the results obtained in the papers tend to confirm theoretical predictions of the effects of increasing returns and H-O factors on IIT.

However, the interpretation of the estimated dynamic panel may be somewhat limited. Namely, the short run dynamics and error variances are assumed the same across groups. Note that in the studies of IIT it may not be a valid assumption. As groups are usually pairs of trading partners, the short run dynamics may be quite different across the groups. One could regard it as different short-run reaction to some macroeconomic shocks. On the other hand, the long run equilibrium relationship between the variables could be similar across the groups. That is due to the fact that usually the countries of interest are taken from a specific economically integrated region. Sometimes, the groups may represent even the whole population rather than a sample from the population. Therefore, the countries may reach the same long-run equilibrium but with a different speed of adjustment. These are the main reasons why the standard pooling methodology is of limited use in the intra-industry trade context.

Having the discussion of common long run equilibrium relationship in mind, the objective is to look for an empirical model that would allow for relaxing the assumptions on short-run homogeneity and the homogeneity of error variances and estimating the common long run effects of factors on the IIT. That leads to the pooled mean group estimator proposed by Pesaran, Shin and Smith (1999). The empirical model setup closely follows Pesaran et al. (1999). To obtain the parameter estimates, a non-linear optimization procedure is adopted. The likelihood function is numerically maximized with respect to the parameters of interest. Understandingly, such a procedure may be computationally demanding and the results may depend on the starting values. To reduce the possibility that the optimization has ended up in a local optima, the maximization is performed for a whole range of starting values. Then the estimates that resulted in the highest likelihood are chosen. The standard errors of the parameters are obtained from the numerical approximation of the Hessian of the likelihood function evaluated at the optimum.

The data closely follows the work previously done by Fainštein and Netšunajev (2010) and Fainštein and Netšunajev (2011). The measures of the level of intra-industry trade calculated as Grubel-Lloyd index (Grubel and Lloyd, 1975) for the pairs of the Baltic countries and their 5 main trading partners are used as dependent variables. The index is decomposed into its horizontal and vertical component as suggested by Greenaway, Hine and Milner (1994). This gives 3 dependent variables for separate estimations: vertical IIT, horizontal IIT and total IIT.

The panel is constructed in the following way. The groups are 15 pairs of Baltic States and their five main trading partners (5 pairwise relations for each of the Baltic States). The time span is nine years (1999-2007). One could have used more recent data, but that is avoided due to the potentially extreme behaviour of the variables in the crisis period. Therefore, the panel consists of 135 observations in all.

The augmented Dickey-Fuller (ADF) tests for stationarity of the IIT series for each of the groups in the panel is conducted for the 1 lag and nonzero mean model. The test statistic values for all of the series are above the 5% critical values. That is the evidence in favour of the hypothesis that all IIT processes are not integrated of order zero. Further, the first differences in IIT series are stationary, giving good grounds for the use of error correction specification.

A word of caution should be given about the estimation procedure and potential results prior to the discussion of exact specifications and inference. Note that time span $T = 9$ is quite small for the panel used and the number of estimated parameters is quite large (more then 30). Therefore, there is a possibility of small sample distortions in the estimation. This feature complicates inference about the speed of adjustment and short run dynamics but, even with biased estimates, one could draw some relevant conclusions. The interest is in the long run effects and hence short run coefficients are not of significant interest.

The current interest is in the existence of the long run relationships between IIT and the theory based dependent variables. In what follows, five potential long run homogeneous relationships are distinguished. These are as follows:

1. There is a long run homogenous effect of market size.
2. There is a long run homogenous effect of the difference in income distribution.
3. The long run relationship is based on the effect of difference of human and physical capital.
4. The long run relationship is based on the effect of market size and factor endowments
5. The long run relationship is based on the effect of differences in factor endowments and income distribution.

Note that the first three specifications solely examine the dependency of IIT on market size, income distribution or factor endowments, whereas fourth specification controls for joint effects of market size and factor endowments and fifth for joint influence of factor endowments and income distribution.

The estimated mean adjustment coefficients are not very different across the models; they oscillate at around -0.3. Relatively large standard errors are due to the estimation precision and small sample issues. That means the estimates might be biased in the current case or, put differently, the estimates may represent the lower bound of the effects. Hence, the reader is invited to think of the results as of the estimated lowest possible effect.

The results for the first specification suggest that there is hardly a long run effect solely of the market size on IIT. The inference would be problematic due to high standard errors for both vertical and total IIT. Also, low *p*-values of the normality test for HIIT and TIIT could be an indication of a misspecification. A similar picture can be seen in the results for the second specification. The only exception is the long run relationship between income distribution and VIIT, which may be positive.

The estimated long run parameters for the third specification reveal that for the vertical IIT both factor endowment variables have high standard errors and therefore it would be hard to justify the long run effects behind. For both horizontal and total IIT, there is hardly a long run effect of the difference in human capital. But the long run effect of difference in physical capital represented by the difference in electricity consumption per capita should not be neglected. However, the *p*-values of the normality test for both HIIT and TIIT would suggest that the underlying distributional assumption may not be valid.

The next specification controls are for the effect of market size in addition to the factor endowments. First, note that the Jarque-Bera test (Jarque and Bera, 1987) fails to reject normality; hence, one is on a more solid ground with the inference. One could see that for vertical IIT both market size and difference in educational spending have a common long run effect. For horizontal and total IIT, all of the factors could be seen as having the long run effect.

Consider the last specification. Results only show strong evidence in favour of the normality assumption for vertical IIT. All factor endowment variables and income distribution have a long run effect on VIIT. The positive long run effect of the human capital endowment on VIIT is present for specifications 4 and 5, but it is of different magnitude. As to horizontal and total IIT, the inference is problematic due to low *p*-values, although the long run effect may be there.

To summarize the findings briefly, it is possible that neither factor endowments nor market size solely have a long run effect on the IIT in the Baltic countries. As for income distribution, it may have a positive long run effect on vertical IIT, though not on HIIT and TIIT. Therefore, it should be a combination of different factors that have a long run effect on IIT. That may be due to different reasons. First, the behaviour of the real data is different to what the theoretical models would imply and hence in reality it may be very well that the IIT is influenced by a combination of different factors. Second, the theory tells us about short run dynamics, though empirically long run effects are analyzed. Those may not coincide and in the long run the interaction of different factors may be more sophisticated then the short run dynamics.

Admittedly, the precision of the results in the present study may suffer due to numerical optimization of the likelihood function; however, the use of a range of starting values may reduce these concerns. The time span of the panel is short, which makes separate group-by-group estimation impossible. That leads to limitations in the robustness checks of some of the underlying assumptions.

CONCLUSIONS

In the first part of the thesis, the research is focused on the development of foreign trade flows between Estonia and the EU. To distinguish the trade diversion and the trade creation effects, the Finger-Kreinin coefficient of trade similarity of Estonian exports and imports to/from EU and CIS countries is used. As a result, a decreasing similarity of exports is documented, i.e., no essential trade diversion of exports occurred. The import similarity also declined. This indicates that the main import articles from the eastern markets are remaining unchanged and the growth of imports from the West occurred due to the expansion in other commodity groups.

The biggest commodity groups with the comparative advantage measured by the Balassa index on the EU markets are wood and articles of wood, furniture, bedding, electrical machinery, dairy products, other fabricated textile articles, cotton and articles thereof, articles of iron or steel, articles of apparel and clothing accessories, fish and crustaceans. The econometric analysis shows a clear despecialization tendency in trade with the EU in the analyzed period.

In the second part of the thesis, the dynamics of IIT in the Baltics is analyzed. In recent years, the share of IIT has had a general tendency to increase. VIIT plays a dominant role in trade flows. Previous papers have shown that the share of IIT should increase with trade liberalization. In the present study, similar dynamics for the Baltic States in 1999–2007 is observed. After foreign trade policy liberalization and structural economic reforms, trade flows in the Baltic States substantially increased.

The findings show that the share of TIIT in the Baltic States has significantly increased, though the structure of IIT is different in each country. While in Estonia and Latvia the increase in VIIT has resulted in the growth of TIIT, in Lithuania it was due to the growth of HIIT. As a trade and industry policy implication, Estonia and Latvia should support and develop sectors that contribute more to HIIT than to VIIT, which is based on factor endowments. Supporting sectors with potentially high HIIT trade will be especially beneficial for the countries and the region in general. The commodity composition of IIT is also different in each country.

The econometric analysis provides some evidence in favour of trade theory, but there may be some issues about which to be cautious. There can be an identification problem, as the GDP of the trading partner has an unexpected sign in all the static panel data models. Some specifications of dynamic panel data suffer from second-order correlation, and there is some evidence against the validity of the instruments used.

The results of the estimations mainly support the theoretical predictions of IIT determinants. Market size as a factor of increasing returns is important for the TIIT of the Baltic States. Transportation cost measured by distance is also an important determinant of IIT. This is more the case for HIIT. Among factor endowment variables supporting the H-O approach, the most significant for the IIT of the Baltic States is the difference in human capital endowment measured by the difference in per capita expenditure on education between countries.

The third part of the thesis exploits the properties of the heterogeneous panel and applies the pooled mean group estimation method to the case of intra-industry trade of the Baltic States. The idea is to estimate the long run relationship between horizontal, vertical and total IIT and theory-based economic factors such as market size, differences in factor endowments and differences in income distribution between the trading partners. For that purpose, five empirical models describing the relationships of interest are considered. The estimation is based on the autoregressive distributed lag model with nonlinear restrictions, which can be represented as a panel regression with the error correction term. The latter represents the long run effects of interest. The concentrated likelihood function is set up and the estimates of the long run parameters using nonlinear optimization are obtained.

The results could be briefly summarized as follows. Neither market size nor factor endowments by themselves have a homogeneous long run effect on IIT. That could be due to the more complicated nature of the IIT than just an influence of one factor or due to the differences across the Baltic States. Notwithstanding, the common positive effect of income distribution on vertical IIT may be present. Considering the effects of the combination of factors it is shown, that if controlled for the market size and factor endowments, then both have an effect on horizontal IIT and total IIT, while only market size and human capital endowment affect VIIT. The long run effect of human capital endowment is found for vertical IIT. It should be emphasized that the majority of the findings are in line with the theoretical predictions.

As an agenda for further research, one can look at more recent trade data and analyze how the recession has influenced the development of IIT in small open economies such as the Baltic countries. The situation may have changed considerably, as the crises influenced the exporting sectors in the Baltic economies. Reduced shares of IIT would indicate a diverting economic connections and potentially wrong policy reactions to the economic downturn. Another interesting project may look at the reaction of IIT on a number of macroeconomic shocks. That would require collecting quarterly data on trade transactions which may not be straightforward. A convincing way of identifying shocks of interest will be needed.

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APPENDIX 1. Foreign Trade Patterns between Estonia and the EU

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Foreign Trade Patterns Between Estonia and the EU

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Abstract In this paper, we focus on the development of the foreign trade flows between Estonia and the EU. We observe rapid reorientation of the trade flows from the former Soviet Union towards Western markets because of economic reforms and foreign trade liberalization. Moreover, we determine the commodity groups with a comparative advantage in the EU market and analyze its dynamics. Further analysis of the intra-industry trade (ITT) shows that vertical IIT plays a dominant role in Estonian-EU IIT flows. Shares of total, vertical, and horizontal IIT have grown rapidly since 2004, the year of accession to the EU.

Keywords Estonia · Comparative advantage · Vertical/horizontal intra-industry trade

JEL F15 · O57

Introduction

After re-establishing independence in 1991, Estonia began to implement structural economic reforms. The keyword of those reforms was reorientation- from the former Soviet market to Western markets and, especially, the EU market. This reorientation led to the liberalization of the economy and trade. The development of the foreign trade since the liberalization was more rapid than GDP growth, especially in the beginning of the transition process.

For the extremely open Estonian economy, foreign trade is the main engine of the economic growth. The Estonian foreign trade balance has been in deficit since 1994, and the deficit has grown more than 11 times. The main reason for this growth in

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deficit is the rapid growth of importing which was generated by a strong domestic demand for investment and consumption goods. Understanding the main factors behind the structural development of Estonian trade is an important condition for effective macroeconomic and industrial policy.

In this paper, we focus on the development of foreign trade flows between Estonia and the EU. The objectives are to analyze the nature and aspects of structural changes that occurred in trade flows from the beginning of the 1990s up to 2007 and to determine the factors behind these changes, including comparative advantage and intra-industry trade. We base our work on the statistical and econometric analysis of the data available on trade flows.

First, we analyze the dynamics of trade flows between Estonia and the EU. The next sections are devoted to Estonian comparative advantage and intra-industry trade. Both sections present theoretical framework as well as the empirical analysis. Conclusions follow in the final section of the paper.

Dynamics of Trade Flows Between Estonia and the EU

The Estonian economy is characterized by a high level of openness. The important factors in Estonian economic openness are its advantageous geographical location and remarkably liberal trade regime. In the early 1990s, the ratification of bilateral free trade agreements formed the legislative basis for the development of trade with both EU members and, at that time, the potential members. Estonia signed *The European Agreement* (Association Agreement) in June of 1995 which came into force in February 1998. The economic sense of the agreement was to abolish all trade barriers (if there were any) to industrial products and to create a formal free trade area between Estonia and the EU. The transition period for the agreement was not implemented because Estonia already operated with a liberal trade policy and had very marginal import taxes. The agreement ended up having more of a political and institutional influence. Estonia has been a member of the WTO since 1999 and a member of the EU since 2004—in both roles helping to implement common foreign trade policies.

In the beginning of the 1990s, rapid reorientation of the Estonian foreign trade from the markets of the Commonwealth of Independent States (CIS) to Western markets took place. Among the reasons for the trade reorientation in the beginning of the transition were the high inflation in Russia, the collapse of the system of payments, the introduction of import tariffs in Russia, the rise in prices of raw materials, and an unstable overall economic climate. The domestic consumer demand had also been oriented mostly towards Western imported goods. The reorientation could also be explained by the adjustment of the artificial structure of foreign trade with former Soviet states to a foreign trade structure naturally determined by factors of geopolitical location, comparative advantage, and foreign demand.

Table 1 presents the shares of export and import trade flows between Estonia and the EU and Estonia and rest of the world (ROW). Hereinafter, under the EU, we have summed up the trade flows between Estonia and European countries that are currently members of the EU. The straightforward conclusion is that the

Table 1 Distribution of Estonian export and import between EU and ROW, %

Flow	Partner	1991	1993	1995	1997	1999	2001	2003	2005	2007
Export	EU	15.3	64.1	70.38	77.63	85.66	80.83	82.43	77.79	69.93
	ROW	84.7	35.9	29.62	22.37	14.34	19.17	17.57	22.21	30.07
Import	EU	19.4	68.4	78.54	83.49	84.67	81.79	76.56	76.30	78.60
	ROW	80.6	31.6	21.46	16.51	15.33	18.21	23.44	23.70	21.40

Statistics Estonia. Statistical e-Database, authors' calculations

reorientation in trade flows from the former Soviet to European partners took place very quickly in the early 1990s. In 1993, the share of the European exports and imports had already reached 64.1% and 68.4% respectively.

If the shares of European exports and imports are quite stable, then the volume of trade exploded. In 1995, European imports amounted to 21.5 billion Estonian kroons, and in 2007, it reached 140.5 billion. Estonian exports to European partners amounted to 13.4 billion Estonian kroons in 1995 and reached 87.9 billion Estonian kroons in 2007.

