INTRA-INDUSTRY TRADE INSIDE EUROPEAN UNION: THE CASE OF POLAND AND SLOVENIA

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INTRODUCTION

- This paper analyses intra-industry trade (IIT) between Poland and Slovenia as Central European countries (CEC-2) having entered the EU in 2004 and the core European Union member states (EU-15).
- The paper verifies vertical product differentiation and focuses primarily on country-specific determinants such as, for instance, size differences, income inequality differences, technological differences, foreign direct investments differences, and distance as a measure for transportation costs.
- While the last important supposition is associated with geographical distance, the gravity model is introduced as a particular type of specification.

THE PAPER IS STRUCTURED AS FOLLOWS

- Section Two provides an overview of the literature:
  - 2.1. The gravity model in its basic form, and
  - 2.2. Three suppositions of the Flam and Helpman (1987) theory.
- Section Three represents the model and methodology used to analyse determinants of intra-industry trade:
  - 3.1. Methodology
  - 3.2. The Model.
- Section Four describes the data sources and presents:
  - 4.1. The dataset
  - 4.2. Dependent variable
  - 4.3. Results of the regression analysis.
- The final section provides concluding comments.

2.1.THE GRAVITY MODEL IN ITS BASIC FORM

The gravity model is a particular type of specification which is inspired by Newton's law of gravity.

The gravity approach says that attractiveness between two entities is proportional to the product of their mass and inversely proportional to the distance which separates them. In its basic form, the gravity model states that the foreign trade between two countries is a positive function of their GDP as a proxy variable for their respective supply and demand and a negative function of the distance between two countries:

$$\ln trade_{ijt} = \alpha_0 + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GDP_{jt} + \alpha_3 \ln Dist_{it} + \varepsilon_{ijt}$$

2.2. FLAM AND HELPMAN THEORY (1987)

- This model introduces the so-called product cycle hypothesis which was proposed by Vernon (1966). This hypothesis predicts the appearance of the new high quality products and disappearance of old, low quality products
- In this way it incorporates a quality-based product cycle in the model, where the advanced North states shifts production to higher quality varieties and abandons the production of lower quality products whose production is taken over by the less developed South country.
- The structure of international trade is determined by cross-country differences in technology, country size and income distribution, where these three suppositions are introduced in the present analysis.

2.2. FLAM AND HELPMAN THEORY (1987)

- Flam and Helpman also suppose that an individual with income *I* chooses a consumption level of the homogenous products and a quality level of the differentiated goods. While the consumer chooses a combination of both goods, individuals with a higher income consume more of the homogenous product and a higher quality of differentiated product.
- Differences in skills are reflected in differences in the endowment of the effective labour supply, which is adequately presented by means of income classes where the set of income classes is chosen to be the unit interval
- Therefore this paper introduces the Gini coefficient, which ranges from 0 to 1, as a proxy variable for income inequality differences.

2.2. FLAM AND HELPMAN THEORY (1987)

- The model predicts not only upgrading in the terms of the technology for the less developed South country, but also a catching-up process: an improvement in the technology improves the efficiency in producing of differentiated products which raises the price of the produced variety and wage rates.
- A higher range of technological progress in the South country narrows down the technological gap between these two states. This process brings the falling wage rates in the North's and the South's relative efficiency in the production of differentiated products which can lead to a switch in the patterns of production and trade between these two hypothetical states.

3.1. METHODOLOGY

- Most studies have estimated the gravity model by using cross-section data, but recently several authors have argued that standard cross-section data leads to biased results because they do not control for heterogeneous trading relationships.
- This analysis introduces the panel data and a fixed effects estimator (FE), Pooled Least Squares (GLS), the fixed effects vector decomposition (FEVD) method, and Generalized Method of Moments (GMM) system estimator as estimation techniques for the gravity model.
- The tests show that the introduced fixed effects estimator (FE) method and fixed effects vector decomposition (FEVD) method have the most reliable results.

3.2. THE MODEL

- This paper tests below presented specification of the gravity model:

$$\ln IIT_{ij,t} = \alpha_{ij} + \alpha_1 \ln GDPD_{ij,t} + \alpha_2 \ln GINID_{ij,t} + \alpha_3 \ln RESD_{ij,t} +$$

$$+ \alpha_5 \ln FDID_{ij,t} + \alpha_5 \ln Dist_{ij} + \lambda_t + \varepsilon_{ij,t}$$

- where $lnIIT_{ij,t}$ is the logarithm of the share of IIT, $GDPD_{ij,t}$ is a proxy variable for size differences , $GINID_{ij,t}$ is a proxy variable for income inequality differences, $RESD_{ij,t}$ is a proxy variable for technological differences , $FDID_{ij,t}$ is a proxy variable for foreign direct investment differences differences, and $DIST_{ij,t}$ is a proxy variable for transportations costs between two observed countries.

3.2. THE MODEL

- The first hypothesis of this paper is that the share of IIT is determined by size differentials, where GDP differences between the EU-15 and the two observed countries are used as a measure for size differences. This proxy variable is suggested by Flam and Helpman's (1987) theory, where the expected sign is positive (+).
- This paper alternatively introduces $GDPD1_{ij,t}$, and $RCS_{ij,t}$ as proxy variables for size differences which are suggested by Holger (2009) and Caporale et al. (2009):

$$GDP1_{ij,t} = \frac{GDP_{i,t}}{GDP_{j,t}}$$

$$RCS_{ij,t} = \left[1 - \left(\frac{GDP_{i,t}}{GDP_{i,t} + GDP_{j,t}}\right)^2 - \left(\frac{GDP_{j,t}}{GDP_{i,t} + GDP_{j,t}}\right)^2\right]$$

3.2. THE MODEL

- The second tested hypothesis is that income inequality differences between two countries in bilateral trade are positively correlated with the share of intra-industry trade as a dependent variable.
- This hypothesis tests the supposition of the Flam and Helpman theory, which predicts that the higher the relative income of the EU-15 members, and the larger the share of income of the CEC-2 individuals that consume imported varieties from EU-15 members, the larger the share of intra-industry trade. The expected sign is positive (+).
- As mentioned, personal income distribution, which is measured by the Gini coefficient differences between EU-15 members and both Central European countries, is introduced as a proxy variable for income inequality differences. The values of this coefficient range between 0 and 1.

