The post-accession patterns of intra-industry trade between New Member States and EU-15: why so different?

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According to the theoretical literature, the intra-industry trade patterns are influenced a. o. by the similarities in development level of trading partners (that is by the similarities in economic potential, production structures, consumers’ tastes, consumers’ incomes etc.) and by economic integration. This paper covers the problem of the influence of the European integration on the intra-industry trade patterns of New Member States (NMS-10). The data show, that the 2004 accession effect on intra-industry trade among the countries is generally positive due to economic convergence process, however its impact appears to be highly diversified between the particular New Member States.

The research question is whether the tendencies in changing patterns are alike among the New Member States, as the countries acceded to the EU or rather diversified. The answer leads to a conclusion whether the accession to the EU is a dominant factor for intra-industry trade in catching-up New Member States or this accession is not as important factor as the others. I used the Grubel – Lloyd (GL) index, and marginal intra-industry trade index for particular EU-10 countries to measure the share of two-directional trade before and after accession. I used the econometric model with IIT determinants that help to explain the disparities between the particular UE-10 countries’ intra-industry trade patterns.

Keywords: intra-industry trade, new EU Member States
JEL Classification: F14, F15
1. Introduction

The phenomenon of the intra-industry trade (IIT) is characteristic, when investigating developed countries, among which the majority of international trade take place. The firms from these countries participate actively in international fragmentation of production and in trade of semi products. These firms also produce outputs, which are identical in global scale.

The IIT phenomenon is often linked with vertical and horizontal product differentiation, however in the beginning the IIT was rather related to economic integration, for instance within the European Communities or within Benelux.

Interesting idea is to examine, how does trade patterns change when countries after economic and political transition in Central and Eastern Europe enter an organism composed of developed countries, such as European Union. I also seek a proof, that the economic convergence contributes to expanding IIT. This paper covers also the problem of the influence of the European integration on the intra-industry trade patterns of New Member States (NMS-10).

The aim of this paper is to identify the other factors than EU membership, that affect patterns of the horizontal and vertical intra-industry trade in the NMS-10 countries (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia) in the period 1995-2009 and especially vertical high quality IIT that reflects the structure of economy. The econometric analysis follows the description of changes in the IIT development in the analyzed countries with the EU-15.

The structure of the paper is as follows: Section 2 reviews the brief theoretical foundations of intra-industry trade. Section 3 presents briefly the empirical studies on IIT between NMS-10 and EU. In section 4 I discuss the methodology, thus, the data and measurement of IIT indices. The section 5 investigates the determinants of IIT and present the econometric model and therefore the results. The section 6 summarizes the main findings in this paper and contains conclusions.

2. Brief survey of theory

In the beginning, the issue of IIT was investigated by Verdoorn (1960), Balassa (1967) and Grubel (1967). That time, the special attention was taken to economic integration as a contributor to development of IIT within the countries in Western Europe. Even limitation or suppressing the trade barriers implies the development of IIT. This is because, the trade barriers limit the trade of close substitutes. Furthermore, the economic integration helps in intra industry specialization that is intra industry exchange of product components (Balassa (1967)). Grubel and Lloyd (1975) confirmed, that the IIT develops better between the developed countries which are
in customs union or in the other form of trade agreement, than between the developing countries not bound by such agreements.

The first surveys, which tried to explain a nature of IIT, were conducted by Krugman (1979, 1983), Lancaster (1980) and Helpman (1981). Their contributed to the theoretical foundations of IIT by binding this phenomenon with imperfect competition and product differentiation. This two way trade occurred among developed countries with similar technology, factor endowments and income. A literature provides two main types of differentiation: vertical (by quality) and horizontal (by other attributes than quality).

Falvey (1981), Falvey and Kierzkowski (1987) examined the vertical differentiation models, that stand for vertical IIT. In these papers, IIT could be explained by comparative advantage and by the differences of factor endowments between two countries. The model based on assumption that the countries relatively endowed with capital specialize and export high quality products, and on the other hand the countries relatively endowed with labor specialize and export low quality products. What is important, Falvey (1981) demonstrated, that using model 2x2x2 could explain the coexistence of vertical IIT and inter-industry trade.