It is necessary to specify the ways in which the geographical reorientation of foreign trade occurred. One should distinguish trade diversion and trade creation effect. The terms were first introduced by Jacob Viner (Viner 1950). Trade diversion is defined as a shift in trade from a more efficient supplier outside the customs union towards a less efficient supplier within the union. On the other hand, trade creation means that a customs union creates trade that would not have existed otherwise. As a result, the supply occurs from a more efficient producer of the product. In our case, the trade diversion is the growth in trade with western partners at the expense of decline in trade with eastern partners in their respective sectors. The opposite effect is the creation of new commodity flows to the western markets.

To study the actual trade diversion at a disaggregated level, we calculate the Finger-Kreinin coefficient (FK) as follows:

$$FK(i) = \sum_i [\min s(i,k), s(i,l)]$$

Where: s(i,k) and s(i,l) are the export/import share of sector i in export/import to/from markets k and l, respectively. The coefficient captures the similarity of trade flows between the trade partners. As a result of the trade diversion, similarity may increase. The similarity decreases if no diversion happens.

Table 2 presents values of Finger-Kreining coefficients of trade similarity of Estonian exports and imports to/from EU and CIS countries from 1993–2002. One can observe a decreasing similarity of exports meaning that no essential trade diversion occurred in export flows in the given period. This could partly be explained by the trade creation with the western countries based on FDI inflow, which made the structure of exports to the EU diverge from that of CIS countries.

The import similarity also declined. This indicates that the main import articles from eastern markets have remained unchanged, and the growth of imports from the west has occurred due to the expansion in other commodity groups.

Table 2 Finger-Kreining coefficients of similarity between Estonian foreign trade with the EU and CIS

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
EXPORT	0.4690	0.3779	0.3949	0.3247	0.3083	0.2965	0.2938	0.3008	0.3012	0.2947
IMPORT	0.4114	0.3826	0.3699	0.3172	0.3023	0.2911	0.2929	0.2611	0.2778	0.2657

Statistics Estonia. Statistical e-Database, authors' calculations

The Comparative Advantage

Comparative advantage is the central concept in explaining the foreign trade patterns. The recent empirical works in this field are concentrated on measuring comparative advantage (see Hoen and Oosterhaven 2004; Moenius 2006), analyzing its dynamics (see Young 1991; Fertö 2007), and factor endowments as a main determinant according to Heckscher-Ohlin (H-O) model (Findlay 1970).

The most common measure of a country's comparative advantage is the Balassa index of revealed comparative advantage (Balassa 1965). According to this approach, the trade flows reveal the comparative advantage of nations. The index is calculated as follows:

$$RCA_{jk} = \frac{x_{jk}/X_j}{\sum_j x_{ji}/\sum_j X_j}$$

Where: x_{jk} represents the export of product k by country j; X_j is the total export of country j. Several authors have tried to improve this indicator (De Benedictis and Tamberi 2001; Moenius 2006) as its asymmetry and problems with logarithmic transformations make it difficult to use the index in econometric analysis. However, the main advantage of the Balassa index is its clear theoretical foundation and interpretation of empirical results. Therefore, we used this original index in our research.

Table 3 provides the calculations of the revealed comparative advantage index for HS2 (the commodity groups for the commodities which possess the comparative advantage in this market (RSA>1)).

The commodity groups with the highest comparative advantage in the EU market are wood and articles of wood (44), furniture, bedding, mattresses, etc. (94), electrical machinery (85), dairy products (04), other made-up textile articles (63), cotton and articles thereof (52), articles of iron or steel (73), articles of apparel and clothing accessories etc. (62), electrical machinery and equipment (85), and fish and crustaceans (03).

From 1995–2007, comparative advantage in the EU market for most of the commodity groups decreased. The RSA increased for such groups as oil seeds and oleaginous fruits (12), explosives, pyrotechnic products (36), wood pulp (47), printed books (49), carpets and other textile floor coverings (57), glass and glassware (70), lead and articles thereof (78), and furniture (94).

Another indicator of a country's comparative advantage is the trade coverage ratio (TC). It is defined as a ratio of a country's exports of a given commodity group to the country's imports of the same commodity group:

$$TC_i = X_i/M_i$$

Where: M(i)- country's imports of commodity I; X(i)- country's exports of commodity i.

Table 3 Commodity groups with the highest Balassa indices, ranked by index values in 2007

	1996	1998	2000	2002	2004	2006	2007
..44 Wood and articles of wood	20.2	23.1	17.1	20.1	18.1	16.4	16.7
..14 Vegetable plaiting materials	16.8	8.6	7.7	6.6	12.2	16.6	16.0
..78 Lead and articles thereof	4.6	0.4	0.3	0.4	3.5	5.7	9.0
..94 Furniture; bedding; mattresses,	5.2	4.7	4.4	7.1	7.7	7.9	7.4
..53 Other vegetable fibre;	5.3	11.2	16.1	26.1	13.5	8.4	6.5
..63 Other fabricated textile articles;	10.0	9.9	9.1	9.6	10.7	7.6	6.2
..47 Wood pulp or of other fibrous cellulose material	0.2	0.0	0.0	0.1	0.1	1.3	4.7
..31 Fertilizers	6.3	2.1	3.6	3.9	5.0	3.5	4.7
..65 Headgear and parts thereof	7.1	5.3	4.0	4.8	4.2	3.6	4.0
..62 Articles of apparel and clothing accessories, not knitted or crocheted	6.8	5.8	4.7	5.2	4.0	3.1	2.7
..36 Explosives; pyrotechnic products;	0.5	0.6	0.8	2.2	2.8	2.7	2.7
..04 Dairy products; bird's eggs; natural honey; edible products of animal origin, ...	2.6	0.9	1.5	2.2	2.6	2.1	2.6
..85 Electrical machinery and equipment and parts thereof...	1.0	2.4	3.4	2.4	2.7	2.5	2.3
..81 Other base metals; cermets; articles thereof…	5.2	1.8	0.6	4.0	2.6	2.1	2.2
..03 Fish and crustaceans, seafood and other aquatic invertebrates	3.1	3.9	2.6	2.6	2.7	2.2	2.0
..12 Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; ...	1.1	0.8	0.4	0.7	0.6	1.9	2.0
..73 Articles of iron or steel	1.7	1.7	1.6	2.2	1.6	1.6	2.0
..52 Cotton and articles thereof	9.8	6.7	4.6	4.3	4.1	2.6	1.9
..57 Carpets and other textile floor coverings	0.5	0.7	1.2	1.9	2.5	1.9	1.8
..70 Glass and glassware	1.1	1.0	0.8	1.2	1.5	2.0	1.8
..49 Printed books, newspapers, pictures and other products of the printing industry; ...	0.2	0.3	0.3	0.5	0.8	1.6	1.8
..96 Miscellaneous manufactured articles	0.2	0.4	0.8	1.7	1.9	1.7	1.6
..61 Articles of apparel and clothing accessories; knitted or crocheted	3.5	2.8	1.9	2.2	2.0	1.4	1.3
..86 Railway and tramway locomotives, rolling-stock and parts thereof; ...	0.6	0.6	0.8	0.8	0.9	1.2	1.3

Statistics Estonia. Statistical e-Database, authors' calculations

If TC is above one, the country specializes in the given sector assuming that it has a comparative advantage in this sector. Because the trade coverage ratio reflects the proportion of exports to imports of the same country, it describes an internal comparative advantage versus an external comparative advantage on the export markets.

Comparison of the TC and RCA values in different sectors draws interesting conclusions. By definition partial similarity exists between these indices. At the very general level, the values of both indices should be greater than the unit for export-oriented commodity groups and smaller than the unit for import-oriented commodity groups. However, there are groups that do not fit into this scheme. Firstly, if the TC value of a group is smaller than the unit and its RCA value is greater than the unit, then an economy has a strong position on the European market for these goods even if it does not have the internal comparative advantage (imports exceed the exports). Secondly, if the TC value is higher than the unit and RCA is smaller than the unit, the economy does not have a strong position on the European market, even if it gained the comparative advantage in the given group, as the share of exports in this group is smaller than the respective share of imports to the EU from the rest of the world.

If the absence of discrimination in Estonian trade with the EU is assumed, then a number of analytical conclusions can be drawn. In the first case, the perspectives for development of exports in the group in question are rather narrow as there is no internal comparative advantage. Given the lack of investments, the share of these groups in imports from the EU can decline. The second alternative provides rewarding analytical results. In this case, there is a potential for a commodity group to increase its share of exports to the EU market, as the group's share in the EU imports is small compared to the existing internal comparative advantage.

Table 4 represents the distribution of Estonian exports by TC and RCA values in 2007. According to the present analysis, the following biggest commodity groups have both an internal and external comparative advantage on the EU market: fish and crustaceans (03), dairy products (04), wood and articles of wood (44), articles of apparel and clothing accessories etc. (62), other fabricated textile articles (63), other base metals; cermets; articles thereof (81) and furniture, bedding, mattresses, etc. (94).

There is a strong export growth potential for sizeable groups: cereals (10), preparations of meat, of fish, or of crustaceans (16), tanning or dyeing extracts (32), ships, boats, and floating structures (89).

Recently several methods of trade pattern dynamic analysis have been developed (Hinloopen and Van Marrewijk 2001; Brasili et al. 2000; Proudman and Redding 2000). The focus has been on the stability of the comparative advantage measure over time. Following Dalum et al. (1998) and Fertö (2007), we analyzed the stability of distribution of the Balassa index of revealed comparative advantage between two periods. The Regression model has the form:

$$RCA^{2007}{}_k = \alpha + \beta RCA^{1995}{}_k + \varepsilon_k$$

Table 4 Distribution of Estonian exports by TC and RCA values for HS 2 digit commodity groups, 2007

TC>1, RCA<1	TC>1, RCA>1
1,10, 16, 25, 32, 75, 89, 97, 99	3, 4, 14, 31, 43, 44, 47, 49, 53, 57, 62, 63, 65, 78, 81, 86
TC<1, RCA<1	TC<1, RCA>1
2, 5, 6, 7, 8, 9, 11, 13, 15, 17, 18, 19, 20, 21, 22, 23, 24, 26, 28, 29, 30, 33, 34, 35, 37, 38, 39, 40, 41, 42, 45, 46, 48, 50, 51, 54, 55, 56, 58, 60, 66, 67, 68, 69, 71, 72, 74, 75, 76, 79, 80, 82, 83, 84, 87, 88, 90, 91, 92, 93.	12, 14, 36, 52, 59, 61, 64, 70, 73, 85, 95, 96.

Statistics Estonia. Statistical e-Database, COMEX database, authors' calculations

Where: 1995 and 2007 superscripts describe the first and last year of analysis; RCA is the Balassa index of revealed comparative advantage of product k; α and β are linear regression parameters; and ε is residual term.

The value of β indicates the specialization dynamic:

- $0<\beta<1$ indicated despecialization (decline of commodity groups with high RSA and growth of commodity groups with low RSA in the considered period)
- $\beta=1$ indicated unchanged pattern of specialization,
- $\beta>1$ indicated strengthening of specialization in considered period.

Estimation results are represented in Table 5. The results show a clear tendency of despecialization in trade with the EU in the considered period. The estimation statistics indicate a high level of confidence of the results.

The Heckscher-Ohlin model predicts that a country's trade pattern depends on their relative factor endowments. According to this prediction, the essential change in trade specialization implies the changes of relative factor endowments of a country compared with its main trade partners.

To analyze the factor intensity of Estonian trade flows with the EU we used the approach developed in UNCTAD (2002). According to this approach, commodities are grouped into six categories: primary commodities, labor-intensive and resource based manufactures, manufacturing with low skill and technology intensity, manufacturing with medium skill and technology intensity, manufacturing with high skill and technology intensity, and unclassified products. The general tendency of Estonian exports to the EU because of this aggregation is to decrease shares of labor-intensive and resource based commodities and to increase shares of manufacturing with low and medium skill and technology intensity. The share of high skill and technology goods are still low.

To analyze the relationship between comparative advantage and factor intensity we calculated the export shares of commodity groups with comparative advantage RCA>1 in total export of considered category of factor intensity. Table 6 presents the results. As can be seen, the specialization is located mainly in primary commodities and manufacturing with medium skill and technology intensity. In the considered

Table 5 Stability of RSA between 1995 and 2007

Variable	Coefficient
α	0.29
	(1.47)
β	0.65[a]
	(12.01)[b]
Adjusted R-squared	0.6
F-statistic	144
Prob(F-statistic)	0.00
Included observations	97

[a] denote coefficient estimates significant at 1% confidence level

[b] denote t- statistic in brackets

Table 6 Share of export groups with RCA >1 according to factor intensity

Commodity group	1995	2007
Primary commodities	21.8%	28.9%
Labor-intensive and resource based manufactures	11.1%	9.5%
Manufacturing with low skill and technology intensity	11.0%	13.1%
Manufacturing with medium skill and technology intensity	51.8%	45.6%
Manufacturing with high skill and technology intensity	0.9%	0.7%
Unclassified products	3.4%	2.2%

Statistics Estonia. Statistical e-Database, authors' calculations

period, specialization increased in primary commodities and decreased in manufacturing with medium skill and technology intensity, which has not improved the trade pattern. This confirms our previous result about despecialization in trade with the EU.

Intra-Industry Trade

Intra-industry trade (IIT) plays a very important role in the trade patterns, especially in that of transition countries and is often considered as a measure of product integration between the markets.

Horizontal IIT (HIIT) is the exchange of commodities differentiated by attributes other than quality. The models of horizontal IIT are considered to be of a greater relevance to trade among developed countries. The models of vertical IIT (VIIT) are considered to reflect trade flows between developed and developing countries. The models explaining horizontal IIT are very different from the Ricardian and Heckscher-Ohlin type models and are based on an imperfectly competitive market structure. Vertical IIT occurs, according to the H-O model, based on comparative advantages and depends on resource endowments and factor proportions.

In Krugman's (1979) model, the supply side consists of a large number of firms, each producing a particular variety of the product under increasing returns. On the demand side, individuals consume varieties of goods and any new differentiated goods available on the market enter the consumer's basket. International trade in this model creates a larger integrated market in which intra-industry specialization between countries may enable firms to reduce unit costs and access to a larger number of varieties increases consumer welfare, international trade between countries with the same technology and factor endowments will occur.

The following papers are main references for the theoretical explanation of vertical IIT. Falvey (1981) constructs a 2-country, 2-factor (capital and labor), 2-goods (one homogenous, one differentiated) model with perfect competitive markets. The countries have different technologies in producing differentiated goods. More capital is used to produce higher quality differentiated commodities. The relative capital abundant economy (i.e., the high-income country) will specialize in the export of high quality varieties and vice versa. There is no explicit demand side in this model.

Falvey and Kierzkowski (1987) introduce the demand side. All consumers have the same preferences, each individual demands only one variety of the differentiated product, which is determined by his income. High-income individuals consume higher quality varieties, with different income levels in the economy guaranteeing demand for every variety produced. Since each variety of a differentiated product is manufactured in only one country and consumed in both countries, intra-industry trade arises. All in all in the model, there are three main sources for trade to occur: factor endowments, factor requirements to produce goods, and income distribution.

Empirical works show that, as a result of trade liberalization, IIT increases. A simple but very appealing theoretical model of the process is presented by Mardas and Nikas (Mardas and Nikas 2008). In their 2-country 2-good model, one of the goods is homogenous, and the other is vertically differentiated. The countries differ in their levels of development. The less developed country produces low quality differentiated goods, while the other country produces medium and high quality differentiated goods. Both countries impose ad-valorem tariffs on imports. After creation of a free trade area between the countries (tariffs reduced to 0), both countries expand volumes of their exports that give rise to VIIT.

