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The impact of global economic crisis on the intra-industry trade of Visegrad Group Countries and the EU-15

International Journal of Management and Economics 33, 156-177

2012
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Introduction

The economic and financial crisis has recently heavily affected European countries and this implied the changes in trade patterns. The firms, especially those that act within the Visegrad Group countries, but also participate in international product fragmentation, suffered dried-up liquidity and thus shortages in production. Consequently, many parts of supply chain were relocated. Some of items produced in the Visegrad Group were shifted to other locations. OECD stated that a massive fall (about 12.5 %) in global trade in 2009 was caused by the collapse in demand, especially the demand for machinery and transport equipment, problems with trade financing and vertically integrated nature of global supply chains. It also estimated that global trade decreased by 1 % due to new protectionist measures, however, on a global scale protectionist measures were significantly smaller than all growth-stimulating instruments.

The previous studies suggested that the EU enlargement – with the economic growth boost - had a positive impact on the size and structure of intra-industry trade (later: IIT or two-directional or two-way trade) of the new member states with the EU-15, both through the demand and supply side. However, due to the insufficient data, the knowledge of the influence of global economic circumstances, such as the crisis, on intra-industry trade of these countries was limited.

Within the EU, the anti-crisis protectionist measures – if any – are far indirect and rather weak. So, the impact of the crisis on trade patterns should be visible by the other channels. The paper discusses the changes in trade patterns inside such strongly bound internally organism as the European Union.

One can expect, that economic crisis may strongly weaken the convergence process of the Visegrad Group countries. The paper investigates this problem in trade aspect and it is one of responses of how much – and how – the crisis affects the intra-industry trade. It also examines the more dynamic form of two-way trade – marginal intra-industry trade (MIIT) – that is interpreted how big share of changes in trade (both rise and lose) is two-directional. This dynamic form of trade is important in determining the evolution
in trade patterns during the changing environment, such as the phenomenon of economic and financial crisis, to observe structural adjustments in production and trade.

The structure of the paper is as follows: Section II elaborates on brief theoretical foundations on intra-industry trade and intra-industry trade. Section III presents the used methodology of construction of IIT and MIIT and the data to be computed. Section IV deliberates on sensitivity analysis of the threshold that distinguishes horizontal and vertical trade, section V describes a simple econometric model that examines the influence of specific factors on marginal intra-industry trade. Section VI contains recapitulation of the main findings of the paper and conclusions.

Theoretical background

When the research on IIT started, a special attention was paid to economic integration (even limitation and suppressing the trade barriers) as positively influencing IIT levels in Western Europe (Balassa 1967). This is possible, as the trade barriers limit the trade of close substitutes, so if they are minimized, the imports of foreign substitutes increases. Furthermore, the economic integration magnifies intra-industry specialization, thus intra-industry exchange of product components (Balassa 1967). Grubel and Lloyd (1975) confirmed the significance of the existence of customs union on IIT, basing on developed countries.

The other important issue in the theoretical foundations of IIT bound this phenomenon with imperfect competition and product differentiation (Krugman 1979, 1983; Lancaster 1980 and Helpman 1981). The literature provides the two main types of differentiation: vertical (by quality) and horizontal (by other attributes than quality). Each type of differentiation corresponds to a specific type of trade.

Falvey (1981), Falvey and Kierzkowski (1987) examined the vertical differentiation models, for explaining vertical IIT. In these papers, IIT could be influenced 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, whereas the countries relatively endowed with labour specialize and export low quality products. What is important, Falvey (1981) demonstrated, that model 2x2x2 could explain the coexistence of vertical IIT and inter-industry trade.

On the other hand, the theory focusing on horizontal IIT bases on demand side: the favourite variety approach and love of varieties approach. Krugman (1979) was the first researcher that examined the horizontal differentiation in trade, and he was basing 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 favourite variety was introduced by Lancaster (1980).
An interesting – and thus commonly used – distinction of vertical and horizontal was proposed by Greenaway, Hine, Milner (1994, 1995), which improved the explanations of both types of IIT. The authors used the prices to approximate the product quality by utilizing the concept of traded product unit values. If the unit values of exported and imported goods are significantly diverging, the IIT is vertical, and otherwise it is horizontal. The Authors suggested that vertical trade is rather similar to trade in traditional models of comparative advantage, whereas horizontal trade is closer to non-traditional trade theories.