Flam and Helpman (1987) pointed the technological and income differences between countries as important contributors to IIT. The so-called North-South trade structure is determined by technology and income abundance in the North, and that is why the North exports products of high quality and South exports products of lower quality. The source for vertical IIT is also a trade with semi products (Jones and Kierzkowski (1990), Arndt and Kierzkowski (2001), Cheng and Kierzkowski (2001)). Nowadays, different approaches are considered, those based on comparative advantage, and those based on imperfect competition.

On the other hand, horizontal IIT is easily explained by the economies of scale. Horizontal IIT is two way exchange of products with comparable quality and various other characteristics. The theory bases on demand side: the favorite variety approach and love of varieties approach. Krugman (1979) was a pioneer in horizontal differentiation in trade, based on models with monopolistic competition. He used the concept of love of varieties, that consumers are eager to have many varieties of a product, and welfare increases thanks to the variety of goods. The approach with favorite variety was introduced by Lancaster (1980).

A method proposed by Greenaway, Hine, Milner (1994, 1995) ameliorated the explanations the difference between the types of IIT. The authors used the prices to approximate the product quality by utilizing the concept of product unit values. Authors suggested, that vertical trade is rather alike to trade in traditional models of comparative advantage, whereas horizontal trade is nearer to non-traditional trade theories.
This accurate disentangle of IIT helps better precise the likeness of examined economies, or in case of developing economies, helps better assess the convergence process to developed economies. Particularly, the occurrence of horizontal trade is typical to highly developed countries, which produce highly processed outputs. Simultaneously the consumers can afford buy sophisticated alike goods.

3. Brief survey of empirical studies on IIT between NMS-10 and EU

In the 1990s there was an absence of such studies concerning literally these countries. However, the analyses concerning CEEC, that is Central and Eastern Europe Countries (or selected countries in the region) and EU and determinants of IIT development in these countries appeared. The argument for such studies was, that the scale of trade between the UE and the CEEC was considerable. The studies have revealed the development of IIT and identified some determinants for it. Hoekman and Djankov (1996) found exports performance and economic growth in the CEEC implied the IIT increase.

Freudenberg and Lemoine (1999) pointed that IIT between EU-CEEC is of vertical nature and CEEC exported mainly lower quality products. Interesting studies were made by Aturupane, Djankov and Hoekman (1997) who proved, that among all trading EU partners, the countries of post-communist bloc represented the highest IIT share. Furthermore, these studies pointed, that about 80-90% of two way trade was linked to product differentiation, labor intensity, economies of scale and FDI inflows. Horizontal IIT increased thanks to investments, product differentiation, industry concentration and decreased because of economies of scale and labor intensity. When concerning vertical IIT, it was positively implied by economies of scale, labor intensity and FDI flows. Important factor was also the intensity of transition in the post-communist countries. For instance Czech Republic and Slovakia improved their IIT faster than the other countries in the region.

The changes of the IIT intensity in the CEECs were analyzed in details by Caetano and Galego (2007), Ferto and Soos (2006), Fidrmuc and Djablik (2003), Gabrisch and Segnana (2002, 2003), Gabrisch (2006), Hoekman and Djankov (1996), Kamiński (2001), Kandogan (2003). The CEFTA countries were analysed by Cernosa (2005), the Visegrad countries were examined by Kawecka-Wyrzykowska (2009) and IIT of Poland was examined by Czarny and Śledziewska (2008, 2009), Czarny, Śledziewska and Toporowski (2008), Klimek (2007), Michałek and Śledziewska-Kołodziejska (2000), Molendowski (2007). For instance, on a case of Poland, Czarny, Śledziewska and Toporowski (2008) pointed the importance of EU accession to Poland’s IIT with the EU member states. In case of Visegrad countries it was noticed, that in these countries the growing IIT proved the ongoing process of the economic ad political transition and economic convergence to the EU.
4. Methodology and measurement of data

I collected trade data based from the COMEXT in Eurostat according to CN nomenclature for UE-15 as a group, and NMS-10 separately within 1995-2009. I decided to use this packet of data because of strong disaggregation level, that helps to assess better the nature of the trade.