The common measure of the level of intra-industry trade is Grubel-Lloyd (*GL*) index (Grubel and Lloyd 1975):

$$GL_{CD,i} = 1 - \frac{\left|X_{CD,i} - M_{CD,i}\right|}{\left(X_{CD,i} + M_{CD,i}\right)} \tag{1}$$

Where: $M_{CD,i}$ stands for country *C*'s imports of commodity group *i* from country *D*; and $X_{CD,i}$ is country *C*'s export of commodity group *i* to country *D* in the particular year. The index takes the values between 0 and 1. When there are exports and no imports or vice versa, the index takes the value 0. The higher values represent the higher share of IIT. The *GL* indices can be aggregated across N industries (or HS commodity codes) as a trade-weighted average of the industry indices:

$$GL_{CD,N} = \frac{\sum_{i=1}^{N} \left(GL_{CD,i}(X_{CD,i} + M_{CD,i})\right)}{\sum_{i=1}^{N} (X_{CD,i} + M_{CD,i})} \tag{2}$$

The methodology to disentangle horizontal and vertical components was introduced by D. Greenaway, R. Hine and C. Milner (1994, 1995) and. thus, is known in the literature as the *GHM* approach. It is based on the assumption that the gap between the unit value (UV) of imports, and the UV of exports for each commodity reveals the type of trade, as relative prices reflect relative quality (Stiglitz 1987).

Formally the horizontal (vertical) IIT is measured as:

$$GHM_{ik}^{p} = \frac{\sum \left(X_{lik}^{p} + M_{lik}^{p}\right) - \sum \left|X_{lik}^{p} - M_{lik}^{p}\right|}{\sum (X_{lik} + M_{lik})} \tag{3}$$

Where: *p* denotes whether the product is horizontally or vertically differentiated; *i* is an industry; *l* is a product; *k* is a trading partner.

The bilateral trade of a horizontally differentiated product j occurs if the unit values of exports UV_j^X and imports UV_j^X for a dispersion factor α (e.g. 0.15, 0.25) satisfies the following inequality:

$$1 - \alpha \leq \frac{UV_j^X}{UV_j^M} \leq 1 + \alpha \tag{4}$$

Bilateral vertical IIT occurs if:

$$\frac{UV_j^X}{UV_j^M} < 1 - \alpha, \text{or} \frac{UV_j^X}{UV_j^M} 1 + \alpha \tag{5}$$

Greenaway et al. (1994) tests for dispersion factor α between 0.15 and 0.35. As a result, the authors adhere to α=0.15 (although even when taking α=0.35 a large amount of vertical IIT is observed). Contemporary literature suggests α should take values 0.15–0.25 (Azhar and Eliott 2006; Fertö 2005a). In this paper, we stick to α=0.25.

The discussion about approaches to decomposition of IIT still goes on in the literature. Another widely used method was presented by Fontagné and Freudenberg (1997). They argue that the trade in an item is considered to be two-way when the value of the minority flow (for example imports) represents at least 10% of the majority flow (exports). In case the condition is not satisfied, the trade flow is defined as an inter-industry one. Further authors use a unit value approach to distinguish between horizontal and vertical IIT. Taking into consideration that there is no consensus in the literature on the use of a particular approach to decompose IIT, we use in this paper the *GHM* methodology.

We use a disaggregated Harmonized System (HS) 8-digit level set of data on the trade flows between Estonia and EU countries for the period 1999–2007. Data originates from the Eurostat e-database. The *GL* indices are computed for the whole set of commodities using (1). Further, the indices are aggregated using (2). The highest level of aggregation is 21 sections of HS. In the tables below, we use the following notation: T – aggregated *GL* index computed using (1), i.e., share of IIT, V – share of VIIT in the total IIT, i.e., aggregated GHM^V index computed using (3), H – share of HIIT in the total IIT, i.e., aggregated GHM^H index computed using (3).

Intra-industry trade should shed more light on the level of integration into the EU. Countries with different economic development are either engaged in vertical IIT of commodities or in the sub-contract works. Horizontal IIT involves finished products with similar quality. Taking into account the structural reforms and the fact that Estonia is at a lower economic development level then the majority of the main trading and FDI inflow partners, we expect IIT for Estonia to increase and VIIT to have a higher share then HIIT in 1999–2007.

Table 7 shows the trade-weighted average IIT, VIIT, and HIIT for Estonia-EU trade within the analyzed period. Total IIT dynamics shows minor fluctuations in the years 1999–2003. In the period 2004–2007, total IIT increased. Vertical IIT shows similar dynamics as total IIT. In general, it experiences a period of growth, although it falls once in 2006. Horizontal IIT is around 0.1 before 2004 and after stabilizes to around 0.14. In general, the share of vertical IIT is significantly higher than the share of horizontal IIT. That is consistent with the findings of other contributors (c.f. Fertö 2005b, Fontagné et al. 2006). Vertical IIT experienced greater growth (33.3%) then horizontal IIT (27.7%) if comparing relevant shares in 1999 and 2007. Within this period, the common year for increase in IIT to start is 2004. This is the year of accession to the EU.

Next, we present the commodity composition of IIT. The shares of VIIT, HIIT, and IIT for 1999 and 2007 are presented in the Table 8 below. Within this period, the share of IIT has decreased for the whole set of commodities: products of the chemical or allied industries (section 6), wood pulp or of other fibrous cellulosic material, paper (section 10), optical, photographic, cinematographic, measuring, checking, precision, medical, or surgical instruments, and apparatus, clocks and watches, musical instruments (section 18),works of art (section 21). For other sections, a share of IIT increased.

The following four sets of commodities had he highest share of IIT in 2007: arms and ammunition, parts and accessories thereof (section 19, *GL* 0.63), footwear, headgear, umbrellas, sun umbrellas (section 12, *GL* 0.59), animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes (section 3, *GL* 0.48), textiles and textile articles (section 11, *GL* 0.48).

Conclusions

In this paper, we are focusing on the development of foreign trade flows between Estonia and the EU. As a result of the economic reforms and foreign trade liberalization, rapid reorientation of trade flows from the former Soviet to Western markets has taken place. In 1993, the share of European exports and imports had already reached 64.1% and 68.4%, respectively. The volume of trade with the EU has exploded.

To distinguish the trade diversion and the trade creation effects, we calculated the Finger-Kreinin coefficient of trade similarity of Estonian exports and imports to/from EU and CIS countries. As a result, we have observed a decreasing similarity of exports, i.e., no essential trade diversion of exports occurred. The import similarity also declined. This indicates that the main import articles from the eastern markets are remaining unchanged and the growth of imports from the west occurred due to the expansion in other commodity groups.

Table 7 Intra-industry trade development in Estonia in 1999–2007, EU-27 trade flows

Year	V	H	T
1999	0.18	0.11	0.30
2000	0.18	0.11	0.28
2001	0.19	0.11	0.30
2002	0.19	0.11	0.30
2003	0.21	0.11	0.31
2004	0.24	0.12	0.35
2005	0.24	0.14	0.37
2006	0.21	0.15	0.36
2007	0.24	0.14	0.38

Authors' calculations based on Eurostat HS data at 8-digit level

Table 8 Commodity composition of IIT for Estonia in 1999 and 2007, EU-27 trade flows

HS section	1999			2007		
	V	H	T	V	H	T
1. Live animals; animal products	0.07	0.18	0.24	0.21	0.10	0.31
2. Vegetable products	0.14	0.18	0.32	0.23	0.10	0.33
3. Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes	0.01	0.05	0.06	0.03	**0.45**	**0.48**
4. Prepared foodstuffs; beverages, spirits and vinegar; tobacco	0.18	0.06	0.24	0.23	0.12	0.35
5. Mineral products	0.08	0.03	0.11	0.06	0.19	0.25
6. Products of the chemical or allied industries	0.13	0.22	0.36	0.20	0.09	0.29
7. Plastics and articles thereof; rubber and articles thereof	0.19	0.24	**0.43**	0.29	0.18	**0.47**
8. Raw hides and skins. leather. fur skins and articles thereof;	0.11	0.17	0.28	0.28	0.13	**0.41**
9. Wood and articles of wood	0.06	0.03	0.10	0.19	0.13	0.32
10. Wood pulp or of other fibrous cellulosic material; paper and paperboard and articles thereof	0.16	0.13	0.29	0.20	0.07	0.27
11. Textiles and textile articles	0.15	0.13	0.28	0.32	0.15	**0.48**
12. Footwear, headgear, umbrellas, sun umbrellas	0.16	0.13	0.29	0.31	0.29	**0.59**
13. Articles of stone, plaster, cement, asbestos, mica or similar materials; ceramic products; glass and glassware	0.14	0.05	0.19	0.24	0.05	0.29
14. Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal and articles thereof	0.22	0.01	0.22	0.30	0.01	0.32
15. Base metals and articles of base metal	0.19	0.11	0.30	0.22	0.21	**0.42**
16. Machinery and mechanical appliances; electrical equipment; parts thereof	0.29	0.11	0.39	0.32	0.08	0.40
17. Vehicles, aircraft, vessels and associated transport equipment	0.18	0.06	0.24	0.21	0.24	**0.45**
18. Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; clocks and watches; musical instruments	0.31	0.12	**0.44**	0.33	0.03	0.36
19. Arms and ammunition; parts and accessories thereof	0.13	0.00	0.13	**0.58**	0.06	**0.63**
20. Miscellaneous manufactured articles	0.17	0.14	0.31	0.29	0.13	**0.42**
21. Works of art, collectors' pieces and antiques	0.17	0.00	0.17	0.01	0.00	0.01

Authors' calculations based on Eurostat HS data at 8-digit level

Values ≥0.4 are in bold

The biggest commodity groups with the comparative advantage measured by the Balassa index on the EU markets are wood and articles of wood, furniture, bedding, mattresses, electrical machinery, dairy products, other fabricated textile articles, cotton and articles thereof, articles of iron or steel, articles of apparel and clothing accessories, electrical machinery and equipment, fish, and crustaceans. The econometric analysis shows a clear tendency to despecialization in trade with the EU in the considered period.

The comparative analysis of TC and RCA for the commodity groups differentiates the category of goods with a stable comparative advantage, goods with an unstable comparative advantage and goods with export potential. In the last category are cereals, preparations of meat, of fish, or of crustaceans, tanning or dyeing extracts, ships, boats, and floating structures.

For the previous years, the share of intra-industry trade in Estonia increased. To analyze IIT, HIIT, and VIIT, we used an approach developed by Greenaway et al. Decomposition on VIIT and HIIT was made on the basis of the unit values of import and export. The empirical evidence shows that the share of IIT in the Estonian-EU trade significantly increased and formed 38% of trade flows in 2007. Vertical IIT plays a dominant role in IIT flows. Shares of IIT, HIIT, and VIIT started to rise remarkably in 2004, the year of accession to the EU.

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Further Reading

Statistics Estonia. Statistical e-Database. http://pub.stat.ee

APPENDIX 2. Intra-Industry Trade Development in the Baltic States

Intra-Industry Trade Development in the Baltic States

Grigori Fainštein and Aleksei Netšunajev

ABSTRACT: This paper investigates intra-industry trade (IIT) dynamics for Estonia, Latvia, and Lithuania in 1999–2007. IIT is decomposed into its vertical and horizontal components based on differences in import and export unit values. Results show that shares of IIT have increased within the period, with vertical IIT dominating. Shares of total vertical and horizontal IIT have grown since 2004, the year of accession to the European Union. Using panel data analysis, we estimate three static models and a dynamic model of IIT determinants. We find market size to be important in the Baltic states for IIT in general and for horizontal IIT in particular. A negative relationship between distance and share of IIT is a standard finding. Among factor endowment variables, we find difference in human capital to be significant in explaining IIT.

KEY WORDS: Baltic states, determinants of intra-industry trade, vertical/horizontal intra-industry trade.

Intra-industry trade (IIT) plays a very important role in trade patterns, especially in that of transition countries and is often considered as a measure of product integration between markets. Veeramani (2001) shows, using the example of India, that trade liberalization biases trade expansion in the direction of IIT. IIT provides evidence on the level of integration into the world economy. The level of IIT in a country is characterized by the factors of vertical specialization (the location of different stages of production in different countries, including subcontracts) and horizontal IIT involving finished products.

For the current analysis, we have limited ourselves to a homogeneous region of the transition states, the Baltic countries, which experienced the highest gross domestic product (GDP) growth in 2004–6, compared to other new members of the European Union. The Baltic countries are unique in the sense that during Soviet times trade flows were almost completely oriented to the East. Other Central and Eastern European (CEE) countries during the so-called Iron Curtain period had some foreign trade activities with Western countries. After the fall of the Soviet Union, the Baltic countries experienced rapid structural reorientation in trade flows from Eastern to Western countries, while in the other CEE countries, the reorientation was not as dramatic. The Baltic states have much in common, but there are some important differences. Estonia positions itself as a part of Northern Europe, whereas Latvia and Lithuania tend more toward Central Europe. Therefore, although at first glance a homogeneous region, the Baltic states may have heterogeneity in IIT. The Baltic countries appear to be a group with a unique economic background that makes them an interesting research subject in the field of international trade.

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The aim of the paper is to provide empirical evidence on IIT patterns in Estonia, Latvia, and Lithuania and to analyze determinants of IIT in the period 1999–2007. There have been several similar studies on IIT of CEE countries, such as Kandogan (2003) and Janda and Münich (2004). It should be pointed out that the time horizon of the previous studies does not cover the major change in trade policy of the former socialist countries—accession to the European Union. The time period in the current study covers 1999–2007, thus allowing us to capture the effect of accession to the European Union and to avoid inaccurate trade data from an earlier period. Taking into account this time horizon and the unique economic background of Baltic countries, it is relevant to conduct a study of IIT for these three countries. The empirical analysis is based on Eurostat eight-digit Harmonized System (HS) trade data. Econometric analysis of gravity models is extended beyond the conventional methodology and takes advantage of dynamic panel data, a method that has not been widely used. Therefore, this paper contributes to the literature by providing a deeper analysis of a unique region and going beyond standard econometric techniques.

Theoretical Framework, Measurement, and Decomposition of Intra-Industry Trade

The idea of IIT was first introduced in the 1960s. Simultaneous import and export within an industry was initially observed for Belgium, the Netherlands, and Luxembourg (Benelux) by Verdoorn (1960). Since then, the concept of IIT has made enormous steps forward and is known to be very important in contemporary trade studies. Recent data show that 27–44 percent of global trade, depending on the level of aggregation used in estimations, is intra-industry (Brühlart 2008). Previous studies show that nine of the top-ten bilateral IIT flows exist in the European Union (Fontagné et al. 2006, p. 467).

Returning to classical papers on IIT, Grubel and Lloyd (1975) in their empirical study of trade flows showed that among major industrialized countries trade flows exist within the same industries, which trade theories of that time, such as Ricardian and Heckscher-Ohlin (H-O), could not explain. This fact resulted in the development of new formal trade theories to explain the nature of IIT.

After the main distinction between intra- and interindustry trade flows was made, the literature suggested that a meaningful distinction could be drawn between horizontal and vertical components of IIT. Horizontal and vertical IIT are different in nature and thus different models are used to explain and predict trade flows.

Horizontal IIT (HIIT) is the exchange of commodities differentiated by attributes other than quality. The models of HIIT are considered of greater relevance to trade among the developed countries. The models of vertical IIT (VIIT) are considered to reflect trade flows between developed and developing countries. Models explaining HIIT are very different from the Ricardian and H-O-type models and are based on an imperfectly competitive market structure. VIIT occurs according to H-O model logic, based on comparative advantages and depending on resource endowments and factor proportions. Thus, different country characteristics are important as the determinants of IIT in the two types of models.

A distinction between components of IIT also has implications for welfare analysis. HIIT is associated with relatively low factor-market adjustment costs as a result of trade liberalization. This effect is referred to in the literature as the “smooth adjustment hypothesis.” Adjustment costs may be higher for VIIT (Brühlart 2000).

