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A role of trade costs in intra industry trade: an evidence from selected EU CEE countries

Summary:

This paper addresses the issue of the influence of the transaction costs on the intra-industry trade patterns on the example of the Visegrad Group countries. The reason for this study has foundations in a fact, that the EC CEE countries (in this article: Czech Republic, Hungary, Poland and Slovakia) compete with the other regions with relative low production costs (i.e. through wages). Low transportation, or more broadly trade costs, becoming increasingly important at the firm level during the downturn, may additionally help integrate this region with the rest of the EU.

The author applies the Grubel – Lloyd (GL) index as an intra industry trade measure and with using gravity models, he examines a role of infrastructure quality and other trade cost-related variables on trade patterns.

The results of modelling are not clear. The geographic distance is an important factor, as well as a time needed to import/export goods from/to the examined countries. However, the quality of roads and railroads, the costs of import and export appear to be insignificant.

Keywords: intra-industry trade, transaction costs, new EU Member States

JEL: F1, F14, F15

Introduction

The transaction costs were rarely examined in theoretic and empiric studies, which was noticed by p.ex. Bergstrand and Egger (2006). However, their magnitude may affect trade patterns, which was observed by Anderson and van Wincoop (2004).

The recent studies concerning the evolution of trade patterns in EU CEE suggested that the EU enlargement – with the economic growth boost, trade liberalisation, new productions standards - 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. What was interesting in most of these studies, the geographic distance was a significant obstacle to appearance of two-way trade.

However, the geographic distance, despite being often used as an explanatory variable in econometric models that explain intra industry trade shares, in theoretic literature has moderate reason for affecting negatively two-way trade. That became a reason for seeking alternative empiric trade costs proxies.

The structure of the paper is as follows: Section II elaborates on brief theoretical foundations on intra-industry trade and trade costs. Section III presents the used methodology of construction of IIT. Section IV describes a simple econometric model that examines the influence of particular factors on intra-industry trade shares. Section V 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 (p.ex. Balassa (1967)). Grubel and Lloyd (1975) confirmed the significance of the existence of customs union on IIT, basing on developed countries. The cuts in tariffs may be treated as lowering the trade costs that enhance rather intra- then inter industry trade.

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), Falvey (1981), Falvey and Kierzkowski (1987)). 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.

Surprisingly, little attention is paid to the intra-industry trade in aspect of transportation costs, or more broadly trade costs. To some extent, the first studies concerning the trade barriers might be classed as trade costs, but this certainly did not exhaust the subject. Brander and Krugman (1983), dealt with the problem, by extending the Brander (1981) model with zero-cost transportation. They contributed with the analysis of intra-industry trade model with non-zero transport costs, known as "reciprocal dumping model". In the model, the higher transportation costs are, the smaller amount of goods are traded.

Anderson and van Wincoop (2004) pointed at the fact the trade costs should not be neglected in terms of trade patterns, as the average markup reach approximately even 170%. Bergstrand and Egger (2006) developed the early models of intra industry trade, and created a general equilibrium model with a differentiated and homogenous good to present an influence of trade costs on intra-industry trade. Their theoretical results showed that the higher costs are given, the lower intra-industry trade shares are. Also, the trade costs differences between the homogenous and differentiated goods matter and the marginal effect of these costs are dependent of relative factor endowment differences. To approximate the trade costs, they use a gross c.i.f./f.o.b. ratios as a markup on exported goods prices. The empiric evidence proved the theoretic results. Greenaway et al. (2010), in a developed heterogeneous firm intra-industry trade model, also taken into the account trade costs, however this factor was inferior to technological and productivity gaps between the trading countries, which proven to be a significant factor to size and direction of intra-industry trade resource reallocation.

The empirics of intra-industry trade of EU CEE countries rarely include trade costs. The first papers rather on economic transition of these countries, also point at their gradual inclusion to the global supply chain. They showed the mainly vertical feature of two-way trade with rather low quality of goods or CEE regions specialisation in semi-products due to historic conditions (see: p.ex. Aturupane et al. (1997), Djankov et al. (1996)). The later papers assessed two-way trade in aspect of economic integration of some countries of the CEE region with the EU, especially after 2004 EU enlargement or focused on specific branch, like automotive industry (Ambroziak (2010), Cernosa (2007), Czarny et al. (2008), Kawecka-Wyrzykowska (2009), Toporowski(2010)). They pointed at the increasing relative quality of exported goods from the CEE region due to massive investments and technological shocks.