The data were processed according to the Grubel and Lloyd (1975) methodology. According to them, the total trade is disentangled to inter industry trade, and IIT. The IIT share varies between [0,1]. The 0 value means that there is no IIT within this trade, whereas 1 means that all trade is of intra-industry nature. The transitional values point the co-existence of both types of trade. The so-called Grubel-Lloyd index was calculated as follows:

\[
GL_i = \frac{\sum_{i=1}^{n} w_i GL_i = \frac{\sum_{i=1}^{n} (X_i + M_i)}{\sum_{i=1}^{n} (X_i + M_i)} GL_i = 1 - \frac{\sum_{i=1}^{n} |X_i - M_i|}{\sum_{i=1}^{n} (X_i + M_i)}
\]

where:

- \( w_i \) – a share of trade with product \( i \) in total trade,
- \( GL_i \) – Grubel-Lloyd index of product \( i \),
- \( X_i \) – export of product \( i \),
- \( M_i \) – import of product \( i \).

The index may be utilized for whole country, but also for selected industry. The results may depend on selected statistical nomenclature (like HS, CN or SITC) and a level of aggregation. That is why it is difficult to compare directly, and this is principal reason for results differences. Moreover the results also vary in consequence of using alternative to Grubel-Lloyd indexes.

To disentangle the IIT to horizontal and vertical, Greenaway, Hine and Milner’s (1994, 1995) approach was executed, but with above mentioned another statistical nomenclature. Their approach is convenient to researchers, because it allows to precisely determine the shares of IIT of horizontal and vertical nature. According to their concept, the price per p.ex. weight of a selected good (the concept of Unit Value of a good) reflects the quality of this product. In two way trade the unit value of homogenous or almost similar goods are alike. But in case of strongly differentiated goods (especially when concerning quality), the unit values are diversified.

There are also other methods of measuring horizontal and vertical IIT. P.ex. Fontagné, Freudenberg (1997), adjusted the imbalance in trade and proposed its own method, that
distinguishes two way trade of similar goods, two way trade of differentiated goods and one way trade. However Nielsen and Lüthje (2002) proved, that the method is interior to Greenaway, Hine and Milner's method.

According to Greenaway, Hine and Milner (1994, 1995), for each product within a specific statistic nomenclature there exists its unit value. The unit value of exported good is described as $UV_{i}^{Ex}$, where $i$ is the particular product. The unit value of imported good described as $UV_{i}^{Im}$. The authors assumed that the horizontal trade is when the difference between $UV_{i}^{Ex}$ and $UV_{i}^{Im}$ does not exceed +/- 15%. So the following condition, called the similarity criterion, should be satisfied:

$$1 - 0.15 \leq \frac{UV_{i}^{Ex}}{UV_{i}^{Im}} \leq 1 + 0.15$$

(2).

The other researchers sometimes narrow or enlarge these brackets, however 15% is the most popular.

A vertical trade exists when, the following conditions are met:

$$1 - 0.15 \geq \frac{UV_{i}^{Ex}}{UV_{i}^{Im}}$$

(3a)

or

$$1 + 0.5 \leq \frac{UV_{i}^{Ex}}{UV_{i}^{Im}}$$

(3b).

The inequality (3a) stands for vertical IIT and country exports low quality goods and import higher quality goods. This vertical trade is called low quality vertical IIT. The inequality (3b) stands for vertical IIT and country exports high quality goods and import lower quality goods. This vertical trade is called high quality vertical IIT.

The Greenaway, Hine and Milner’s (1994, 1995) approach have a weakness embodied in condition (2), because of only illusory symmetry. This condition for country $x$ trading with country $y$ should be the same as condition for country $y$ trading with country $x$. But in reality this condition for country $y$ is as follows:

$$\frac{1}{1 + 0.15} \leq \frac{UV_{i}^{Ex}}{UV_{i}^{Im}} \leq \frac{1}{1 - 0.15}$$

(4).
Now, some products classified earlier as products traded within vertical integration, may appear as products traded within horizontal integration, and inversely. To minimize this inconvenience I used the concept used among others by Crespo and Fontoura (2001), which is describe as follows: The inequality

\[
\frac{1}{1 + 0.15} \leq \frac{UV^E_{i}}{UV^F_{i}} \leq 1 + 0.15
\]  

(5)

stands for horizontal integration, whereas (3b) and inequality

\[
\frac{1}{1 + 0.15} > \frac{UV^E_{i}}{UV^F_{i}}
\]  

(6a)

stands for vertical integration.