Krugman (1979) and Lancaster (1980) made major contributions to the development of the new trade theories and related IIT to imperfect competition and economies of scale. They focused on simultaneous export and import of products of the same type and similar quality, which is what we now call HIIT.

In Krugman's (1979) model, the supply side consists of a large number of firms, each producing a particular variety of the product under increasing returns. On the demand side, individuals consume varieties of goods, and any new differentiated good available on the market enters the consumer's basket. International trade in this model creates a larger integrated market in which intra-industry specialization between countries may enable firms to reduce unit costs, and access to a larger number of varieties increases consumer welfare. Krugman demonstrates that the interaction between economies of scale and horizontal product differentiation may cause international trade between countries with the same technology and factor endowments. The following papers are the main references for the theoretical explanation of VIIT.

Falvey (1981) and Falvey and Kierzkowski (1987) developed a model in which IIT was driven by vertical product differentiation, and import and export of similar products were distinguished by quality differences. Their models differ from the standard H-O model in the way that differences in factor endowments explain intra-industry rather than inter-industry specialization.

Falvey (1981) constructs a two-country, two-factor (capital and labor), two-goods model with perfectly competitive markets, one good is homogeneous and the second is differentiated. Countries have different technologies to produce differentiated goods. More capital is used to produce a higher quality differentiated commodity. The relative capital-abundant economy (i.e., the high-income country) will specialize in the export of high-quality varieties, and vice versa. There is no explicit demand side in this model. This model provides a clearly testable hypothesis: the share of VIIT is positively correlated with the per capita income difference between trading partners.

Falvey and Kierzkowski (1987) introduce the demand side to the model. In their model, they assume that countries have the same tastes and technology, but different factor endowments. The supply side is similar to that in Falvey (1981). Each economy is described as two sectors, one producing a single homogeneous good and the other producing a differentiated product. Both sectors employ labor, while capital is used only in the sector producing the differentiated product. The more capital-intensive the production of a commodity, the higher the quality.

On the demand side, all consumers have the same preferences, and each individual demands only one variety of the differentiated product, which is determined by the individual's income. High-income individuals consume higher quality varieties, and different income levels in the economy guarantee demand for every variety produced. Since each variety of a differentiated product is manufactured in only one country and consumed in both countries, IIT arises. All in all in the model there are three main sources for trade to occur: factor endowments, factor requirements to produce goods, and income distribution. The patterns of trade and that of vertical IIT in particular depend on the influence of these three sources. The relatively labor-abundant country will export lower quality labor-intensive varieties of differentiated product. The range of varieties demanded will depend on income distribution. The greater the difference in relative factor endowments (per capita income differences), the more IIT will arise.

Empirical works show that as a result of trade liberalization IIT increases. A quite simple but very appealing theoretical model of the process is presented by Mardas and

Nikas (2008). In their two-country, two-good model, one good is homogeneous and the other is vertically differentiated. Countries differ in levels of development. The less developed country produces a low-quality differentiated good, while another country produces a medium- and high-quality differentiated good. Both countries impose ad valorem tariffs on imports. After creation of a free trade area between the countries (tariff reduced to zero), both countries expand their volumes of export that give rise to VIIT.

Empirical studies of the determinants have not distinguished between vertical and horizontal components of IIT over time but, instead, use the total share of IIT. Greenaway et al. (1994, 1995) were among the first ones to separate IIT into its vertical and horizontal components. Recent studies show that VIIT plays a very important role in the trade flows of countries (Crespo and Fontoura 2004; Fertö 2005b; Fontagné and Freudenberg 1997; Greenaway et al. 1994, 1995).

The common measure of the level of IIT is the Grubel–Lloyd (*GL*) index (Grubel and Lloyd 1975):

$$GL_{CD,i} = 1 - \frac{\left| X_{CD,i} - M_{CD,i} \right|}{\left(X_{CD,i} + M_{CD,i} \right)} \quad . \tag{1}$$

$M_{CD,i}$ stands for country *C*'s import of commodity group *i* from country *D,* and $X_{CD,i}$ is country *C*'s export of commodity group *i* to country *D* in the particular year. The index takes values between 0 and 1. When there is export and no import or vice versa, the index takes a value of 0. If there is neither import nor export of a particular commodity, the index cannot be calculated. The *GL* indexes can be aggregated across *N* industries (or HS commodity codes) as a trade-weighted average of the industry indexes:

$$GL_{CD,N} = \frac{\sum_{i=1}^{N} \left(GL_{CD,i} (X_{CD,i} + M_{CD,i}) \right)}{\sum_{i=1}^{N} (X_{CD,i} + M_{CD,i})} . \tag{2}$$

The methodology to disentangle horizontal and vertical components was first introduced by Greenaway et al. (1994, 1995) and thus is known in the literature as the *GHM* approach. It is based on the assumption that the gap between the unit value (UV) of import and the UV of export for each commodity reveals the type of trade, as relative prices reflect relative quality (Stiglitz 1987). At first, Greenaway et al. calculated overall IIT for the UK using an unadjusted *GL* index and then divided it into horizontal and vertical components based on the relative unit values of export and import (unit values calculated per ton) (Greenaway et al. 1995).

Formally the horizontal (vertical) IIT is measured as:

$$GHM_{ik}^{p} = \frac{\sum \left(X_{lik}^{p} + M_{lik}^{p} \right) - \sum \left| X_{lik}^{p} - M_{lik}^{p} \right|}{\sum \left(X_{lik} + M_{lik} \right)} . \tag{3}$$

where *p* denotes whether a product is horizontally or vertically differentiated, *i* is an industry, *l* is a product, and *k* is a trading partner.

Bilateral trade of a horizontally differentiated product *j* occurs if the unit values of export UV_j^X and import UV_j^M for a dispersion factor α (e.g., 0.15, 0.25), satisfies the following inequality:

$$1 - \alpha \le \frac{UV_j^X}{UV_j^M} \le 1 + \alpha \,. \quad (4)$$

Bilateral vertical IIT occurs if:

$$\frac{UV_j^X}{UV_j^M} < 1 - \alpha \quad \text{or} \quad \frac{UV_j^X}{UV_j^M} > 1 + \alpha. \quad (5)$$

According to Crespo and Fontoura (2004), the unit value approach on the whole has some shortcomings. First, consumers may buy expensive products for reasons other than quality, at least in the short run. Second, values of two bundles may differ if the mix of products differs, so that one bundle contains a higher proportion of high unit value items than the other. Another problem often mentioned is some possible randomness in choice of α (Kandogan 2003). Nevertheless, the unit value approach is widely accepted and used in the contemporary empirical literature.

Greenaway et al. (1994) test for dispersion factor α being between 0.15 and 0.35. As a result, the authors keep $\alpha = 0.15$, although even taking $\alpha = 0.35$, a large amount of VIIT is observed. The contemporary literature suggests that α should take values 0.15–0.25 (Azhar and Eliott 2006; Fertö 2005a). Referring to the latter study, we keep $\alpha = 0.25$.

The dispersion factor $\alpha = 0.25$ of relative unit value might be considered arbitrary at first glance. But the use of this criterion can be justified, first, by the assumption that differences in factors other than quality (transportation, insurance, and other freight costs) do not usually cause a difference in export and import unit values by more than 25 percent. Second, recent studies have found that results increasing the range from 0.15 to 0.25 do not radically alter the division of trade into horizontally and vertically differentiated products (Fertö 2005a).

The *GHM* approach has been criticized apart from the critique of the randomness of choice of α. Fontagné and Freudenberg (1997) criticize the use of Equation (4). They find that the right-hand side is not consistent with the left-hand side of the equation. They suggest instead:

$$\frac{1}{1 + \alpha} \le \frac{UV_j^X}{UV_j^M} \le 1 + \alpha \,.$$

However, in the empirical literature, the original Equation (4) is used (cf. Crespo and Fontoura 2004; Fertö 2005a, 2005b). In the paper, we also adhere to the original Equation (4).

Another widely used method of decomposition of trade into HIIT and VIIT is presented in Fontagné and Freudenberg (1997). They provide detailed analysis on defining and measuring IIT. The authors point out some additional drawbacks of the *GHM* approach and argue that the resulting measure is not a *GL* indicator, since it shows the share of total horizontal (vertical) trade in total trade. As an alternative, they propose categorizing trade as two-way trade in similar products, two-way trade in vertically differentiated products, or one-way trade. This approach is known in the literature as *FF* or *CEPII.*

"Trade in an item is considered to be 'two-way' when the value of the minority flow (for example import) represents at least 10 percent of the majority flow (export)" (Fontagné and Freudenberg 1997, p. 30). The following formal condition for two-way trade to exist in product *j* should be satisfied:

$$\frac{\min(X_j, M_j)}{\max(X_j, M_j)} > 10\% \cdot \tag{6}$$

If the condition is not satisfied, the trade flow is defined as IIT. However, the 10 percent criterion for separating inter- from intra-industry trade is questionable (Crespo and Fontoura 2004, p. 54). Furthermore, the authors use a unit value approach to distinguish between HIIT and VIIT. Export and import unit values should differ more than 15 percent for two-way trade for vertically differentiated products to occur. If the condition is not satisfied, two-way trade is considered to be in horizontally differentiated products.

The discussion of approaches decomposing IIT is ongoing in the literature. Both *GHM* and *FF* are criticized for reflecting *degree* rather than *level* of IIT (Fertö 2005b; Nilsson 1997, 1999). The literature also offers alternative methods to distinguish between vertical and horizontal IIT. Azhar and Elliott (2006) develop a modified geometric tool called "product quality space," based on the Grubel-Lloyd index. Fertö (2005b) uses Nilsson's (1997, 1999) approach, which means he divides the numerator from (3) by the number of traded products *n:*

$$N_k^p = \frac{\sum\left(X_{lk}^p + M_{lk}^p\right) - \sum\left|X_{lk}^p - M_{lk}^p\right|}{n}. \tag{7}$$

This yields the average level of horizontal (vertical) IIT per product group.

Fertö (2005b) tests *GHM*, *FF*, and *N* approaches using Hungarian trade data for agri-food products. As a result, the three indexes yield a good consistency for analyzing shares of VIIT and HIIT in trade flows. Six out of nine possible pairs show a high level of correlation.

Kandogan (2003) uses values of export and import at two different levels of aggregation. The higher level of aggregation defines industries, and the lower level defines different products in each industry. Trade in products of an industry is aggregated to find the trade in that industry. Using trade data at a higher level of aggregation, the total amount of IIT in each industry is computed by finding the amount of export matched by import. The amount of matched trade in each product of an industry is computed using data at a lower level of aggregation, that is, HIIT. The rest of the IIT in this industry is the trade of different products, that is, vertical IIT. The method uses SITC data and is not directly applicable to HS data. The latter may be more valuable for current analysis as it provides a higher level of disaggregation and allows the extraction of more information from the data.

Fully acknowledging the advantages and possible shortcomings of *GHM* methodology, we adhere to it in our paper.

Intra-Industry Trade in the Baltic States

After reestablishing independence in the early 1990s, the Baltic countries started to carry out structural economic reforms. The development of foreign trade at the beginning of the liberalization period was more rapid than GDP growth. By the end of the 1990s, the transition period was over and the natural trade patterns restored. Therefore, we focus on the period 1999–2007 as it represents the post-transition growth period. In 2004, the Baltic states became members of the European Union. Before accession, Estonia had one of the most liberal trade policies in the world, while Latvia and Lithuania had somewhat higher protection measures in the form of import taxes. After accession, the EU trade policy was implemented.

Table 1. Import and export dynamics of the Baltic states in 1999 and 2007 (millions of euros, current prices)

Flow	Reporter	Partners	1999	2007	Change in %
Import	EE	EU25	2,355.80	8,969.90	380.75
	LT	EU25	2,608.70	12,134.93	465.17
	LV	EU25	2,087.58	8,637.09	413.74
	EE	Non-EU	868.34	2,456.89	282.94
	LT	Non-EU	1,740.44	5,677.72	326.22
	LV	Non-EU	683.88	2,542.66	371.80
Export	EE	EU25	1,937.65	5,630.47	290.58
	LT	EU25	1,899.03	8,040.89	423.42
	LV	EU25	1,254.73	4,379.29	349.02
	EE	Non-EU	321.60	2,405.05	747.84
	LT	Non-EU	685.47	4,468.48	651.89
	LV	Non-EU	361.97	1,682.98	464.95

Source: Eurostat database, authors' calculations.

For the extremely open Baltic economies, trade development is the main engine of economic growth. Table 1 shows import and export flows in 1999 and 2007 for the Baltic states in millions of euros. Trade flows are shown for two groups of partners: EU25 stands for trade flows between the Baltic states and 25 EU member states while non-EU represents trade flows between the Baltic states and the rest of the world. By 2007, export and import had increased severalfold. Import from the European Union has experienced larger growth then import from non-EU countries. The main reason for such rapid import growth is strong domestic demand for investment and consumption goods. Export to non-EU countries has grown faster in comparison with intra-EU export. Still intra-EU trade flows strongly dominate by volume in both import and export trade flows. All three countries in 2007 ran significant trade deficits. The volume of Lithuanian exports and imports exceeded the flows of Estonia and Latvia. This feature is common in trade flows between the Baltic states and the European Union and in flows between the Baltic states and the rest of the world. This is a natural observation as Lithuania has the largest economy among the three Baltic states.

IIT should provide further evidence on the level of integration into the European Union and world economy, as it plays a very important role in the trade patterns of transition countries. It is often considered as a measure of product integration between markets. With trade liberalization, generally the level of IIT increases.

The Baltic states experienced large inflows of foreign direct investment (FDI). The main sources of FDI were neighboring Western and Nordic countries. Countries with different economic development are either engaged in VIIT of commodities or in subcontract work. In both cases, industrial cooperation may take place. HIIT involves finished products of similar quality.

Taking into account the structural reforms and the fact that Baltic countries are at a lower economic development level than the majority of the main trading and FDI inflow partners, we expect IIT in general for the Baltic states to increase and VIIT to have a higher share than HIIT in 1999–2007.

Table 2. IIT development in the Baltic states in 1999–2007

	Average			Estonia			Latvia			Lithuania		
	V	H	T	V	H	T	V	H	T	V	H	T
1999	0.17	0.08	0.25	0.19	0.10	0.29	0.14	0.07	0.22	0.16	0.07	0.23
2000	0.16	0.09	0.25	0.18	0.09	0.27	0.14	0.08	0.22	0.15	0.11	0.26
2001	0.17	0.08	0.25	0.19	0.10	0.29	0.16	0.06	0.22	0.15	0.09	0.24
2002	0.15	0.11	0.26	0.19	0.09	0.28	0.15	0.06	0.22	0.13	0.14	0.27
2003	0.16	0.10	0.26	0.20	0.10	0.30	0.14	0.07	0.22	0.14	0.12	0.26
2004	0.17	0.11	0.28	0.21	0.12	0.32	0.17	0.09	0.26	0.14	0.12	0.26
2005	0.18	0.13	0.31	0.22	0.15	0.37	0.17	0.13	0.30	0.16	0.11	0.27
2006	0.20	0.13	0.32	0.22	0.13	0.34	0.23	0.10	0.32	0.17	0.14	0.31
2007	0.21	0.13	0.34	0.24	0.14	0.37	0.25	0.09	0.34	0.18	0.14	0.32

Source: Authors' calculations based on Eurostat HS data at eight-digit level.