In most of recent papers, only geographic distance and common border represent transportation or trade costs. To some extent, a membership to a multinational organism, such as European Union might be indirectly treated as an inverse cost (see p.ex.: Toporowski (2010), Czarny et al. (2011)). However, all these features still don't exhaust the existing problem of transportation or trade costs' influence on two-way trade.

The methodology and measurement of data

I collected bilateral trade data based from the COMEXT in Eurostat according to 8 digit CN nomenclature for Czech Republic, Hungary, Poland, Slovakia with EU-15 countries within 2006-2010. This level of aggregation was applied because of strong disaggregation level that helps to assess better the nature of the trade. I decided to limit the research period due to the availability of explanatory variables: the accessible trade costs-related time series (p.ex. the assessment o roads quality, the days to trade) are collected since 2005 and 2006.

The main IIT ratios were calculated at the country-level in line with the Grubel and Lloyd (1975) method. According to them, the IIT share cannot be lower than 0% of total bilateral trade and cannot exceed 100% of total bilateral trade. The transitional values between 0% and 100% mean the co-existence of both types of trade (inter- and intra-industry). The so-called Grubel-Lloyd index has the following form:

$$GL = \sum_{i=1}^{n} w_i GL_i = \sum_{i=1}^{n} \left(\frac{X_i + M_i}{\sum_{i=1}^{n} (X_i + M_i)}\right) GL_i = 1 - \frac{\sum_{i=1}^{n} |X_i - M_i|}{\sum_{i=1}^{n} (X_i + M_i)} \quad (1)$$

where:

wi – a share of trade with product *i* in total trade,

GLi – Grubel-Lloyd index of product *i*,

Xi – export of product *i*,

Mi –import of product *i*.

Estimations of the models

The database, apart from IIT shares, consists of mean GDP per capita of a selected pair of trading countries, differences in their GDP per capita and total trade value. These data were taken from Eurostat. There are also some variables that represent broadly the trade costs. First is geographic distance between capitals. But also the others were take into the account, like the quality of road and railroad infrastructure (entrepreneurs' subjective assessment with scale: 1-worst to 7-best), taken from Global Competitiveness Report. A synthetic index is obtained based on a combination of 80% of the assessment of road and 20% of railroad infrastructure, which corresponds to the structure of transport types, by which the goods are mainly traded in analysed countries. Because all data are bilateral, the index I used is the mean of the combined assessment of each trading pair transport infrastructure.

Also, the data concerning the trade burdens linked with trade are applied to the model (data taken from World Bank's Doing Business). Each of these following three variables: documents, days and costs needed to trade, originally are divided to exports and imports. I combined these features divided for exports and imports into "trade", to achieve one synthetic index for each variable, and then united the indices for each pair of countries. In case of costs of trade, the data is originally in USD, however I created the alternative to this measure with adjusting it with the EUR/USD rate and tested both indices.

In Table 1, one may find the details of gathered data, in particular: mean, median, standard deviation, minimum and maximum. In case of trade standard deviation was higher than the mean, which points at high variability or some extreme observations of this factor.

Table 1. Descriptive statistics

Variable	Mean	Median	St. Dev.	Min	Max
IIT	0.1661	0.1706	0.0962	0.007	0.4722
MeanGDP (in EUR)	22,965.28	24,272.77	3,725.395	12,681.38	31,516.89
DiffGDP (in EUR)	13,742.85	12,000	10,163.45	300	55,900
T (in EUR)	4.88 (bn)	2.44 (bn)	9.17 (bn)	29.3 (mn)	58.9 (bn)
Geographic Distance	1,523.32	1343.5	734.35	79	3338
Number of documents to trade	5.17	5	0.66	3.5	8.25
Days to trade	14.43	13.5	2.8	11	22.5
Costs to trade (originally in USD per container)	993.51	987.5	172.56	618.75	1,479.75
Costs to trade (in EUR per container)	716.19	714.16	128.03	424	1,105.45
Assessment of roads and railroads quality	4.39	4.53	0.52	2.71	5.3

As seen in the Table 1, apart from the variables that represent trade costs, the other are also applied. I analyzed the determinants for IIT linked with consumers welfare, p. ex. the level of GDP per capita (in line with Helpman (1981)): the general welfare of trading countries, but also the differences between their incomes. Also, I introduced a dummy variable that represents an existence of a common border between the trading countries.