I conducted research on trade data between NMS-10 (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia) and EU-15 in the period 1995-2009.

The economic and political transition, that was made in the majority of examined countries contributed to technological upgrade of economy. These changes were mainly implied by the appearance of multinational firms in the region. As a consequence of the technological changes, the vertical as well as horizontal IIT were growing considerably.

Graph 1. The dynamics of IIT between the NMS-10 countries and EU-15 in the period 1995-2009

Source: own calculations based on COMEXT
The data in the graph 1 show undoubtedly, that within the research period, the IIT growth was significant. The only country that noted the IIT decrease since the 1995, was Cyprus. The greatest increase in IIT experienced Poland, however its IIT is still lower than IIT in Czech Republic. The changes of IIT in Czech Republic was considerable in the first years of research period and lately (especially after EU enlargement) these changes were rather negligible. The lowest IIT during the research period noted Lithuania and Latvia. It was probably caused by fact, that these countries were relatively small and also descended from Soviet Union, that means their relations with EU-15 were built from scratch. Nevertheless, they were catching up the other countries and accelerated IIT growth after EU enlargement. The most volatile IIT was in Cyprus, however it is probably affected by its size, where a more significant order decides the total amount of flow in particular industry. It may also be caused by the unique tax system.

When considering horizontal IIT, generally it was growing during the whole period among the countries. It reflects the structural changes that occurred in the NMS-10 economies. What is important, it is the fact, that the horizontal IIT growth accelerated after the EU enlargement among the countries with the lowest IIT indices before the enlargement, but also among Poland, Slovakia and Slovenia. It could be implied by changes in technologies of production forced by EU law (p.ex. standards protecting the environment and human health). It is interesting, that Czech Republic reached a peak in 2004 and since then remained a little below the summit. It may be interpreted that the EU enlargement didn’t improve the horizontal two way trade in this country. But in fact, Czech Republic has the biggest share of horizontal IIT, probably because its previous development of economic relations with the EU and successful transition in 1990s.

Graph 2. The dynamics of horizontal IIT between the NMS-10 countries and EU-15 in the period 1995-2009
A considerable and stable growth of vertical high quality IIT was observed during whole research period. What is interesting, the growth accelerated slightly after the EU enlargement. Almost the entire period the biggest vertical high quality IIT was in Hungary, which was a FDI target for multinational firms. After 2004 its growth also accelerated, as in the other countries.

Graph 3. The dynamics of vertical high quality IIT between the NMS-10 countries and EU-15 in the period 1995-2009

As concerning changes in vertical low quality IIT, it remained relatively stable (Hungary, Slovakia, Estonia, Slovenia, Poland), in some countries slightly increased (Lithuania, Latvia, Cyprus) and has substantially fallen in Czech Republic after the EU enlargement. The change in this type IIT in the above mentioned country proves the continuation of positive changes in the trade and economic relations of Czech Republic with the EU. The decrease occurred when the alike increase in the vertical high quality IIT took place. The country limited its economic activity as supplier of low quality or semi products, and became a producer of better quality goods.
To sum up this section, there is a positive trend in IIT changes, but, what is more important, in particular cases the structure of IIT especially after the enlargement proves the progress in changing the trade nature of low to high quality goods production and exports.

5. Determinants of IIT and econometric model

In this section I analyze a model, to identify the main country-specific determinants of IIT between NMS-10 and EU-15 within the 1995-2009. The estimation is not limited to only total IIT trade, but its disentangled to horizontal and high quality vertical trade. Therefore I analyze the different determinants for each type of trade, which approach is commonly used. Differently to the other researchers, I did not disentangled to only horizontal and vertical trade, but I additionally researched the determinants for high quality trade, that is important to understand the economic development of catching-up countries.