The traditional – “static” – IIT may explain the trade configuration and specialization in a particular period, but it does not explain and predict the structural adjustments – that is changes – in trade patterns. In this context, the structure of changes in trade patterns is important. This is the reason for investigating much more dynamic indices such as Marginal intra industry trade, based on changes of the trade flows.

Firstly, this issue was examined by Hamilton and Kniest (1991). They stated that the high level of IIT in one particular year does not justify \textit{a priori} any prediction of the similar pattern of the change in trade flows. Even the observed increase in static IIT between two periods does not fully reflect intra-industry adjustment. In certain cases, a rise in IIT may cover a process of intra- and inter-industry trade changes. Brülhart (1993) compared the existing MIIT indices and proposed its own methodology, adopted in this paper and presented in the next section.

**The methodology and measurement of data**

I collected trade data based from the COMEXT in Eurostat according to CN nomenclature for the Visegrad group countries with EU-15 countries separately within 2004–2010 (in case of MIIT the data for 2003 were also used). This dataset was used because of strong disaggregation level that helps to assess better the nature of the trade. I decided to eliminate the accession effect of trade patterns and concentrate on global economic crisis, so this is a reason for limiting research period to after the EU big enlargement. The focus only on the impact of the crisis and the mitigation of the accession effect on trade patterns of the Visegrad Group is motivated by the fact, that the author has already proved the positive impact of the EU membership on selected countries (Toporowski 2010), and thus there is no need to investigate this research problem once again.

The main IIT indices were computed in line with the Grubel and Lloyd (1975) method. According to them, the total trade is divided into inter- and intra-industry trade and the IIT ratio 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:
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\[
GL = \sum_{i=1}^{n} W_i GL_i = \sum_{i=1}^{n} \left( \frac{X_i + M_i}{\sum_{i=1}^{n} (X_i + M_i)} \right) GL_i = 1 - \frac{\sum_{i=1}^{n} |X_i + M_i|}{\sum_{i=1}^{n} (X_i + M_i)}
\]

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 GL index may be computed for a whole country, as well as for a 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 the alternative to Grubel-Lloyd indices.

To divide the IIT into horizontal and vertical part, the Greenaway, Hine and Milner’s (1994, 1995) approach was introduced. This method is convenient, because it enables to precisely disentangle IIT into a horizontal and vertical part. According to their concept, the price per p.ex. weight of a selected item (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, so this means that the IIT is horizontal. But in case of strongly differentiated goods (especially when concerning quality), the unit values are diversified, so IIT is vertical.

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 an exported good is described as \(UV^{Ex}_i\), where \(i\) is the particular product. The unit value of an imported good is described as \(UV^{Im}_i\). The authors assumed that the horizontal trade is when the difference between \(UV^{Ex}_i\) and \(UV^{Im}_i\) does not exceed \(\alpha\), where \(\alpha\) is 15% in most cases. However, in section V I will discuss the sensitivity of the indices due to the thresholds. So the following condition, called the similarity criterion, should be satisfied:

\[
1 - \alpha \leq \frac{UV^{Ex}_i}{UV^{Im}_i} \leq 1 + \alpha
\]

On the other hand, vertical trade exists when the similarity criterion is not satisfied, thus when the following conditions are met:

\[
1 - \alpha > \frac{UV^{Ex}_i}{UV^{Im}_i}
\]

\[(3a)\]
and
\[ 1 + \alpha < \frac{UV_{i}^{Ex}}{UV_{i}^{lm}} \] \hspace{1cm} (3a)

The Greenaway, Hine and Milner’s (1994, 1995) approach has a weakness (condition (2) and (3b)), because of only illusory symmetry. Some products classified as products traded within vertical integration from the viewpoint of a reporting country, may appear as products traded within horizontal integration from the viewpoint of a partner country, and inversely. To minimize this inconvenience the concept following Fontagné and Freudenberg (1997) is introduced, which was approved among others by Crespo and Fontoura (2001).