We now look at empirical evidence on IIT in the Baltic states. In this paper, we use two sets of trade data on the Baltic states' trade flows. The first one is disaggregated data at the HS eight-digit level on the Baltic states' total imports and exports in the period 1999–2007. This set is used to construct the analytical tables presented in this section. The second set of data covers disaggregated trade at the HS eight-digit level between Baltic states and their relevant top-five export partners.[1] We use this set of data to compute shares of IIT, VIIT, and HIIT for pairs of trading partners. Data are from the Eurostat database. The *GL* indexes are computed for the Baltic states' whole set of commodities using Equation (1), and further indexes are aggregated using Equation (2). The highest level of aggregation is based on HS sections.[2] In the tables, below we use the following notation: T—aggregated *GL* index computed using Equation (1), that is, the share of total IIT (TIIT), V—share of VIIT in total IIT, that is, the aggregated GHM^V index computed using Equation (3), and H—share of HIIT in total IIT, that is, the aggregated GHM^H index computed using Equation (3).

Table 2 shows trade-weighted average TIIT, VIIT, and HIIT separately for each Baltic state and on average. Average TIIT dynamics shows minor fluctuations in the years 1999–2003, but in the period 2004–7, TIIT increases. VIIT shows a tiny reduction in 2002–3 and experiences a growth period in 2004–7. HIIT is about 0.1 before 2004 and after that stabilizes at a value of 0.13. In general, the share of VIIT is significantly higher than the share of HIIT. This is consistent with the findings of other researchers (cf. Brühlart 2008; Fertö 2005b; Fontagné et al. 2006). Average HIIT experiences greater growth (62.5 percent) than VIIT (23.5 percent) if compared to relevant shares in 1999 and 2007. During the period, the common year for increase in IIT to start is 2004. This is the year of accession to the European Union for the Baltic states. The common feature of the countries is that VIIT dominates significantly over HIIT. Nevertheless, the countries are quite different not only in terms of total share of IIT but also in terms of structure of IIT.

In Estonia, VIIT increased from 0.19 to 0.24 and HIIT from 0.10 to 0.14 during the observed period. Estonia had the highest share of TIIT in 2007. In Latvia, VIIT increased from 0.14 to 0.25, while HIIT increased from 0.07 to 0.09. In Lithuania, VIIT increased from 0.16 to 0.18, while HIIT increased from 0.07 to 0.14. In Estonia and

Latvia, growth of VIIT mainly contributed to the growth of TIIT, while in Lithuania HIIT was the main engine of increase in TIIT. Therefore, the economic mechanism of the process is different. On the one hand, increase in IIT in Estonia and Latvia was due mainly to comparative advantage and depended on factor endowments of these two Baltic countries. On the other hand, in Lithuania scale economies and increasing returns drove IIT through its horizontal component. In 2007, the gap between VIIT and HIIT was lowest in Lithuania.

Next we briefly discuss the commodity composition of IIT for individual countries. First, we consider the commodity composition of Estonia. During the period, the share of IIT decreased for only two sets of commodities:

1. Products of the chemical or allied industries (section 6[3]);
2. Optical, photographic, cinematographic, measuring, checking, precision, medical, or surgical instruments and apparatus; clocks and watches; musical instruments (section 18).

For other sections, the share of IIT increased. The following three sets of commodities had the highest share of IIT in 2007:

1. Arms and ammunition, parts and accessories thereof (section 19, *GL* 0.62);
2. Footwear, headgear, umbrellas, sun umbrellas (section 12, *GL* 0.57);
3. Works of art, collectors' pieces, and antiques (section 21, *GL* 0.54).

In Latvia, the share of IIT decreased for the following set of commodities:

1. Vegetable products (section 2);
2. Mineral products (section 5);
3. Natural or cultured pearls, precious or semiprecious stones, precious metals, metals clad with precious metal, and articles thereof (section 14);
4. Arms and ammunition, parts and accessories thereof (section 19);
5. Works of art, collectors' pieces, and antiques (section 21).

For other sections, the share of IIT increased. The following three sets of commodities had the highest share of IIT in 2007:

1. Products of the chemical or allied industries (section 6, *GL* 0.49);
2. Prepared foodstuffs; beverages, spirits, and vinegar; tobacco (section 4, *GL* 0.47);
3. Textiles and textile articles (section 11, *GL* 0.44).

Within the period in Lithuania, the share of IIT decreased for the following set of commodities:

1. Live animals; animal products (section 1);
2. Mineral products (section 5);
3. Vehicles, aircraft, vessels, and associated transport equipment (section 17);
4. Works of art, collectors' pieces, and antiques (section 21).

For all the others, the share of IIT increased. The following three sets of commodities had the highest share of IIT in 2007:

1. Optical, photographic, cinematographic, measuring, checking, precision, medical, or surgical instruments and apparatus; clocks and watches; musical instruments (section 18, *GL* 0.44);

2. Prepared foodstuffs; beverages, spirits, and vinegar; tobacco (section 2, *GL* 0.42);
3. Raw hides and skins, leather, fur skins, and articles thereof (section 11, *GL* 0.40).

The commodity decomposition and therefore IIT-oriented sectors of economies are different in the Baltic states. This could be because of historical reasons, geopolitical reasons, and other reasons that affect the development of economic connections between countries. The main trade partners for the Baltic states were previously mentioned (see note 1). If Estonia tends more toward the northern countries (Finland, Sweden) attracting trade and business partners from these countries, then Latvia and Lithuania tend more toward European countries such as Germany and Poland. Russia is a more important trade partner for Latvia and Lithuania, which might show a higher persistence of Soviet economic connections.

Econometric Analysis

A number of testable hypotheses relating to country-specific factors and IIT can be drawn from theoretical models. These factors include cross-country differences in per capita income, income distribution, market size, physical and human capital endowment, and so on. In this section, we analyze determinants of total IIT and its vertical and horizontal components using different models. As a dependent variable we use previously computed shares of IIT.

Data for the analysis are from the following sources: www.nationmaster.com for GDP, GDP per capita, and electricity consumption; www.indo.com for distance calculation; United Nations University data on Gini coefficients; UNESCO Institute for Statistics and UN data on education expenditure; Estonian, Latvian, and Lithuanian Statistics Office data for GDP and GDP per capita for the last year of our estimations.

In the empirical literature, primarily cross-section and panel data analysis are used. In our estimations we use panel data and dynamic panel data analysis to capture cross-country and time-dependent effects. For the estimation, we use a panel of trade flow between the Baltic states and five main trading partners for 1999–2007 with 135 observations. All the regressions and tests are done using E-Views software. Regression results are presented in tables with standard errors in parentheses.

Three static panel data models using fixed effects (FE) and random effects (RE) and a dynamic panel data model have been estimated. Considering static panel data models, in order to choose between either FE or RE estimates, Hausman tests have been conducted. The test did not provide convincing evidence for or against one of the estimators. Using FE models limits the scope of the question under examination because time-invariant variables are eliminated. Coefficients yielded by the FE regressions were not appealing, and were hard to explain economically. Therefore, we use the RE models and present the regression results for the latter ones. Dynamic panel data specification and discussion of the test statistics follows later.

The first model considers the simplest gravitation model approach and follows Kandogan (2003). We regress measures of IIT against the GDP of both countries and distance; the model reads:

$$\log IIT_{i,j,t} = \alpha_1 \log GDP_{i,t} + \alpha_2 \log GDP_{j,t} + \alpha_3 \log DIST_{i,j} + v_{i,j} + \varepsilon_{i,j,t}, \quad (8)$$

Table 3. Model 1: Panel regression results for Baltic states' IIT

Explanatory variable	TIIT	VIIT	HIIT
$\log GDP_{\text{Baltic state}}$	0.235*** (7.05)	0.173*** (4.13)	0.294*** (3.93)
$\log GDP_{\text{Partner country}}$	–0.07*** (-3.67)	–0.026 (–1.31)	–0.147*** (–4.01)
$\log DIST$	–0.23*** (–3.7)	–0.22*** (-3.57)	–0.32*** (–2.860)
Const	–0.273 (–0.76)	–0.77 (–2.11)	–0.65 (–0.98)
Observations	135	135	135
Adj. R^2	0.351	0.279	0.294
F-stat.	25.17***	10.8***	15.84***

Source: Authors' calculations based on collected data.
*, **, *** coefficient estimates significant at the 1, 5, and 10 percent confidence levels, respectively.

where $\log IIT_{i,j,t}$ is log of measure of total, vertical, and horizontal IIT, i = Baltic state, and j = partner country, t = time; $\log GDP_{i,t}$ is log of GDP of Baltic state; $\log GDP_{j,t}$ is log of GDP of partner country; $\log DIST$ is log of distance between the capital cities of countries i and j; and $v_{i,j}$ is unobserved country-specific heterogeneity. The expected signs for vertical and horizontal IIT are $\alpha_1, \alpha_2 > 0$ and $\alpha_3 < 0$.

Regression results are shown in Table 3, which reveals that all variables are statistically significant for TIIT and HIIT. GDP of the partner country has an unexpected sign. One possible explanation could be the lower economic growth of partner countries compared to the growth rate of Baltic states and also their foreign trade development. Regression results show that GDP and distance are the most important factors for HIIT development. GDP captures the market size of a country and thus shows the importance of scale effect in HIIT. Distance is also more important in explaining HIIT than VIIT, as VIIT includes technological cooperation.

In the next model we included additional variables to capture factor endowment according to the H-O approach. The model reads as follows:

$$\log IIT_{i,j,t} = \alpha_1 \log GDP_{i,t} + \alpha_2 \log GDP_{j,t} + \alpha_3 \log DIST_{i,j} + \alpha_4 \log DGINI_{i,j,t} + \alpha_5 \log DED_{i,j,t} + \alpha_6 \log DEL_{i,j,t} + \alpha_7\, DUMEU_{i,j,t} + v_{i,j} + \varepsilon_{i,j,t}, \quad (9)$$

where $\log DGINI_{i,j,t}$ is the difference in Gini index of income distribution between Baltic state and partner country; $\log DED_{i,j,t}$ is the absolute difference in per capita expenditure on education between countries as a proxy for difference in human capital; $\log DEL_{i,j,t}$ is the absolute difference in energy consumption kWh per capita as a proxy for difference in physical capital; and $DUMEU_{i,j,t}$ is a dummy variable indicating the partner country is a member of the European Union.

In the theoretical models presented above, VIIT is modeled as a difference in quality. According to the H-O approach, a higher quality product is produced using more capital-intensive technologies and vice versa. Here we assume that capital-intensive technologies demand more electricity and thus difference in electricity consumption serves as

Table 4. Models 2 and 3: Panel regression results for Baltic states' IIT

	Model 2			Model 3		
Explanatory variable	**TIIT**	**VIIT**	**HIIT**	**TIIT**	**VIIT**	**HIIT**
log$GDP_{\text{Baltic State}}$	0.187*** (4.21)	0.113*** (2.18)	0.21*** (2.13)			
log$GDP_{\text{Partner country}}$	–0.07*** (–3.16)	–0.03 (–1.52)	–0.11*** (–2.52)			
log*DIST*	–0.25*** (–3.21)	–0.26*** (–4.25)	–0.30*** (–2.09)	–0.26** (–4.88)	–0.29*** (–2.6)	–0.28*** (–4.13)
log*DGINI*	0.03 (1.19)	0.04 (1.23)	0.09 (0.15)	0.04** (1.67)	0.01 (0.33)	0.04 (1.21)
log*DED*	–0.05* (–1.81)	–0.02 (–0.72)	–0.14*** (–2.16)	–0.08*** (–3.06)	–0.2*** (–3.41)	–0.02 (–0.69)
log*DEL*	0.02 (1.00)	0.01 (0.55)	0.05 (1.22)	0.02 (1.06)	0.06 (0.11)	0.009 (0.37)
DUMEU	–1.197 (1.00)	–0.22*** (–2.22)	–0.1 (–0.44)	–0.23*** (–2.62)	–0.15 (–0.82)	–0.27*** (–2.42)
log*DYPC*	—	—	—	–0.16 (–0.62)	–0.11 (–0.83)	–0.19 (–0.48)
log*AVY*	—	—	—	0.17*** (2.09)	0.04 (0.27)	0.25*** (2.36)
Constant	–0.1 (–0.21)	–0.37 (–0.82)	–1.21 (–1.18)	0.07 (0.18)	–1.07 (–1.37)	–0.23 (–0.48)
Observations	123	123	123	123	123	123
Adj. R^2	0.308	0.188	0.196	0.346	0.26	0.18
F-stat.	8.76***	5.03***	5.24***	10.2***	7.44***	4.93***

Source: Authors' calculations based on collected data.
*, **, *** coefficient estimates significant at the 1, 5, and 10 percent confidence levels, respectively.

a proxy for physical capital. The assumption could be subject to criticism that not all capital-intensive production demands more electricity, but in major sectors of industry, the assumption is not far from reality. Therefore, we predict a higher level of VIIT with larger differences in the factor endowments between trading partners. Thus, the expected signs for vertical IIT are $\alpha_4, \alpha_5, \alpha_6, \alpha_7 > 0$.

For HIIT, increasing returns factors dominate, and therefore, a negative sign of factor endowment variables is expected. Countries' similarity and product differentiation are the main factors of this type of trade.

The results for the model are presented in Table 4 under Model 2. In this specification, we observed a high significance of difference in human capital for IIT in TIIT and also HIIT with the expected sign. Difference in physical capital and income distribution variables have the expected sign for VIIT, but are not statistically significant. The dummy variable for the EU country is statistically significant for VIIT but has an unexpected sign. The market size and distance variables are significant and have the same signs as in the previous model.

In the third specification, following Brühlart (2008), we replace GDP variables with variables of average GDP and absolute difference in per capita GDP between trading partners. The first one captures the market size and the second the factor endowment difference. The model is as follows:

$$\log IIT_{i,j,t} = \alpha_1 \log DYPC_{i,j,t} + \alpha_2 \log \mathrm{AVY}_{j,j,t} + \alpha_3 \log DIST_{i,j,t} + \alpha_4 \log DGINI_{i,j,t} + \alpha_5 \log DED_{i,j,t} + \alpha_6 \log DEL_{i,j,t} + \alpha_7\, DUMEU_{i,j,t} + v_{i,j} + \varepsilon_{i,j,t}, \quad (10)$$

where $\log DYPC_{i,j,t}$ is the absolute difference in GDP per capita of Baltic state and partner country, and $\log AVY_{i,j,t}$ is the average GDP of the trading partners.

The results are shown in Table 4 under Model 3. As can be seen, market size variables have the expected sign and are significant for TIIT and HIIT. The variable of the difference in per capita GDP between trading partners is statistically insignificant.

Finally, we estimate a dynamic panel data model to check the persistence of the IIT process and analyze whether there could be some uncaptured effect of factor endowment variables. The model reads:

$$\log IIT_{i,j,t} = \gamma \log IIT_{i,j,t-1} + \alpha_1 \log DED_{i,t} + \alpha_2 \log DEL_{j,t} + \alpha_3 \log DGINI_{t,j} + v_{i,j} + \varepsilon_{i,j,t}. \quad (11)$$

The estimation is done using Arellano-Bond (AB), fixed effects, and random effects procedures and yields the results presented in Table 5.

In the AB model, further lags of $\log(H/V/T)IIT$ are used as instruments for the first lag variable while other explanatory variables are assumed to be exogenous. The Sargan test of overidentifying restrictions for the model provides some evidence against the validity of the instruments, particularly in the TIIT and HIIT specifications (Table 6).

Tests for second-order autocorrelation show that it could be present in the TIIT specification. The tests reveal some possible problems with the AB approach, but in general the estimates seem appealing and economically sensible. The other appealing model could be FE, as it eliminates time-invariant variables. The coefficients of the FE model are different from those of the AB model. Statistically significant variables are indeed the same, except for $\log HIIT_{t-1}$ and $\log GINI$ variables for the HIIT specification. It is fairly difficult to determine the exact effect of factor endowment variables on IIT, though a positive effect of difference in educational spending ($\log DED$) per capita is certain. The effect is of a higher magnitude for HIIT than for VIIT. The process of IIT and TIIT is highly persistent. A positive effect of difference in the Gini indexes could be plausible for HIIT and a positive effect of differences in physical capital ($\log DEL$) and income distribution ($\log DGINI$) could be plausible for TIIT.