I considered the determinants proposed by Helpman (1987), that is the economic distance between researched countries and the EU-15 (as an absolute difference in GDP per capita. I considered the distance from the capitals of NMS-10 to the EU-15. In this case I used the Fidrmuc and Djablik (2003) approach of average weighted distance, measured in km, that is calculated as following:

$$R_i = \sum w_j D_j$$  \hspace{1cm} (7)
where $D$ a distance between country $i$ and country $j$ and $w$ is a share of country $j$ GDP in total EU-15 GDP. I also used a dummy variable that represents the membership to the EU.

I used the panel data techniques to estimate the determinants. The estimated model is presented by the following equation:

$$\ln(IIT_{it}) = \alpha_0 + \alpha_1 \ln(R_{it}) + \alpha_2 \ln(ED_{it}) + \alpha_3 EU_{it} + \epsilon_{it} \quad (8)$$

where $R$ is a weighted distance form capital in country $i$ to the capitals of the EU-15, $ED$ is economic distance between each examined country and the EU-15 average (Eurostat data), and $EU$ is dummy variable standing for EU membership in period $t$.

According to Helpman and Krugman (1985) works, the countries economic and geographic distance (measured by the difference in GDP per capita) are negatively correlated with IIT. According to the intuition, EU membership helps to converge the NMS-10 to the EU015. Therefore I expected a positive correlation between this explanatory variable and IIT.

In model examining determinants for horizontal IIT I used the following equation:

$$\ln(HIIT_{it}) = \alpha_0 + \alpha_1 \ln(T_{it}) + \alpha_2 \ln(ED_{it}) + \alpha_3 \ln(HIIT_{it-1}) + \epsilon_{it} \quad (9)$$

where $T$ is total trade between selected country and the EU (Eurostat data), that represents the magnitude and intensity of economic relations on the axis country-EU-15. I expect, that this magnitude implies the growth of horizontal IIT. Likewise in previous model I expect, that economic distance is of negative sign. In this and in the next models I also used lagged explained variables, because of the fact, that the economic processes linked with trade structure are relatively sluggish.

I also estimated a model that examines the determinants for vertical IIT, and I was considering the following model:

$$\ln(VIIT_{it}) = \alpha_0 + \alpha_1 \ln(GDP_{it}) + \alpha_2 \ln(T_{it}) + \alpha_3 \ln(VIIT_{it-1}) + \epsilon_{it} \quad (10).$$

In this model I expect the positive relation between both GDP (Eurostat data) and trade with vertical IIT.

The interesting issue was also the search for determinants for vertical IIT with high quality for researched countries. This model may be helpful to determine the factors to improve NMS-10 exports toward with more sophisticated and higher quality products. I estimated the following model:

$$\ln(VhighIIT_{it}) = \alpha_0 + \alpha_1 \ln(O_{it}) + \alpha_2 \ln(ED_{it}) + \alpha_3 \ln(GDP_{it}) + \alpha_4 \ln(VhighIIT_{it-1}) + \alpha_5 EU_{it} + \epsilon_{it} \quad (11).$$
where $O$ represents a relative openness of the country $i$ with the EU-15 (measured as the total trade with the EU compared to its GDP). I expect that $O$, GDP and EU has positive signs with vertical high quality IIT, whereas ED is expected to have negative sign.