The modified similarity criterion condition is formulated as follows:
\[ \frac{1}{1 + \alpha} \leq \frac{UV_{i}^{Ex}}{UV_{i}^{lm}} \leq 1 + \alpha \] \hspace{1cm} (5)

and the inequality (3b) is replaced by:
\[ \frac{UV_{i}^{Ex}}{UV_{i}^{lm}} \leq \frac{1}{1 + \alpha} \] \hspace{1cm} (6)

The intuitive measure of MIIT is a transposition of the Grubel-Lloyd index to the changes of trade flows within industries, described as follows:
\[ MIIT = 1 - \frac{\sum_{i=1}^{n} |\Delta X_{i} - |\Delta M_{i}| |}{\sum_{i=1}^{n} |\Delta X_{i} + |\Delta M_{i}| |} \] \hspace{1cm} (7)

where \( \Delta X_{i} \) and \( \Delta M_{i} \) represent one-year change in exports and imports of product \( i \).

The economic and political transition, that was made in the majority of the examined countries contributed to technological upgrade of economy. These changes were mainly implied by the appearance of multinational firms in the region. However, during the economic and financial crisis, the positive trends linked with convergence within the EU were weakened. Nevertheless, the convergence process was not stopped.

Graph 1 presents the share of IIT and MIIT during the period 2004–2010. It is visible, that before 2008 (except for the Czech Republic) the trade patterns, through the rising IIT as well as MIIT indices, suggested the increasing role of the Visegrad Group countries in the global (or rather macro-regional) supply chain. But after the beginning of the crisis, the rate of IIT growth was weakened. Especially in Hungary and in the Czech Republic, the levels of two-way trade were decreasing, whereas in Poland
and in Slovakia the indices held the achieved earlier levels, and the IIT ratio increased in 2010. What is interesting the drops in intra-industry trade began in 2009, but as concerning the MIIT levels, the sharp losses in ratios occurred only in 2008, and in subsequent years, the indices started recovering.

**GRAPH 1. Intra-industry and marginal intra-industry trade of Czech Republic, Hungary, Poland and Slovakia with EU-15 in 2004–2010 [%]**

![Graph 1](image)

Source: the author’s calculations based on COMEXT, Eurostat

Thus, the changes in marginal intra-industry trade showed strong, but short-term structural adjustments just as the crisis started. The backwardation on international specialization was ephemeral, and the examined countries integrated further with the EU-15, until the probable aggravation of global economic circumstances takes place.

Graph 2 presents the trends in IIT of comparable quality goods of the Visegrad Group countries with the EU-15. The crisis did not influence negatively the horizontal IIT indices. The only country that experienced a drop after the beginning of the crisis, was the Czech Republic. However, in case of this member state, its high level of horizontal IIT was systematically dropping since the beginning of the research period. In the last year, Poland reached higher horizontal IIT levels than Czech Republic. The systematic rise of these indices in Poland, Hungary and Slovakia showed that crisis influenced rather more EU-15 than the Visegrad Group in trade terms.
As regard two-directional trade of exchanged goods the Visegrad countries export items with relatively better quality (see: graph 3) than the imported goods within the same branch. The same applies to the case of horizontal IIT: the decrease is visible in 2009 (except of Poland, where the vertical high quality IIT index was increasing until 2010). The examined countries' indices in the whole period were generally rising, however the weakest trends were noticed in Hungary and Czech Republic, and the strongest increases occurred in Slovakia although tempered during the crisis. So, the upgrade of technological process still takes place (however weaker) and more sophisticated goods started being produced in the Visegrad Group countries due to relocation of particular parts of global supply chain.

Graph 4 shows the trends in two-directional trade of exchanged goods when Visegrad countries export items with relatively lower quality than the imported goods within the same branch. In general, the levels the IIT ratios were maintained, however after the beginning of the crisis the indices were lowering (except for Slovakia and the Czech Republic). It could mean, that a lower part of better quality goods were imported, probably due to more restricted financial conditions of households in the Visegrad Group countries. Probably it also could be imposed by lowering the prices of exported goods from EU-15 or relatively stronger inflation (also in producer prices) in the Visegrad Group countries.
GRAPH 3. **Vertical high quality IIT of Czech Republic, Hungary, Poland and Slovakia with EU-15 in 2004–2010 [%]**