Conclusions

IIT forms nearly one-third of world trade. In recent years, the share of IIT had a general tendency to increase. VIIT plays a dominant role in trade flows. Previous papers have shown that the share of IIT should increase with trade liberalization. In the current study, we have observed similar dynamics for the Baltic states in 1999–2007. After foreign trade policy liberalization and structural economic reforms, trade flows in the Baltic states dramatically increased. Strong domestic demand for consumption and investment goods was financed primarily through capital inflows from the Western and Nordic countries.

Theoretical models show that HIIT and VIIT are of a different nature. For HIIT, increasing return factors play a key role. One of the most straightforward positive dependences is between HIIT and market size, that is, a country's GDP. For vertical differentiation

Table 5. Dynamic panel regression results for Baltic states' IIT

Estimated model	Independent variable	log*TIIT*	log*HIIT*	log*VIIT*
Arellano-Bond (AB)	logIIT_{t-1}	0.28*** (0.11)	0.064 (0.13)	0.25*** (0.25)
	log*DED*	0.13*** (0.05)	0.22*** (0.096)	0.12* (0.11)
	log*DEL*	–0.007 (0.03)	0.024 (0.066)	–0.044 (–0.04)
	log*DGINI*	0.03 (0.03)	0.09** (0.058)	0.023 (0.025)
	Constant	–0.759* (0.24)	–1.6998 (0.42)	–0.734* (–0.72)
	Number of instruments	32	32	32
	Observations	99	99	99
FE	logIIT_{t-1}	0.4572*** (0.07)	0.5221*** (0.073)	0.4812*** (0.08)
	log*DED*	0.1413*** (0.032)	0.1853*** (0.08)	0.1215*** (0.04)
	log*DEL*	–0.0137 (0.031)	–0.0438 (0.062)	0.0109 (0.039)
	log*DGINI*	0.0518 (0.017)	0.0488 (0.044)	0.0407 (0.02)
	Constant	–0.9297 (0.017)	–1.452*** (0.33)	–1.135*** (0.18)
	R^2	0.42	0.33	0.38
	F-stat	24.54	17.29	13.98
	Observations	117	117	117
RE	logIIT_{t-1}	0.4742*** (0.07)	0.5294*** (0.08)	0.4855*** (0.071)
	log*DED*	0.0660*** (0.024)	0.0271 (0.05)	0.0354 (0.026)
	log*DEL*	–0.0366* (0.025)	–0.0626 (0.049)	–0.0176 (0.03)
	log*DGINI*	0.0354* (0.020)	0.0085 (0.049)	0.0295 (0.026)
	Constant	–0.6655 (0.104)	–0.993*** (0.189)	–0.831 (0.10)
	R^2	0.39	0.31	0.35
	Wald χ^2	80.26	46.52	42.48
	Observations	117	117	117

Source: Authors' calculations based on collected data.

***, **, * coefficient estimates significant at the 5, 10, 15 percent confidence levels, respectively.

Table 6. Sargan test for overidentifying restrictions

Tested specification	Test statistic	*p*-value
TIIT	47.9	0.007
HIIT	43.3	0.020
VIIT	30.7	0.270

Source: Authors' calculations based on collected data.

models, H-O similar factor endowments are of primary importance. The difference in factor endowments and income distribution should positively correlate with VIIT.

There are some limitations of the methodology applied in our paper. First, the *GHM* approach for computing the IIT and decomposing it into HIIT and VIIT is subject to criticism. The approach builds upon the comparison of import and export unit values, where the threshold for a trade flow to be HIIT or VIIT might be said to suffer from randomness. Our findings show that the share of TIIT in the Baltic states has significantly increased, though the structure of IIT is different in each country. While in Estonia and Latvia the increase in VIIT has caused the growth of TIIT, in Lithuania it was due to the growth of HIIT. As a trade and industry policy implication, Estonia and Latvia should support and develop sectors that contribute more to HIIT than to VIIT, which is based on factor endowments. Supporting sectors with potentially high HIIT trade will be especially beneficial for the countries and the region in general. Commodity composition of IIT is also different in each country.

The econometric analysis in the last part of the paper provides some evidence in favor of trade theory, but there may be some issues to be cautious about. There could be an identification problem, as GDP of the trading partner has an unexpected sign in all the static panel data models. Some specifications of dynamic panel data suffer from second-order correlation, and there is some evidence against the validity of instruments used. Results of the estimations support to some extent the theoretical predictions of IIT determinants. Market size as a factor of increasing returns is important for TIIT of the Baltic states. Transportation cost measured by distance is also an important determinant of IIT. This is more the case for HIIT. Among factor endowment variables supporting the H-O approach, the most significant for the IIT of the Baltic states is the difference in human capital endowment measured by the difference in per capita expenditure on education between countries.

As an agenda for further research, we suggest looking at more recent trade data and analyzing how the recession has influenced the development of IIT in small open economies such as the Baltic countries.

Notes

1. The main export partners in 2007 for Estonia were: Finland 18.0 percent, Sweden 13.0 percent, Latvia 11.0 percent, Russia 9.0 percent, Lithuania 6.0 percent; for Latvia: Lithuania 15.1 percent, Estonia 13.8 percent, Russia 13.0 percent, Germany 8.3 percent, Sweden 7.4 percent; and for Lithuania: Russia 15.0 percent, Latvia 12.8 percent, Germany 10.4 percent, Poland 6.2 percent, Estonia 5.8 percent.

2. Additional information on HS structure is available, for example, at the Web site of the European Commission in the section dedicated to TARIC (http://ec.europa.eu/taxation_customs/dds2/taric/taric_consultation.jsp?Lang=en/).

3. Sections refer to HS structure.

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APPENDIX 3. Intra Industry Trade in the Baltic States: Long Run Analysis

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Intra Industry Trade in the Baltic States: Long Run Analysis

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Abstract: This paper investigates intra-industry trade (IIT) long run homogeneous dynamics in Estonia, Latvia and Lithuania in 1999–2007. The IIT is decomposed into its vertical and horizontal components. The long run effects are estimated as an error correction term in the panel under assumption of heterogeneous short run dynamics. I discuss five potential long run relationships that are based on trade theory and control for the effects of market size, capital endowments and income distribution. The results suggest that neither market size nor human and physical capital endowments taken alone have any long run effect on IIT. Considering the effects of combination of factors I show, that if controlled for the market size and factor endowments (human and physical capital), both have an effect on horizontal and total IIT, whereas only market size and human capital endowment affects vertical IIT. Apart from that I find common effect of income distribution on vertical IIT.

Key words: intra industry trade; long run effects; dynamic heterogeneous panel; Baltic States

JEL codes: F14, F15

1. Introduction

In the empirical trade literature, one could find a substantial bulk of research on the determinants of intra-industry trade (IIT). Authors are mainly interested in the analysis of the IIT in the developing countries. The vast majority of the papers is based on panel data analysis (Fertö, 2005; Kandogan, 2003; Veeramani, 2002). Those papers concentrate on testing trade theory-based hypotheses related to country-specific factors and IIT. These factors include cross-country differences in income distribution, market size, physical and human capital endowments (Krugman, 1979; Flam and Helpman, 1987; Falvey and Kierzkowski, 1987; Shaked and Sutton, 1984). IIT is usually decomposed into its vertical and horizontal components. Horizontal IIT (HIIT) is the exchange of commodities differentiated by attributes other than quality. The models of horizontal IIT are considered to be of greater relevance to trade among the developed countries. The models of vertical IIT (VIIT) are considered to reflect trade flows between developed and developing countries.

The main findings in the empirical literature show that the variables from increasing returns trade theory, such as scale of economies, similarity of income levels play important role especially in determining horizontal IIT, whereas factors such as comparative advantage, dissimilarity in income levels and level of development of trade partners as in Heckscher-Ohlin (HO) theory have less impact on determining vertical IIT (Kandogan, 2003; Veeramani, 2002).

In the above mentioned empirical papers the conventional static panel data models are used. As an outcome of the estimation one could obtain standard pool estimates, fixed and random effects estimates where only

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intercepts could be allowed to differ across groups (e.g., Green (2011) for a textbook exposition). In fact, these pooled models could be subject to a criticism for a number of reasons. For example, problems with the pooled estimation and its interpretation could arise due to some properties of the data and homogeneity restrictions.

Suppose one is interested in the dynamics of economic relations in the panel data context. That may complicate estimation substantially, as the data may be subject to a serial correlation, heteroskedasticity and endogeneity of explanatory variables. The solution to the majority of the aforementioned complications was found by Arellano and Bond (1991), who developed the consistent estimator based on generalized method of moments (GMM).

GMM estimation methods for the dynamic panels proposed by Blundell and Bond (2000) could be used to eliminate the unobserved, say industry specific effects through the equations in first-differences. The GMM estimator also controls for the endogeneity of the explanatory variables using the lags of those variables as valid instruments in the case of an absence of serial correlation. Some recent empirical IIT papers took advantage of the methods and used dynamic properties of the panel data (Faustino and Leitao, 2006; Fainštein and Netšunajev, 2011). These papers suggest that IIT is a persistent process and the result obtained in the papers tend to confirm theoretical predictions of the effects of increasing returns and HO factors on IIT.

However the interpretation of the estimated dynamic panel may be somewhat limited. Namely, the short run dynamics and error variances are assumed the same across groups. Note, that in the studies of IIT it may not be a valid assumption. As groups are usually pairs of trading partners, then short run dynamics may be quite different across the groups. One could regard it as different short-run reaction to some macroeconomic shocks. On the other hand, the long run equilibrium relationship between the variables could be similar across the groups. That is due to the fact that usually the countries of interest are taken from a specific economically integrated region or even if countries are geographically far from each other, they share similar level of economic development. Sometimes the groups may represent even the whole population rather than the sample from a population. Therefore the countries may reach the same long-run equilibrium but with a different speed of adjustment. These are the main reasons why the standard pooling methodology is of limited use in the intra-industry trade context.

Having the discussion of common long run equilibrium relationship in mind, the objective is to look for an empirical model that would allow for relaxing the assumptions on short-run homogeneity and homogeneity of error variances and estimate the common long run effects of factors on the IIT. It should be mentioned that at another extreme it would be possible to estimate separate equations for each group and then produce the mean of the estimates. That would yield consistent estimate of the mean effect (Pesaran and Smith, 1995) without taking into account the fact that some parameters may be common for the groups. But I am interested in something that is in between the pooled and the mean estimation. That leads to the pooled mean group estimator proposed by Pesaran, Shin and Smith (1999).

In the present paper, I limit the analysis with a homogeneous region of the transition states, the Baltic countries, which experienced the highest gross domestic product (GDP) growth in 2004–2006, compared to the other new members of the European Union (EU). The Baltic countries are unique in the sense that during Soviet times trade flows were almost completely orientated to the East. Other Central and East European (CEE) countries during the so-called iron curtain period had some foreign trade activities with Western countries. After the fall of the Soviet Union the Baltic countries experienced a rapid structural reorientation of trade flows from Eastern to Western countries, while the reorientation was not that dramatic in the other CEE countries. That makes Estonia, Latvia and Lithuania an interesting and unique research object in the field of international trade. The Baltic states have much in common in the recent past and that gives a good ground to conduct the long-run analysis based on the assumption of common long run equilibrium. The main contribution of the paper could be summarized as follows. Using the heterogeneous panel data analysis the long run effect of certain factors on IIT of emerging economies is discussed.

The rest of the paper is organized as follows. Section 2 discusses the empirical model setup and associated assumptions. Section 3 describes and discusses the data and presents the main empirical findings of the paper. The last section concludes.

2. The Model Setup

The model setup in this section will closely follow Pesaran et al. (1999). Suppose that there is available data on time periods, t = 1, 2,…,T , and groups, i = 1, 2,…,N and one wishes to estimate an autoregressive distributed lag model (ARDL(p; q)) of the form:

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q} \boldsymbol{\delta}'_{ij} \boldsymbol{x}_{i,t-j} + \mu_i + \epsilon_{it} \tag{1}$$

where $\mathbf{x}_{it}$ is the vector of $(k \times 1)$ explanatory variables for group i; μ_i represents the fixed effects, the coefficients on the lags of the dependent variable, λ_{ij} -s are scalars; and $\boldsymbol{\delta}_i$ are $(k \times 1)$ coefficient vectors. If we stack the time-series observations for each group, then equation (1) can be rewritten as:

$$\Delta y_i = \phi_i y_{i,-1} + X_i \beta_i + \sum_{j=1}^{p-1} \lambda_{ij}^{*} y_{i,-j} + \sum_{j=0}^{q-1} \Delta X_{i,-j} \delta_{ij}^{*} + \mu_i \imath + \epsilon_i \tag{2}$$

In the equation (2) the notation is as follows: $\mathbf{y}_i = (y_{i1},\dots, y_{iT})'$ is a $T \times 1$ vector of observations on the dependent variable of the i-th group; $X_i = (x_{i1}, \dots, x_{iT})'$ is a $T \times k$ matrix of the regressors that vary across groups and time periods; $\imath = (1, \dots, 1)'$ is a $T \times 1$ vector of ones; $\mathbf{y}_{i,-j}$ and $X_{i,-j}$ are j period lagged values of y_i and X_i; $\Delta y_i = y_i - y_{i,-1}$; $\Delta Xi = X_i - X_{i,-1}$.

The reparameterized coefficients of (2) are: $\phi_i = -\left(1 - \sum_{j=1}^{p} \lambda_{ij}\right)$, $\beta_i = \sum_{j=1}^{q} \boldsymbol{\delta}_{ij}$, $\lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \lambda_{ij}$, $j = 1,2 \dots p-1$; and $\boldsymbol{\delta}^{*} = -\sum_{m=j+1}^{q} \boldsymbol{\delta}_{im}$, $j = 1, 2 \dots q-1$.

The model is based on the following assumptions. It should be emphasized that the assumptions will be further discussed in the context of the current dataset in Section 3.

Assumption 1. The disturbances ϵ_{it} i = 1, 2, …, N; t = 1, 2,…, T in (1) are independently distributed across i and t, with means 0, variances $\sigma_i > 0$, and finite fourth-order moments. They are also distributed independently of the regressors x_{it}-s.

Assumption 2. The ARDL(p; q) model in (1) is stable in that the roots of

$$\sum_{j=1}^{p} \lambda_{ij} z_j = 1, \qquad i = 1, 2, \dots, N$$

lie outside the unit circle. This assumption ensures that $\phi_i < 0$ and hence there exists a long-run relationship between y_{it} and x_{it} defined by $y_{it} = -\left(\frac{\beta'_i}{\phi_i}\right) x_{it} + \eta_{it}$ for each i = 1, 2, …, N where η_{it} is a stationary process.

Assumption 3. The long-run coeffcients on X_i, defined by $\Theta_i = -\beta_i/\phi_i$ are the same across the groups, namely $\Theta_i = \Theta$, $i = 1,2, \dots, N$. Then under stated assumptions 1-2 the equation (2) can be rewritten more compactly as:

$$\Delta y_i = \phi_i\left(y_{i,-1} - X_i \Theta\right) + W_i k_i + e_i, i = 1,2, \dots, N \tag{3}$$

where $y_{i,-1} - X_i \Theta \equiv \Pi(\Theta)$ is the error correction component, $W_i = \left(\Delta y_{i,-1}, \dots, \Delta y_{i,-p+1}, \Delta X_i, \dots, \Delta X_{-q+1}, \imath\right)$ and $k_i = (\lambda_{i1}^{*}, \dots, \lambda_{p-1}^{*}, \delta'^{*}_{i,0}, \dots, \delta'^{*}_{1,q-1}, \mu_i)'$.