Table 2. Correlation matrix

	IIT	mean gdp	diff gdp	t	distance	contiguity	quality of (rail)roads	Documents	days to trade	costs (original)	costs (EUR)
IIT	**1**										
meangdp	0.2925	**1**									
diffgdp	-0.1741	0.1303	**1**								
t	0.6602	0.2675	-0.0925	**1**							
distance	-0.4837	-0.4375	-0.2912	-0.3947	**1**						
contiguity	0.541	0.2005	-0.0372	0.5779	-0.4941	**1**					
quality of (rail)roads	0.256	0.4126	0.0225	0.1734	-0.3853	0.2473	**1**				
documents	-0.0693	0.152	-0.0911	-0.1123	0.2238	-0.011	0.1746	**1**			
days to trade	-0.3086	-0.244	-0.4153	-0.1812	0.3786	-0.1545	-0.3594	0.3682	**1**		
costs (original)	-0.0505	0.2394	0.1679	-0.1449	-0.0702	-0.0692	-0.0696	0.2281	0.2754	**1**	
costs (EUR)	-0.05	0.2226	0.1644	-0.1427	-0.0682	-0.0669	-0.0374	0.2355	0.2736	0.9763	**1**

Table 2 presents the correlation matrix between the variables used in the model. Among the non-cost-related variables the total trade is the most correlated variable with IIT. The second strongest correlation is between two-way trade and mean of GDP, which is moderately positively correlated. The differences in incomes are rather weak correlated. Among the variables linked with trade costs the strongest (and negative) correlation has contiguity and geographic distance. The next important trade cost-related variable is "days to trade", but also "businessmen assessment of transport infrastructure quality" is moderately positively correlated. The others are virtually uncorrelated with the IIT.

Firstly I estimated five models, with using panel data techniques basing on GLS and maximum likelihood regressions. The estimated models are presented by the following equations:

$$+\alpha_6 QUAL_t + \varepsilon_t \quad (2)$$

$$+\alpha_6 DOCS_t + \varepsilon_t \quad (3)$$

$$+\alpha_6 DAYS_t + \varepsilon_t \quad (4)$$

$$+\alpha_6 COST_t + \varepsilon_t \quad (5)$$

$$+\alpha_6 COSTEUR_t + \varepsilon_t \quad (6)$$

where GDPDIFF is a difference in GDP per inhabitant between particular examined countries and EU-15 countries. GDPMEAN 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. DOCS represents a variable "documents needed to trade", DAYS represents "days needed to trade" and COST and COSTEUR stand for cost of trade of one container in USD and EUR respectively

Among the non-cost-related variables, 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. I also expected that the differences between GDP per capita of examined countries should affect negatively the explained variable. Among the cost-related factors, 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. Similarly, I expect the quality of transport infrastructure, as a proxy for inverse of costs, should have positive sign. The other variables, like a geographic distance, docs, days and costs to trade should adversely impact the two-way trade. All of these expectations are in line with the correlations between the explanatory and explained variables.

The cost-related factors were assessed separately, but with contiguity and distance in line with the equations (2)-(6). Hence, for each examined trade cost-related variable, one of the preceding equations was estimated. In Tables 3 and 4 there are presented the estimation results. The estimation method (random effects GLS or ML) brought them quite close.