Source: the author's calculations based on COMEXT, Eurostat


Source: the author’s calculations based on COMEXT, Eurostat
Sensitivity analysis

The literature in most cases uses $\alpha$, the threshold level of 15%. However, there are some papers, such as Fukao et al. (2003), where $\alpha$ is at the level of 25% (in order to eliminate exchange rate fluctuations). However, there is still the firm reason in theoretic or empiric field to use 15% threshold level. Greenaway, Hine and Milner (1994, 1995) see their results of the research robust to the choice of the threshold level. However, it was robust to the objectives of the research, that is assessing the determinants for horizontal and vertical intra-industry trade, and the sensitivity analysis was limited to 15–35%. I followed the paper of Ito and Okubo (2011) that extended the sensitivity analysis to 5–50% threshold levels. They stated that the choice of threshold might affect the final results.

I analyzed how the changes in $\alpha$ affect the horizontal and vertical intra-industry trade for each of the analyzed countries. Due to better readability, each type of intra-industry trade and each country is presented separately. In subsequent graphs there are presented the trends of changes in horizontal and vertical trade due to the threshold level, beginning from 5% and ending to 50%. A noticeable thing is that the higher threshold level is, the higher are horizontal intra-industry trade indices, and lower are vertical intra-industry trade ratios. However, this is intuitive: the greater is $\alpha$ the more likely is that unit values are insignificantly different. The most important remark is that, in general the extreme differences between the indices (especially horizontal intra-industry trade) may diverge the indices by even about 20 percentage points.

GRAPH 5. Horizontal intra-industry trade of Czech Republic with the EU-15: a juxtaposition of threshold levels [%]

Source: the author’s calculations based on COMEXT, Eurostat
In case of the Czech Republic, the range of indices due to various $\alpha$ in horizontal intra-industry trade exceeds slightly 25 percentage points in 2010, and the difference in levels between “standard” 15% level and extreme threshold levels are a little more than 15 percentage points (see: graph 5). The difference is huge, as whole intra-industry trade indices reach about 50%. However, also the range of the thresholds is rather big, so it could explain such sensitivity of results. 2006 is a year, where a range is the smallest in case of all the Czech intra-industry trade indices. The highest level of threshold implies also the greatest volatility of horizontal two-way trade indices; it also has a slight positive trend, whereas the others are rather stable. What also is interesting, “standard” threshold level (and lower) in vertical high quality two-way trade in 2009 decreased, whereas in case of applied higher threshold levels, we may observe an increase in indices. The range of vertical high quality and low quality intra-industry trade indices is consequently 10 and 15 percentage points.

**GRAPH 6. Vertical high quality intra-industry trade of Czech Republic with the EU-15: a juxtaposition of threshold levels [%]**

The range of particular intra-industry trade indices due to the choice of $\alpha$ in Hungary does not exceed 20 percentage points. One should note that the trends do not extremely diverge as the thresholds change. During the crisis, we may observe a stag-
nation of horizontal indices in 2009 and the rebound. What is interesting, in 2005 some
horizontal ratios decreased at particular threshold levels (p.ex. 5 %), whereas the oth-
ers rose (similarly this is also a case of vertical low quality). Also noticeable is a stop of
vertical high quality in 2009, and continuation of decreases in 2010.

GRAPH 7. Vertical low quality intra-industry trade of Czech Republic with the EU-15: a jux-
taposition of threshold levels [%]

GRAPH 8. Horizontal intra-industry trade of Hungary with the EU-15: a juxtaposition of
threshold levels [%]

Source: the author’s calculations based on COMEXT, Eurostat
However, in some cases, one may observe a recovery in 2010 (5\% and 10\% for $\alpha$). One may also see a stable decreasing trend in vertical low quality two-way trade indices; therefore, the proposition on maintaining the improvement of quality process is justified. The choice of thresholds has an impact on levels of indices, nevertheless the coherent conclusions may be delivered.