Assumption 4. To estimate the model, I adopt a likelihood approach and assume that the disturbances e_{it} are normally distributed. The parameters of interest are the long-run effects and adjustment coefficients; therefore I work with the concentrated log-likelihood function:

$$L(\varphi)_T = -T/2 \sum_{i=1}^{N} \log\left(2\pi\sigma_i^2\right) - 0.5 \sum_{i=1}^{N} \left(\Delta y_i - \phi_i \Pi(\Theta)\right)' H_i (\Delta y_i - \phi_i \Pi(\Theta)) \quad (4)$$

where $H_i = I_T - W_i(W'_i W_i)^{-1} W'_i$, $\varphi = (\Theta', \phi', \sigma')'$, $\phi = (\phi_1, \dots, \phi_N)'$, $\sigma = (\sigma_1^2, \dots, \sigma_N^2)'$.

To obtain the parameter estimates, a non-linear optimization procedure is adopted. The function in (4) is numerically maximized w.r.t. the parameters of interest. Understandingly, such a procedure may be computationally demanding and the results may depend on the starting values. To reduce the possibility that the optimization has ended up in a local optimum, the maximization of (4) is done for a whole range of starting values. Then the estimates that resulted in the highest likelihood are chosen. The standard errors of the parameters are obtained from the numerical approximation of the Hessian of the likelihood function evaluated at the optimum. The short run coefficients could be consistently estimated by running a set of independent OLS regressions of $\Delta \boldsymbol{y}_i$ on $(\Pi(\widehat{\Theta}), W_i)$ for i = 1, 2, …, N.

In the case of large N and T the mean of the adjustment coefficients can be consistently estimated by the average of the individual coefficients: $\hat{\phi} = N^{-1} \sum_{i=1}^{N} \hat{\phi}_i$ and the variance of this parameter will be given by $\sigma_{\hat{\phi}} = \frac{1}{N-1} \sum_{i=1}^{N} (\hat{\phi}_i - \hat{\phi})^2$.

3. Empirical Analysis

3.1 The Data

The data closely follows the work previously done by Fainštein and Netšunajev (2010) and Fainštein and Netšunajev (2011). The measures of the level of intra-industry trade calculated as Grubel-Lloyd (GL) index (Grubel and Lloyd, 1975) for the pairs of the Baltic countries and their 5 main trading partners are used as dependent variables. The exact pairs of countries could be seen in the Table 1. The index is decomposed into its horizontal and vertical component as suggested by Greenaway, Hine and Milner (1994). That gives three dependent variables for separate estimations: vertical IIT, horizontal IIT and total IIT.

Theoretical models show, that HIIT and VIIT are of a different nature. For HIIT increasing return factors play a key role. One of the most straightforward positive dependence is between HIIT and market size, i.e., GDP of a country. For the models with vertical differentiation, Heckscher-Ohlin similar factor endowments are of primary importance. The difference in factor endowments and income distribution should be positively related to VIIT.

Therefore I consider the following explanatory variables: GDP of the trading partner as a measure of market size, difference in the educational expenditure per capita as a measure of human capital endowment, difference in the electricity consumption per capita as a measure of physical capital endowment and differences in the Gini indexes as a measure of income inequality. All variables are in logs. Exact specifications will be discussed in the Section 3.2. The sources for the explanatory variables are: data from www.nationmaster.com for GDP of trading partners and electricity consumption; United Nations University data on Gini indices; UNESCO Institute for Statistics and UN data on education expenditure.

The panel is constructed in the following way. The groups are 15 pairs (i = 1, …, 15) of Baltic states and their five main trading partners (five pairwise relations for each of the Baltic country). The time span is 9 years (1999–2007). One could have used more recent data, but that is avoided due to potentially extreme behavior of the variables in the crisis period. Therefore, the panel consists of 135 observations in all.

Table 1 ADF Test for Stationarity of IIT Series

Pair of trading partners	VIIT	HIIT	TIIT
EE-FI	-2.9930	-1.4681	-3.0991
EE-LT	-0.8162	-1.6746	-1.0862
EE-LV	-1.0862	-1.1277	-0.7350
EE-RU	-1.0976	-0.7624	-1.9431
EE-SE	-1.0224	-2.0414	-1.6440
LT-DE	-2.7399	-0.2197	-1.1540
LT-EE	-2.4168	-1.2474	-2.2239
LT-LV	-1.7836	-0.3346	-0.7861
LT-PL	-2.0990	-0.4711	-1.0862
LT-RU	-1.6275	-0.3879	-2.3301
LV-DE	-0.7515	-3.1072	-1.0078
LV-EE	-0.1348	-1.4636	-0.6737
LV-LT	-1.2154	-2.1909	-1.2600
LV-RU	-2.2049	-1.9238	-1.7520
LV-SE	-0.5718	-0.8977	-1.0718
	Critical values: 1% 5% 10% -3.43 -2.86 -2.57		

Note: The test was conducted for nonzero mean and 1 lag models.

3.2 Econometric Analysis

As previously discussed, the data consists of yearly observations. Therefore, ones as lag orders p and q are chosen. That is supported by the majority of information criteria (Akaike Information Criterion, Schwarz Criterion) for all of the groups of the panel.

The augmented Dickey-Fuller (ADF) tests for stationarity of the IIT series for each of the groups in the panel were conducted for the 1 lag and nonzero mean model. The results are reported in Table 1. The test statistic values for all of the series are above the 5% critical values. That is the evidence in favor of the hypothesis that all IIT processes are not integrated of order zero. Further, the first differences in IIT series are stationary, giving good ground for the use of error correction specification as in (3).

In the paper I do not investigate the stationarity of the regressors used. The order of integration of the regressors is unlikely to be higher than that of dependent variables which are all shown to be I(1). Therefore asymptotically the estimation results do not change for the cases when the regressors are either I(0) or I(1) processes. (Pesaran et al., 1999).

A word of caution should be said about the estimation procedure and potential results prior to the discussion of exact specifications and inference. Note that time span T = 9 is quite small for the panel I use and the number of estimated parameters is quite large (more then 30). Therefore there is a possibility of small sample distortions in the estimation. For small T one might underestimate ϕ_i, as well as downward bias of lagged dependent variables may be offset by the upward heterogeneity bias discussed in Pesaran and Smith (1995). These features complicate inference about the speed of adjustment and short run dynamics, but, even with biased estimates, one could draw some relevant conclusions. The interest is in the long run effects and hence short run coefficients are not of a significant interest. Further discussion of $\hat{\phi}$ will be based on the fact that it is possibly the lower bound of the effects of interest.

The next important issues to discuss are the assumptions of the model from Section 2. First, ϵ_{it} must be distributed independently across groups and time. In the current empirical application, there is a good reason to think of residuals being independent across groups. The groups are pairs of trading partners, where the short run dynamics is different. This assumption could be justified if one thinks of the pairwise relations of trading partners being quite different. That may not be far away from reality as some of trading partners are not members of the EU and trading partners differ across the Baltic countries. Given the lag order of $y_{i,-1}$ and X_i there is no serial correlation left in the residuals, making ϵ_{it} distributed independently across time.

Second, are ϵ_{it} independent of the regressors? One could think of many possibilities why regressors may not be strictly exogenous in the current study (omitted variables or measurement errors are just some of possible examples). Recall that this assumption is needed for consistent estimation of the short run coefficients (Pesaran, Shin and Smith, 1997). Taking into account the focus of the study, violation of this assumption should cause little problems for the long run analysis. Therefore, even the unlucky case of potentially correlated regressors should affect the result only marginally, if at all.

The next point to discuss is the possibility of testing of the long run homogeneity assumed in the model. That is extensively discussed in Pesaran et al. (1997) and Pesaran et al. (1999). The model with imposed long run homogeneity is a restricted version of the set of country-by-country first order ARDL equations. The fixed effect estimator (imposes common slopes, coefficients and variances) is the most restrictive model. The likelihood ratio test will be useful in the context however one would need to estimate unrestricted models (in the current case ARDL for the set of countries) and the restricted models as in (4). That would be feasible for large T, but in the present framework the model (4) would have too many parameters to estimate, if the concentrated likelihood function is abandoned. The Hausman type tests discussed in Pesaran, Smith and Im (1995) and Pesaran et al. (1997) would require estimation of the same models with high number of parameters as discussed before. Therefore, the judgment of the existence of the long run relationships of interest will be based on the estimated $\widehat{\Theta}$-s and their standard errors.

The current interest is in the existence of the long run relationships between IIT and the theory based dependent variables. In what follows five potential long run homogeneous relationships between Δy_i and X_i are distinguished. Note that the first three specifications examine the dependency of IIT on solely market size, income distribution or factor endowments, whereas fourth specification controls for joint effects of market size and factor endowments and fifth for joint influence of factor endowments and income distribution.

(1) There is a long run homogenous effect of market size. $\Theta = (\theta^{\Delta GDPPartner})$

(2) There is a long run homogenous effect of the difference in income distribution. $\Theta = (\theta^{\Delta Gini})$

(3) The long run relationship is based on the effect of difference of human and physical capital. $\Theta = (\theta^{\Delta Education}, \theta^{\Delta Electricity})'$

(4) The long run relationship is based on the effect of market size and factor endowments $\Theta = (\theta^{\Delta GDPPartner}, \theta^{\Delta Education}, \theta^{\Delta Electricity})'$

(5) The long run relationship is based on the effect of differences in factor endowments and income distribution. $\Theta = (\theta^{\Delta Education}, \theta^{\Delta Electricity}, \theta^{\Delta Gini})'$

To start with, I would like to discuss is the assumption of the normality of the residuals in the model (1). Understandingly, the residuals of interest could be calculated only once (3) is fully estimated. In the current setup it is not feasible due to limitations discussed earlier and hence the assumption could not be formally tested.

Notwithstanding there is no obvious reason to suspect the non-normality of the residuals, as for example one should do when dealing with some financial data.

Having that in mind, in order to try to get some evidence in favor of the distributional assumption, I obtain the residuals using the maximum likelihood estimates of the concentrated log likelihood. These are then subjected to the Jarque-Bera (Jarque and Bera, 1987) normality test. The results of the test for each specification could be found in Tables 2–6. It is clear that the test would fail to reject the null of normality at 5% level for some of the regressions. Those are more associated with the cases when the effects of individual factors (market size, factor endowment, income distribution) on IIT are of interest. The failure of the normality assumption may to some extent reflect the fact that the model may be a bad approximation of the data generating process. Consequently one could also question the validity of the long run relationships in the specifications where the normality does not hold.

Further, from Tables 2–6 one could see that the estimated mean adjustment coefficients $\hat{\phi}$ are not very different across the models; they oscillate at around -0.3. Relatively large standard errors are due to the estimation precision and small sample issues. Recall that the results in the last passage of Section 2 hold for relatively large T. That means that the estimates might be biased in the current case, or put differently, the estimates may represent the lower bound of the effects. Hence, the reader is invited to think of the results as of the estimated lowest possible effect. Next the results for each specification will be discussed in turn.

The results for the first specification are shown in Table 2. Inspecting the estimates and their standard errors one could see that the inference would be problematic due to high standard errors for both vertical and total IIT. Also, low p values of the normality test for HIIT and TIIT could be an indication of a misspecification. This result suggests that there is hardly a long run effect solely of the market size on IIT. A similar picture can be seen in Table 3 where the results for the second specification are presented. The only exception is the long run relationship between income distribution and VIIT, which may be positive.

Table 2 Estimates of Long Run Effects for $\boldsymbol{\Theta} = (\boldsymbol{\theta}^{\Delta GDPPartner})$

Estimate	VIIT	HIIT	TIIT
$\hat{\theta}^{\Delta GDPPartner}$	0.7020 (0.2021)	-0.2062 (0.0974)	0.66971 (1.22381)
$\hat{\phi}$	-0.3548 (0.6390)	-0.3883 (0.6484)	-0.2626 (0.7123)
$LogL_T$	173.93	109.9528	208.6564
Jarque-Bera test p-value	0.05	0.002	0.03

Table 3 Estimates of Long Run Effects for $\boldsymbol{\Theta} = (\boldsymbol{\theta}^{\Delta Gini})$

Estimate	VIIT	HIIT	TIIT
$\hat{\theta}^{\Delta Gini}$	0.3407 (0.0138)	-0.2434 (3.5410)	0.1990 (1.04)
$\hat{\phi}$	-0.2669 (0.6538)	-0.2994 (0.6058)	-0.2699 (0.5332)
$LogL_T$	179.8561	106.4185	193.5685
Jarque-Bera test p-value	0.05	0.001	0.03

The estimated long run parameters for the third specification are presented in Table 4. For the vertical IIT both factor endowment variables have high standard errors and therefore it would be hard to justify the long run effects behind. For both horizontal and total IIT there is hardly a long run effect of the difference in human capital. But the long run effect of difference in physical capital represented by the difference in electricity consumption per capita should not be neglected. However the p values of the normality for both HIIT and TIIT would suggest that the underlying distributional assumption may not be valid.

Table 4 Estimates of Long Run Effects for $\boldsymbol{\Theta} = (\boldsymbol{\theta}^{\Delta Education}, \boldsymbol{\theta}^{\Delta Electricity})'$

Estimate	VIIT	HIIT	TIIT
$\theta^{\Delta Education}$	0.3112 (0.44)	-0.3275 (0.1248)	0.3466 (0.1908)
$\theta^{\Delta Electricity}$	0.0312 (2.9148)	-1.4217 (0.0378)	-1.0236 (0.0454)
$\hat{\phi}$	-0.3664 (0.6662)	-0.4115 (0.9126)	-0.3239 (0.5369)
$LogL_T$	182.9730	114.2986	216.7204
Jarque-Bera test p-value	0.28	0.02	0.01

The results for the next specification are shown in Table 5. That specification controls for the effect of market size in addition to the factor endowments. First, note that the Jarque-Bera test fails to reject normality; hence, one is on more solid ground with the inference. One could see that for vertical IIT both market size and difference in educational spending have common long run effect. For horizontal and total IIT, all of the factors could be seen as having the long run effect.

Table 5 Estimates of Long Run Effects for $\boldsymbol{\Theta} = (\boldsymbol{\theta}^{\Delta GDPPartner}, \boldsymbol{\theta}^{\Delta Education}, \boldsymbol{\theta}^{\Delta Electricity})'$

Estimate	VIIT	HIIT	TIIT
$\theta^{\Delta GDPPartner}$	-1.1293 (0.0386)	0.6554 (0.0417)	0.3888 (0.0014)
$\theta^{\Delta Education}$	1.6398 (0.0451)	-0.0295 (0.0034)	0.0679 (0.0021)
$\theta^{\Delta Electricity}$	-0.1698 (0.2294)	-1.0501 (0.0409)	0.1112 (3.3×10^{-4})
$\hat{\phi}$	-0.2416 (0.7270)	-0.3125 (0.8279)	-0.4465 (0.9551)
$LogL_T$	275.3645	236.0802	332.0228
Jarque-Bera test p-value	0.06	0.05	0.07

Consider the last specification. Results in Table 6 only show strong evidence in favor of the normality assumption for vertical IIT. All factor endowment variables and income distribution have a long run effect on VIIT. The positive long run effect of the human capital endowment on VIIT is present for specifications 4 and 5, but it is of different magnitude. As to horizontal and total IIT, the inference is problematic due to low p values, although the long run effect may be there.