I used the GLS method for panel data with random effects. All the estimates with z-values may be seen in Table 1.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Model (8)</th>
<th>Model (9)</th>
<th>Model (10)</th>
<th>Model (11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explained:</td>
<td>GLS RE</td>
<td>GLS RE</td>
<td>GLS RE</td>
<td>GLS RE</td>
</tr>
<tr>
<td>In R</td>
<td>-1.9939</td>
<td>(-3.96)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In ED</td>
<td>0.8308</td>
<td>(-5.35)*</td>
<td>(-3.67)*</td>
<td>(-3.06)*</td>
</tr>
<tr>
<td>EU</td>
<td>0.1940</td>
<td>(0.79)*</td>
<td>0.1490</td>
<td></td>
</tr>
<tr>
<td>In GDP</td>
<td>-0.0719</td>
<td>(-1.48)*</td>
<td>0.0897</td>
<td></td>
</tr>
<tr>
<td>In IIIt (t-1)</td>
<td>0.7686</td>
<td>(15.31)*</td>
<td>(3.37)*</td>
<td></td>
</tr>
<tr>
<td>In T</td>
<td>0.1341</td>
<td>(2.37)*</td>
<td>0.3283</td>
<td>(7.06)*</td>
</tr>
<tr>
<td>ln O</td>
<td></td>
<td></td>
<td>0.3034</td>
<td>(3.64)*</td>
</tr>
<tr>
<td>In HIIt (t-1)</td>
<td></td>
<td>0.3621</td>
<td>(5.19)*</td>
<td></td>
</tr>
<tr>
<td>In VhighIIt (t-1)</td>
<td></td>
<td></td>
<td>0.6477</td>
<td>(10.65)*</td>
</tr>
<tr>
<td>const</td>
<td>0.3228</td>
<td>(-0.6884</td>
<td>-0.4485</td>
<td>-4.2896</td>
</tr>
<tr>
<td>R squared</td>
<td>0.4588</td>
<td>0.8515</td>
<td>0.6335</td>
<td>0.8073</td>
</tr>
</tbody>
</table>

* is significant at the 5% level.

The estimated model for IIT (8) meets the expectations (without economic distance) and R has negative sign, and EU has positive sign. Contrary to the expectations the economic distance presents positive relation. This result is not consistent with the theoretical foundations. The fit for this model (as $R^2$) is relatively low, however the variables used in the model are significant.

As for a model with vertical IIT, a variable T meets the expectations and have positive sign, but GDP is contrary to expected sign and is negative. Finally, the vertical IIT from the previous period affects strongly and positively current vertical IIT, and the significance of this impact is substantial. Probably thanks to this lagged variable, the $R^2$ is relatively high. Only the constant in this model is insignificant.

The estimates for model with horizontal IIT meet all the expectations. The economic difference is negative to the horizontal IIT level, whereas the total trade affects higher horizontal IIT values. As in previous model, the important variable is horizontal IIT from the previous
period. In both models, the variable EU did not fit the model. This was probably caused by specific group of examined countries. If the sample was extended to p.ex. countries in the CEE region, but not yet acceded to the EU, the significance of this variable would have been more substantial.

The model with determinants for vertical high quality IIT also meets all the expectations. The EU, O, GDP has positive signs, which means that the EU membership affects positively the structure of trade, where countries export higher quality products. Also the economic distance is negatively linked with this type of IIT. It is harmonized with the intuition, that the higher intensity of capital (embodied with the GDP per capita) affects positively the production of goods with higher quality.

6. Main findings and conclusions

This paper presents the empirical evidence on major trends in the nature of trade between separate NMS-10 and EU-15 and examines the determinants of certain types of trade (including IIT, horizontal IIT, vertical IIT, vertical IIT with high quality). The paper provides studies with the most recent highly disaggregated data for 10 countries that acceded the EU in 2004. Also, in the paper I used the panel data in several models to search the determinants for different trade types.

According to the data, the pattern of inter-industry trade based on comparative advantage is still dominant, however it is consequently weakening at the advantage of IIT. In some countries the post-accession period was characterized with stable IIT levels. Therefore the models were constructed to find other than EU membership determinants for certain types of IIT.

The model showed that the accession to the EU increased the IIT, however, probably because of sample of countries, the impact was moderate and in some cases insignificant. Nevertheless, there is an evidence that a convergence process and increasing economic cooperation (trade, investments embodied in the GDP, etc.) have its substantial positive impact on the magnitude and structure of NMS-10 IIT, despite the fact that, in the IIT model, the economic distance was positively correlated.

What is important, that, there is a fact, that slightly increasing post-accession horizontal and vertical high quality IIT are consequences of greater openness of the economies and decreasing differences in incomes between NMS-10 and EU-15. This is important result for economic policy, as it reminds that structural changes in economies and closer economic cooperation with the other member states bring better trade structure.
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