**GRAPH 9.** Vertical high quality intra-industry trade of Hungary with the EU-15: a juxtaposition of threshold levels [\%]

Source: the author’s calculations based on COMEXT, Eurostat

**GRAPH 10.** Vertical low quality intra-industry trade of Hungary with the EU-15: a juxtaposition of threshold levels [\%]

Source: the author’s calculations based on COMEXT, Eurostat
The Poland’s, similarly to Hungary’s, intra-industry trade indices also have a range of at most about 20 percentage points. But still, in case of horizontal intra-industry trade, we may observe a slight increase in ratios at the end of the research period. It points at the increasing level of welfare of the Polish consumers, who are able and prefer to buy more products of comparable (quite high) quality as the EU-15 countries citizens. We may see the interesting tightening of a range of vertical high quality intra-industry trade indices in 2006 and 2007 and after it a widening of a range. Most of the scenarios for $\alpha$ look similar: until 2006 a significant rise of ratios and after it we may observe a stabilization. The vertical low quality intra-industry trade indices seem to be stable and slightly decreasing during the entire research period and besides the different level of indices, the trend seems to be independent to level of $\alpha$.

Slovakia is the last of the examined countries and one of the most interesting. When analyzing the range of horizontal intra-industry trade indices due to the different levels of $\alpha$, we may observe an increasing divergence over time. This may suggest an increasing sensitivity of existing types of trade due to the price changes. The same case is in vertical high quality trade and to some extent in low quality trade. In case of Slovakia, the threshold has an impact on trends of indices. Horizontal trade seems to be stable at “standard” level, but when higher $\alpha$ is applied, the trend started to be increasing. Vertical high quality was increasing until 2008, and after this period, it started dropping. Nevertheless, higher thresholds almost flatten the changes of the measure. The low quality intra-industry trade indices were generally growing at the end of the research period, but when higher $\alpha$ are applied, the increase in indices is not noticeable.
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GRAPH 12. Vertical high quality intra-industry trade of Poland with the EU-15: a juxtaposition of threshold levels [%]

Source: the author's calculations based on COMEXT, Eurostat

GRAPH 13. Vertical low quality intra-industry trade of Poland with the EU-15: a juxtaposition of threshold levels [%]

Source: the author's calculations based on COMEXT, Eurostat
GRAPH 14. Horizontal intra-industry trade of Slovakia with the EU-15: a juxtaposition of threshold levels [%]

Source: the author's calculations based on COMEXT, Eurostat

GRAPH 15. Vertical high quality intra-industry trade of Slovakia with the EU-15: a juxtaposition of threshold levels [%]

Source: the author's calculations based on COMEXT, Eurostat
To sum up this section, I analyzed whether the threshold level different to most common 15% implies the values and trends of particular types of intra-industry trades. The analysis confirmed the significance of the size of $\alpha$, especially when concerning the values of ratios. The trends seem to be more independent of thresholds levels, but there are little exceptions, as in case of Slovakia.

**Estimations**

One should verify whether economic and financial crisis have real impact on intra-industry trade. Therefore, there will be analyzed the determinants for IIT linked with consumers welfare. The most straightforward measure is the level of GDP per capita (in line with Helpman (1981)). However, it is interesting, whether in time of crisis, the difference between incomes – that is difference between the welfares and thus the differences in spending behaviours – of the examined countries and the EU-15 member states still influences the structure of two-way trade. I also checked whether the weakened integration processes (simply measured by total trade between the one of the Visegrad Group and EU-15 countries) during economic downturn impacted the IIT indices. In order to pick other effects of the crisis, I introduced a dummy variable that represents the occurrence of crisis. I also added geographic distance and contiguity dummy variable to supplement a set of variables.
I used the panel data techniques to estimate the determinants. The estimated model is presented by the following equation:

\[ IIT_i = \alpha_0 + \alpha_1 MEANGDP_i + \alpha_2 DIFFGDP_i + \alpha_3 T_i + \alpha_4 DIST_i + \alpha_5 CONTIG_i + \alpha_6 CRISIS_i + \varepsilon_i \]

where DIFFGDP is a difference in GDP per inhabitant between particular Visegrad Group countries and EU-15 countries. MEANGDP is a weighted average of GDP per capita that represents the overall consumers’ welfare for each pair of trading countries. T is a total trade size between the trading countries that represents the overall integration of the states. DIST stands for geographic distance (in km) between the capitals of examined member states, whereas CONTIG is a dummy variable that represents the border between the countries. CRISIS is a straightforward and simplified variable that represents the influence of a crisis through the other channels than the income (just as relocation within supply chain).