Table 6 Estimates of Long Run Effects for $\boldsymbol{\Theta} = (\boldsymbol{\theta}^{\Delta Education}, \boldsymbol{\theta}^{\Delta Electricity}, \boldsymbol{\theta}^{\Delta Gini})'$

Estimate	VIIT	HIIT	TIIT
$\theta^{\Delta Education}$	0.0802 (9.3×10^{-5})	0.1930 (0.0016)	0.7543 (0.0205)
$\theta^{\Delta Electricity}$	0.3742 (1.1×10^{-5})	0.0522 (4.4×10^{-4})	-0.4999 (0.0581)
$\theta^{\Delta Gini}$	0.2829(8.4×10^{-5})	-0.3815 (0.0055)	-1.1886 (0.0254)
$\hat{\phi}$	-0.2102 (0.6279)	-0.2947 (1.0096)	-0.0358 (0.4550)
$LogL_T$	310.3235	247.3202	337.6848
Jarque-Bera test p-value	0.11	0.02	0.01

To summarize the findings briefly, it is possible that neither factor endowments nor market size solely have a long run effect on the IIT in the Baltic countries. As for income distribution, it may have a positive long run effect on vertical IIT, though not on HIIT and TIIT. Therefore, it should be a combination of different factors that have a long run effect on IIT. That may be due to different reasons. First, the behavior of the real data is different of what the theoretical models would imply and hence in reality it may be very well that the IIT is influenced by a combination of different factors. Second, the theory tells us about short run dynamics, though empirically long run effects are analyzed. Those may not coincide and in the long run the interaction of different factors may be more sophisticated then the short run dynamics. Third, to be critical, one should bear in mind that IIT was decomposed into horizontal and vertical components using a dispersion factor as proposed by Greenaway et al. (1994). It may happen that using other dispersion factor and hence, different shares of horizontal and vertical IIT, might lead to different results of the estimation.

4. Conclusions

The paper exploits properties of the heterogeneous panel and applies pooled mean group estimation method to the case of intra industry trade of the Baltic states. The aim of the paper is to estimate the long run relationship between horizontal, vertical and total IIT and theory based economic factors such as market size, differences in factor endowments and differences in income distribution between trading partners. For that purpose five empirical models describing the relationships of interest are proposed. The estimation is based on the ARDL model with nonlinear restrictions which could be represented as a panel regression with the error correction term. The latter represents the long run effects of interest. Further the concentrated likelihood function is set up and the estimates of the long run parameters using nonlinear optimization are obtained.

The results could be shortly summarized as follows. Neither market size, not factor endowments by themselves have homogeneous long run effect on IIT. That could be due to more complicated nature of the IIT then just an influence of one factor or due to differences across Baltic states. Notwithstanding the common positive effect of income distribution on vertical IIT may be present. Considering the effects of combination of factors it is shown, that if controlled for the market size and factor endowments (human and physical capital), both have an effect on horizontal IIT and total IIT, whereas only market size and human capital endowment affects VIIT. The long run effect of human capital endowment is found for the vertical IIT.

Admittedly some weaknesses of the study may be pointed out. First the precision of the results may suffer due to numerical optimization of the likelihood function; however, the use of a range of starting values may reduce these concerns. Second the time span of the panel is short, which makes separate group-by-group estimation impossible. That leads to limitations in the robustness checks of some of the underlying assumptions.

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Majandus, ökonomeetria, majandusteooria, majanduslikud süsteemid, aegridade ökonomeetria, arvutuslikud meetodid ökonomeetrias.

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KOKKUVÕTE

Doktoritöö peamiseks eesmärgiks on analüüsida majandusharusisese kaubanduse (MSK) dünaamikat ja mõjutegureid Balti riikides. MSK mängib olulist rolli väliskaubanduses, eriti üleminekuriikides. Sageli peetakse seda turgude integreerimise näitajaks. Väliskaubanduse laienemisel näitab MSK majanduslike tegurite kohandamise intensiivsust. Väliskaubanduse integreerimise korral, kui riigid vahetavad eri sorte sama tüüpi kaupu, ei pea kapitali ja tööjõudu ümber paigutama impordiga konkureerivatest sektoritest laienevale ekspordisektorile, vaid neid tuleb ümber jaotada samas sektoris. Just sellepärast on MSK dünaamika ja mõjutegurite analüüsil nii suur praktiline tähtsus.

Empiirilises kirjanduses leidub hulgaliselt MSK mõjutegurite uuringuid, kus põhiliselt analüüsitakse arengumaade majandusharusisest kaubandust. Enamik artikleid põhineb paneelandmete analüüsil.

Käesolevas töös analüüsib autor homogeense piirkonna hiljutiste ülemine-kuriikide MSK-d. Vaatluse all on Balti riigid, mida iseloomustab sisemajanduse koguprodukti suurim kasv aastail 2004–2006 võrreldes Euroopa Liidu (EL) teiste uute liikmesriikidega. Balti riigid on unikaalsed selles mõttes, et nõukogude ajal olid kaubavood peaaegu täielikult orienteeritud itta. Teised Kesk- ja Ida-Euroopa riigid arendasid nn raudse eesriide perioodil siiski teatud väliskaubanduslikke sidemeid ka lääne riikidega. Pärast Nõukogude Liidu lagunemist reorienteerisid Balti riigid oma kaubavood kiiresti läände, samas kui teistes Kesk- ja Ida-Euroopa riikides ei olnud muutused nii ulatuslikud.

Balti riikide näol on tegemist ainulaadse riikide grupiga, millel on sarnane majanduslik taust. Neil riikidel on palju ühist, kuid on ka mõned olulised erinevused. Eesti positsioneerib ennast pigem Põhja-Euroopa osana, samal ajal kui Läti ja Leedu samastavad end rohkem Kesk-Euroopaga. Seega, kuigi esmapilgul näib piirkond homogeenne, on Balti riikide MSK-l teatud erinevusi. See muudab need riigid väliskaubanduse valdkonnas huvitavaks uurimisobjektiks.

Balti riikide MSK dünaamikat ja mõjutegureid analüüsitakse doktoritöö kolmes osas. Uurimuse esimeses osas keskendutakse Eesti ja Euroopa Liidu vahelistele kaubavoogude analüüsile. Tolliliiduga liitumisel tekkinud kauba-voogude ümbersuunamise ja kaubavoogude loomise efekte eristatakse antud töös empiiriliselt Finger-Kreinini koefitsiendi abil. See võimaldab uurida Eesti ekspordi ja impordi ning EL-i ja Sõltumatute Riikide Ühenduse liikmete ekspordi, impordi sarnasust. Väitekirjas arvutatud Finger-Kreinini koefitsiendid näitavad, et ekspordi struktuuri sarnasus väheneb, kusjuures olulist kaubavoogude ümbersuunamist ekspordis ei ole toimunud. Ka impordi sarnasusel on vähenemise tendents. See näi-tab, et Eesti peamised impordiartiklid idast on jäänud samaks ning lääne kaupade impordi kasv on toimunud tänu impordi laienemisele uutes kaubagruppides.

Doktoritöö teises osas analüüsitakse MSK dünaamikat Baltikumis.

Viimastel aastatel on MSK osakaal maailma kaubanduses suurenenud. Samasuguse dünaamika olemasolu tõestab doktorant ka Balti riikides aastatel 1999–2007. Analüüsi tulemused näitavad, et MSK osakaal on Balti riikides märgatavalt kasvanud, kuigi selle struktuur on riigiti erinev. Kasutades üldlevinud Grubel-Lloydi ja ühiku hinna metoodikat, on doktorant MSK arvutades jaganud vertikaalseks ja horisontaalseks komponendiks. Domineeriv roll kaubavoogudes on vertikaalsel MSK-l. Eestis ja Lätis ongi MSK kasvu põhjustanud vertikaalse, Leedus aga – horisontaalse komponendi kasv. Seega peaks Eesti ja Läti toetama ja arendama neid sektoreid, mis aitavad rohkem kaasa horisontaalse MSK komponendi kasvule. Toetada sektoreid, millel on suurem mõju horisontaalsele MSK-le, on doktorandi hinnangul kasulik kogu piirkonnale.

Paneelandmete ökonomeetrilise analüüsi tulemused toetavad suurel määral doktorandi teoreetilisi hüpoteese MSK mõjutegurite kohta. Turu suurus kui mastaabiefekti tegur on Balti riikide MSK-l väga oluline. Ka vahemaana mõõdetud transpordikulud on märkimisväärseks mõjuriks. Viimaste roll on suurem horisontaalsel MSK-l. Ressursside külluse muutujatest on kõige olulisem inimkapitali erinevus mõõdetuna erinevusena eri riikides ühe elaniku kohta tehtud hariduskulutustes.

Doktoritöö kolmandas osas kasutatakse Balti riikide MSK analüüsimisel heterogeense paneeli omadusi ja *pooled mean group* hindamismeetodit. Doktorandi eesmärgiks oli hinnata pika perioodi horisontaalse, vertikaalse ja kogu MSK vahelisi suhteid, põhinedes sellistele majanduslikele teguritele nagu turu suurus, erinevused ressursside külluses ja kaubanduspartnerite tulujaotuses. Selleks kasutati viit uuritavaid suhteid kirjeldavat empiirilist mudelit. Hinnang põhineb autoregressiivsel mittelineaarsete piirangutega viitajaga mudelil, mida võib esitada paneeli regressiooni kujul koos vigade parandamise komponendiga.

Doktoritöö tulemused näitavad, et pikal perioodil ei avalda MSK-le üksikult võetuna mõju ei turu suurus ega ressursside külluse mõjutegurid. See võib olla tingitud MSK keerulisemast iseloomust, mitte niivõrd ühe teguri suuremast mõjust või Balti riikide vahelistest erinevustest. Samas võib täheldada tulujaotuse positiivset mõju vertikaalsele MSK-le. Võttes arvesse mitmete mõjutegurite koosmõju, tõestab doktorant, et turu suurus ja ressursside külluse mõjutegurid mõjutavad nii horisontaalset kui ka kogu MSK-d. Samas vertikaalset MSK-d mõjutavad turu suurus ja inimkapital. Töös on tõestatud inimkapitali teguri mõju Balti riikide vertikaalsele MSK-le pikal perioodil. Positiivse aspektina tuleb veel esile tuua, et suurem osa tulemustest on kooskõlas püstitatud teoreetiliste hüpoteesidega.

Doktorant toob välja järgmised praktilise suunitlusega järeldused. Riigi tasandil tuleks kaaluda erinevaid majandusharude toetamise võimalusi. Nii võiksid hariduspoliitika otsused kaasa aidata majandusharudele suurema MSK potentsiaaliga. Kutsehariduse ja ülikoolide õppekavade ja koolitustellimuste ettevalmistamisel võiksid riigid arvestada erialade võimaliku panusega MSK-le. Samuti äri ja ettevõtluse edendamisel ja toetamisel ei tohi unustada majandusharude võimalikku panust MSK-le.

ABSTRACT

The main aim of the thesis is to analyze the dynamics and determinants of intra-industry trade in the Baltic States. Intra-industry trade plays a very important role in trade patterns, especially in that of the transition countries and is often considered a measure of product integration between markets. It is also a proxy for the intensity of possible factor adjustments fostered by trade expansion. If as the results of trade integration countries exchange different varieties of the same type of good, then capital and labour should not be reallocated from a struggling import-competing sector to an expanding export sector, but simply reshuffled within a given sector. For that reasons understanding IIT dynamics is of practical use.

In the empirical trade literature, one can find a substantial bulk of research on the determinants of intra-industry trade. Authors are mainly interested in the analysis of IIT in the developing countries. The vast majority of the papers are based on panel data analysis.

In the present thesis, I limit the analysis with a homogeneous region of the recent transition States, the Baltic countries, which experienced the highest gross domestic product growth in 2004-6, compared to other new members of the European Union. The Baltic countries are unique in the sense that during Soviet times trade flows were almost completely orientated to the East. Other Central and Eastern European (CEE) countries during the so-called Iron Curtain period had some foreign trade activities with Western countries. After the fall of the Soviet Union, the Baltic countries experienced the rapid structural reorientation of trade flows from Eastern to Western countries, while the reorientation was not as dramatic in the other CEE countries.

The Baltic countries appear to be a group with a unique economic background that makes them an interesting research subject in the field of international trade. The Baltic States have much in common, but there are some important differences. Estonia positions itself as a part of Northern Europe, whereas Latvia and Lithuania tend to look towards Central Europe more. Therefore, although at first glance a homogeneous region, the Baltic States may have heterogeneity in IIT.

The research of the dynamics and determinants of the IIT of the Baltic countries using different estimation techniques is summarized in the three parts of the thesis. In the first part, the research is focused on the development of foreign trade flows between Estonia and the EU. To distinguish the trade diversion and the trade creation effects, the Finger-Kreinin coefficient of trade similarity of Estonian exports and imports to/from EU and CIS countries are calculated. As a result, a decreasing similarity of exports is documented, i.e., no essential trade diversion of exports occurred. The import similarity also declined. This indicates that the main import articles from the eastern markets are remaining unchanged and the growth

of imports from the West occurred due to the expansion in new commodity groups.

In the second part of the thesis, the dynamics of IIT in the Baltics is analyzed. In recent years, the share of IIT has had a general tendency to increase. VIIT plays a dominant role in trade flows. In the present study, I observe similar dynamics for the Baltic States in 1999-2007. After foreign trade policy liberalization and structural economic reforms, trade flows in the Baltic States substantially increased. The findings show that the share of TIIT in the Baltic States has significantly increased, though the structure of IIT is different in each country. While in Estonia and Latvia the increase in VIIT caused the growth of TIIT, in Lithuania it was due to the growth of HIIT. As a trade and industry policy implication, Estonia and Latvia should support and develop sectors that contribute more to HIIT than to VIIT, which is based on factor endowments. Supporting sectors with potentially high HIIT trade will be especially beneficial for the countries and the region in general. The commodity composition of IIT is also different in each country.

The results of the estimations support, to some extent, the theoretical predictions of IIT determinants. Market size as a factor of increasing returns is important for the TIIT of the Baltic States. Transportation cost measured by distance is also an important determinant of IIT. This is more the case for HIIT. Among the factor endowment variables that support the H-O approach, the most significant for the IIT of the Baltic States is the difference in human capital endowment measured by the difference in per capita expenditure on education between countries.

The third part of the thesis exploits the properties of the heterogeneous panel and applies the pooled mean group estimation method to the case of intra-industry trade of the Baltic States. The idea is to estimate the long run relationship between horizontal, vertical and total IIT and theory based economic factors such as market size, differences in factor endowments and differences in income distribution between the trading partners. For that purpose, I came up with 5 empirical models describing the relationships of interest. The estimation is based on the autoregressive distributed lag model with nonlinear restrictions, which can be represented as a panel regression with an error correction term.

The results suggest that neither market size nor factor endowments by themselves have a homogeneous long run effect on IIT. That could be due to the more complicated nature of the IIT then just an influence of one factor or due to the differences across Baltic States. Notwithstanding, the common positive effect of income distribution on vertical IIT may be present. Considering the effects that the combination of factors I show, if controlled for the market size and factor endowments, then both have an effect on horizontal IIT and total IIT, whereas only market size and human capital endowment affect VIIT. The long run effect of human capital endowment is found for vertical IIT. It should be emphasized that the majority of the findings are in line with the theoretical predictions.

A number of policy oriented practical conclusions can be drawn from the analysis. Different industry support channels can be considered on the state level, for example governmental educational decisions, e.g. development of professional education and university curricula and educational orders should take into account possibilities to contribute to the development of the industries with IIT potential. Promotion of business and entrepreneurship on the state level must not neglect possible contribution of the industries to the IIT.

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