In all models (1)-(10) MEANGDP and CONTIG remained insignificant. Coefficient of DIFFGDP is negative which proves Linder hypothesis (same demand patterns bring intra industry trade). Contrary, trade volume influences IIT positively. This may be explained by the growing integration of EU CEE with the EU. Among the trade cost-related variables, only DIST and DAYS were significant (at 1% and 5% respectively in each model, which the variable was applied, in case of ML, also variable DAYS was significant at the 1% level). The coefficients were of expected signs: DIST as well as DAYS affected negatively the IIT shares, which proves the expectations, that the costs limit the trade of alike goods. What is interesting, DAYS appeared to be more important than COSTS (nevertheless in USD or in EUR) and model (3) and (8) obtained the biggest R^2 and log likelihood. However, this result in not much surprising, as firms treat time to deliver their products as a specific cost.

Table 3. Estimation results (GLS)

Variable	GLS (1)	GLS (2)	GLS (3)	GLS (4)	GLS (5)
meanGDP	$2.61x10^{-6}$ ($1.85x10^{-6}$)	$2.53x10^{-6}$ ($1.87x10^{-6}$)	$2.09x10^{-6}$ ($1.78x10^{-6}$)	$2.62x10^{-6}$ ($1.85x10^{-6}$)	$2.73x10^{-6}$ ($1.86x10^{-6}$)
DiffDGP	$-2.23x10^{-6}$*** ($7.06x10^{-7}$)	$-2.2x10^{-6}$*** ($7.06x10^{-7}$)	$-2.58x10^{-6}$*** ($6.83x10^{-7}$)	$-2.11x10^{-6}$*** ($7.1x10^{-7}$)	$-2.13x10^{-6}$*** ($7.09x10^{-7}$)
T	$3.8x10^{-12}$*** ($8.6x10^{-13}$)	$3.89x10^{-12}$*** ($8.6x10^{-13}$)	$3.76x10^{-12}$*** ($8.13x10^{-13}$)	$3.94x10^{-12}$*** ($8.59x10^{-13}$)	$3.93x10^{-12}$*** ($8.6x10^{-13}$)
dist	-0.00004*** (0.000013)	-0.000038*** (0.000013)	-0.000033*** (0.000012)	-0.000036*** (0.000013)	-0.000036*** (0.000013)
contig	0.0518 (0.035)	0.0486 (0.0351)	0.0501 (0.0327)	0.0514 (0.035)	0.0511 (0.035)
(rail)roads quality	-0.0107 0.0102	-	-	-	-
documents	-	0.001 (0.006)	-	-	-
days	-	-	-0.0057** (0.0022)	-	-
costs (original)	-	-	-	0.000029 (0.000023)	-
costs (EUR)	-	-	-	-	0.000036 (0.00003)
const	0.2243*** (0.073)	0.1689*** (0.0581)	0.2639*** (0.0625)	0.1383** (0.0607)	0.1385** (0.0607)
observations	300	300	300	300	300
R^2	0.544	0.549	0.588	0.548	0.548

Table 4. Estimation results (maximum likelihood)

Variable	ML (6)	ML (7)	ML (8)	ML (9)	ML (10)
meanGDP	$2.56x10^{-6}$ ($1.8x10^{-6}$)	$2.43x10^{-6}$ ($1.81x10^{-6}$)	$2x10^{-6}$ ($1.72x10^{-6}$)	$2.5x10^{-6}$ ($1.81x10^{-6}$)	$2.6x10^{-6}$ ($1.81x10^{-6}$)

DiffDGP	-2.22x10^{-6}*** (6.79x10^{-7})	-2.18x10^{-6}*** (6.74x10^{-7})	-2.59x10^{-6}*** (6.54x10^{-7})	-2.1x10^{-6}*** (6.77x10^{-7})	-2.12x10^{-6}*** (6.76x10^{-7})
T	3.84x10^{-12}*** (8.23x10^{-13})	3.93x10^{-12}*** (8.26x10^{-13})	3.78x10^{-12}*** (7.81x10^{-13})	3.98x10^{-12}*** (8.27x10^{-13})	3.97x10^{-12}*** (8.26x10^{-13})
dist	-0.00004*** (0.000013)	-0.000038*** (0.000013)	-0.000032*** (0.000012)	-0.000036*** (0.000012)	-0.000036*** (0.000012)
contig	0.05123 (0.03352)	0.0481 (0.0333)	0.0497 (0.0311)	0.0507 (0.0333)	0.0504 (0.0333)
(rail)roads quality	-0.0102 0.0102	-	-	-	-
documents	-	0.001 (0.005)	-	-	-
days	-	-	-0.0058*** (0.0022)	-	-
costs (original)	-	-	-	0.000028 (0.000023)	-
costs (EUR)	-	-	-	-	0.000033 (0.000029)
const	0.2223*** (0.0709)	0.1706*** (0.0562)	0.2685*** (0.0612)	0.1418** (0.0589)	0.142** (0.0589)
observations	300	300	300	300	300
log likelihood	480.9	480.5	483.79	481.23	481.22