### TABLE 1. Correlation matrix

<table>
<thead>
<tr>
<th></th>
<th>IIT</th>
<th>MEANGDP</th>
<th>DIFFGDP</th>
<th>T</th>
<th>DIST</th>
<th>CONTIG</th>
<th>CRISIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIT</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEANGDP</td>
<td>0.3174</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIFFGDP</td>
<td>-0.1949</td>
<td>0.1009</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>0.6575</td>
<td>0.2790</td>
<td>-0.0931</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DIST</td>
<td>-0.4687</td>
<td>-0.4149</td>
<td>-0.2963</td>
<td>-0.3880</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CONTIG</td>
<td>0.5511</td>
<td>0.1916</td>
<td>-0.0374</td>
<td>0.5705</td>
<td>-0.4941</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>CRISIS</td>
<td>0.0701</td>
<td>0.1602</td>
<td>-0.0485</td>
<td>0.0639</td>
<td>0.0000</td>
<td>0.0000</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

Table 1 presents the correlation matrix between the variables used in the model. Total trade is the most correlated variable with IIT. The second strongest correlation is between two-way trade and contiguity. Next variable is geographic distance, negatively correlated with IIT. The least correlated variable is dummy CRISIS. This could mean that dummy variable that represents other channels of crisis, is not sufficient and should be replaced by specific and more detailed determinants or the two preceding channels (welfare and weakened integration) sufficiently explained the changes of IIT during the crisis.

According to the trade theory and to the results collected in correlation matrix, I expected that MEANGDP has positive sign. This would take place because higher incomes enable greater and more diversified consumption. What is more, total trade, as a simple
measure of integration should positively influence the explained variable. Also a common border should have a positive impact as a cross border trade – due to low transportation costs, especially when the borderline is sufficiently long – increases two-way trade. I expected that the differences between GDP per capita of examined countries should affect negatively the explained variable. Also, a geographic distance should have a negative impact.

**TABLE 2. Estimation results**

<table>
<thead>
<tr>
<th></th>
<th>IIT (GLS, random effects)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T</strong></td>
<td></td>
</tr>
<tr>
<td>coef</td>
<td>0.0003***</td>
</tr>
<tr>
<td>St. dev.</td>
<td>0.00013</td>
</tr>
<tr>
<td><strong>MEANGDP</strong></td>
<td></td>
</tr>
<tr>
<td>coef</td>
<td>0.00038***</td>
</tr>
<tr>
<td>St. dev.</td>
<td>0.00014</td>
</tr>
<tr>
<td><strong>DIFFGDP</strong></td>
<td></td>
</tr>
<tr>
<td>coef</td>
<td>-0.00022***</td>
</tr>
<tr>
<td>St. dev.</td>
<td>0.00007</td>
</tr>
<tr>
<td><strong>DIST</strong></td>
<td></td>
</tr>
<tr>
<td>coef</td>
<td>-0.00333***</td>
</tr>
<tr>
<td>St. dev.</td>
<td>0.0012</td>
</tr>
<tr>
<td><strong>CONTIG</strong></td>
<td></td>
</tr>
<tr>
<td>coef</td>
<td>7.84783***</td>
</tr>
<tr>
<td>St. dev.</td>
<td>3.27678</td>
</tr>
<tr>
<td><strong>CRISIS</strong></td>
<td></td>
</tr>
<tr>
<td>coef</td>
<td>0.31821</td>
</tr>
<tr>
<td>St. dev.</td>
<td>0.41676</td>
</tr>
<tr>
<td><strong>CONST</strong></td>
<td></td>
</tr>
<tr>
<td>coef</td>
<td>13.5591***</td>
</tr>
<tr>
<td>St. dev.</td>
<td>4.00645</td>
</tr>
<tr>
<td>Observations</td>
<td>420</td>
</tr>
<tr>
<td>Wald</td>
<td>118.45</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.54</td>
</tr>
<tr>
<td>Hausman</td>
<td>14.91</td>
</tr>
</tbody>
</table>

Equation (8) can be estimated considering a fixed-effects model or a random-effects method. Hausman tests leads us to conclude that the random-effects model is more appropriate (see table 2), as Chi squared remains considerably small and significance is under 1% level.
In table 2, I presented the results of the model I regressed with GLS on the panel data. In the model I introduced 420 observations gathered in 60 groups (pairs of trading states). The model was estimated according to equation (8). What is interesting, the coefficients of all explanatory variables (except of CRISIS) are of expected sign. Also all variables (except of CRISIS) are at 1% significance level.