I estimated again the models without the variables that proved to be insignificant, and examined, whether the time to trade alone has an impact on two-way trade or it is only complimentary to geographic distance. Thus, the models are described with the new following equations:

$$\text{[illegible]}_{ij} = \beta_0 + \beta_1 \text{[illegible]}_{ij} + \beta_2 \text{[illegible]}_{ij} + \beta_3 \text{[illegible]}_{ij} + \beta_4 \text{[illegible]}_{ij} + \varepsilon_{ij} \quad (7)$$

and

$$\text{[illegible]}_{ij} = \beta_0 + \beta_1 \text{[illegible]}_{ij} + \beta_2 \text{[illegible]}_{ij} + \beta_3 \text{[illegible]}_{ij} + \varepsilon_{ij} \quad (8)$$

Table 5. Estimation results

Variable	ML (11)	ML (12)	GLS (13)	GLS (14)
DiffDGP	-2.62x10^{-6}*** (6.55x10^{-7})	-1.9x10^{-6}*** (6.87x10^{-7})	-2.61x10^{-6}*** (6.73x10^{-7})	-1.89x10^{-6}*** (7x10^{-7})
T	4.43x10^{-12}*** (7.04x10^{-13})	5.47x10^{-12}*** (7.11x10^{-13})	4.42x10^{-12}*** (7.24x10^{-13})	5.46x10^{-12}*** (7.24x10^{-13})
Dist	-0.000042*** (0.00001)	-	-0.000043*** (0.000011)	-
Days	-0.0059*** (0.0022)	-0.0071*** (0.0023)	-0.0058*** (0.0022)	-0.0071*** (0.0023)
const	0.3334*** (0.0392)	0.2713*** (0.0392)	0.332*** (0.04)	0.2699** (0.0392)
observations	300	300	300	300
log likelihood	482	474.6	-	-
R^2	-	-	0.581	0.516

As seen in table 5, the results of new GLS and ML models are alike to the previous estimations, that is the coefficients are of expected signs. Difference in GDP per capita and geographic distance as well as time needed to trade affect negatively the two-way shares. Also all variables (now, even days needed to trade) are significant at 1% significance level. A deduction of DIST variable did not change significantly the coefficients and the quality of the models.

The only variable with positive coefficient (apart from constant) it total trade, which points at the relevance of integration of Czech Republic, Hungary, Poland and Slovakia with the EU, and in this context with to the European supply chain, of part of which they have become. The differences in welfare play an important role in shaping trade patterns. The economic distance downsizes IIT, which still underlines the fact that the ongoing economic – and in particular –convergence of the trade patterns to EU-15 results takes place.

Conclusions and final remarks

The presented paper offers empirical evidence on the major trends in the nature of the EU-15 and the EU Central and Eastern Europe countries trade since 2006 and factors that determine the process. The analysis generally consisted of the analysis of a group of econometric models with attention to various trade costs proxies.

The estimations with random effects GLS and ML brought similar results: mean of GDP *per capita* of trading countries appeared to be insignificant, whereas on one hand differences in GDP *per capita* significantly limit IIT, and one the other hand total trade (interpreted here as a proxy for integration) affects positively two-way trade. What is interesting, apart from trade cost-related variables traditionally used in gravity models, such as geographic distance or common border only one of alternative measures (synthetic "days to trade") proved to significantly affect intra-industry trade.

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, the trade costs have also played a role in building trade patterns of EU CEE, by weakening the firms proneness to enter new markets.

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