Each additional 1000 Euros of GDP per capita deliver 0.38 pp greater IIT ratio, so after 2007, the worsening economic situation faded the growth of two way-trade. The results proved the assumption that the crisis, through the income channel weakened the convergence of the trade patterns with the EU-15 countries. Similarly, the influence of total trade is also positive. This means that the weaker integration and loosing the supply chain as a consequence of a crisis negatively impacts the two-way trade, but during weak economic recovery the indices started returning to grow in line with the convergence path.

Even now, the differences in welfare play an important role in shaping trade patterns. The economic distance of 1000 Euros downsizes IIT by 0.22 pp, which mean that the ongoing economic – and in particular – trade convergence of Visegrad Group countries to EU-15 – despite the occurrence of the economic and financial crisis – has not fully stopped. Also, a geographic distance is still the obstacle in developing two-way trade. Each additional 100 km of distance between the capitals stand for less 0.33 pp of intra-industry trade. Also common borders impact positively intra-industry trade. However, the CRISIS variable is insignificant, so this dummy is too straightforward, and in order to examine the influence of the other channels of crisis impact on IIT, specific variables should be used.

Conclusions and final remarks

The presented paper offers empirical evidence on the major trends in the nature of the EU-15 and the Visegrad Group Countries trade after the EU enlargement in 2004. The analysis generally consisted of three empiric parts: description of changes in the trade patterns of the Czech Republic, Hungary, Poland and Slovakia, the sensitivity analysis and the econometric model. The evolving trade patterns were described by the IIT, and its components, as horizontal and two types of vertical trade, as well as by more dynamic two-way trade measure – marginal intra-industry trade index.

The rising IIT and MIIT indices pointed at the increasing engagement of the Visegrad Group countries in global production fragmentation. Even the strongest disturbances on consumer and producer sides caused only a temporary deterioration of the examined countries trade indices and weakened the convergence processes for a short-term only. What is interesting, the losses in IIT were visible not before 2009. But MIIT sharply decreased in 2008, so it means that the structural adjustments occurred immediately in deteriorating global economic circumstances.
As concerning the components of two-way trade, horizontal as well as high quality vertical IIT ratios were generally stable or increasing, while on the other side the shares of low quality vertical IIT were generally stable or decreasing. That could point at relative improvement in the quality of goods produced in the Visegrad Group countries, or adversely a relative deterioration of quality of items produced in the EU-15 (or just goods values, through the various levels of inflation of the examined countries and their trade partners) due to the economic and financial crisis. However, worth analyzing is the sensitivity of values and trends of parts of intra-industry trade to threshold levels. It seems that the choice of a particular threshold affects the share of a specific intra-industry trade type, but in most cases it does not change trends significantly.

In this paper I examined the channels by which the crisis influenced the trade patterns. I chose several variables used in gravity models, such as trade magnitude, average GDP per capita and the difference between GDP per capita for each pair of trading countries, a geographic distance between the capitals of the examined countries and two dummy variable: one that stands for common border and second one that stands for the occurrence of crisis. To address a problem properly, I considered a panel data approach. In line with expectations, such factors as the total trade and the average of GDP per capita and common borders affect positively the IIT, whereas economic and geographic distance influences negatively the two-way trade share. That proves the insight that welfare and integration channels of a crisis have a significant impact on trade pattern. The dummy variable crisis proved to be insignificant, so it suggests that specific variables should be used or (little probable) the two channels (welfare and integration) satisfy most of crisis impact on trade patterns between Visegrad Group and the EU-15.

To sum up, after the EU enlargement, the Visegrad Group countries experienced boosted improvements in their economies and in trade patterns due to the ongoing and accelerated convergence process. However, once economic and financial crisis started, the convergence was weakened, albeit not significantly and for a short term. The evidence showed that the weakening took place through the welfare and integration channels, but one may not exclude the existence of the other channels, that could have certain impact on the Visegrad Group countries’ intra-industry trade.

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