3.2. THE MODEL

- The third hypothesis predicts that technological differences between two countries in bilateral trade are positively correlated with the share of intra-industry trade, where the difference in the number of researchers per thousand employed (full time equivalent) between EU-15 and both CEC represents a proxy variable for technological differences. The expected sign is positive (+).
- We also test the number of firms applying leading technology and firms with low technology for each country as a proxy variable for technological differences between CEC-2 and EU-15 members as proposed by Gabrisch (2006).
- The problem is that this alternative proxy variable for technological differences is highly correlated with GDP differences as the main proxy variable for size differentials.

3.2. THE MODEL

- The fourth supposition of this paper predicts that foreign direct investments are positively correlated with the share of intra-industry trade. The foreign direct investment net inflow differences between CEC-2 and EU-15 members are used as a proxy variable. A positive sign is to be expected (+).
- This proxy variable is introduced to reinforce the thesis that foreign direct investments are an important deterministic factor for the share of IIT, which simultaneously reduces the development gap as measured by GDP per capita differences between the core EU members and CEC-2 countries.

3.2. THE MODEL

- Geographical distance, which is included as the last explanatory variable, represents the essentiality of the gravity model. If we suppose that costs of transportation and other freight costs measured as geographical distance between capital cities of CEC-2 and capital cities of EU-15 members increase with distance, a negative sign for is to be expected (-).
- Thus bilateral distance is measured in kilometres between the partner countries' capital cities and weighted by (population) share of the capital city in the overall country's population (distw). The data sources for these explanatory variables are presented in the following section.

4.1. DATA

- The data on yearly bilateral trade flows, as for instance exports and imports by values and by weights between both Central European countries and 15 European Union member states, are provided from the EUROSTAT statistics database.
- Because of the nature of the unit value approach these data are carefully cleansed. Thus the newly formed sample of data includes only those products (or items) which have (completed) values and weights of the exports and imports at the selected five-digit level of SITC (Rev.3) from 1999 to 2008.
- The core EU-15 members are: AUT, BEL, DEN, FIN, FRA, GER, GRC, IRL, ITA, LUX, NED, PRT, SPA, SWE, UKD.

4.2. DEPENDENT VARIABLE

- Thus one of the tasks of this analysis is also to measure horizontal and vertical intra-industry trade by using Greenaway, Hine and Milner methodology (1994) at the five-digit level of the SITC. This methodology supposes a calculation of the Grubel and Lloyd (1975) index:

$$B_j = \frac{\left[(X_j + M_j) - |X_j - M_j|\right] * 100}{(X_j + M_j)} \qquad (0 \leq B_j \leq 100)$$

where, B_j represents the Grubel and Lloyd index for a particular industry j at the five-digit level of SITC, X_j represents exports of that particular industry, while M_j represents imports of that particular industry.

4.2. DEPENDENT VARIABLE

- The intra-industry trade at the aggregate level, which represents the dependent variable in the present analysis, is measured by using the similar index (Grubel and Lloyd, 1975) for the weighted average.
- For instance, the share of total or vertical intra-industry trade of the CEC-2 countries in trade with EU-15 members from 1999 to 2008 is measured by using GL index for weighted average.
- The introduced Greenaway, Hine and Milner methodology also supposes the separation of total IIT into the belonging shares of horizontal IIT (HB_j) and vertical IIT (HB_j):

$$\overline{B_j} = HB_j + VB_j$$

Table1: IIT for Selected Polish Subsections

Intra-industry trade in 1999									
Subsectors specialized in products of higher qu					Subsectors with relatively high share of horizonta				
SITC	GL-TOTAL	HORIZ	**VERT1**	VERT2	SITC	GL-TOTAL	**HORIZ.**	VERT1	VERT2
61	28,25	3,04	**13,06**	12,15	54	6,33	**1,28**	1,88	3,16
78	45,15	7,20	**21,29**	16,65					
79	18,59	1,73	**8,65**	8,21					
83	22,45	3,27	**10,20**	8,98					
Intra-industry trade in 2008									
Subsectors specialized in products of higher qu					Subsectors with relatively high share of horizonta				
SITC	GL-TOTAL	HORIZ	**VERT1**	VERT2	SITC	GL-TOTAL	**HORIZ.**	VERT1	VERT2
53	13,34	1,65	**6,76**	4,94	57	30,24	**6,55**	9,36	14,33
54	28,03	2,70	**12,67**	12,67	67	31,28	**7,10**	10,69	13,50
58	41,41	7,74	**18,85**	14,81	68	27,62	**6,75**	7,48	13,39
61	32,60	5,15	**15,87**	11,58					
65	27,99	4,52	**11,88**	11,59					
78	60,29	7,26	**29,03**	24,00					
83	32,74	4,29	**14,42**	14,03					
84	64,09	11,05	**33,66**	19,38					
88	25,07	2,74	**13,69**	8,64					

Source: Eurostat and author's calculations at the five-digit level of SITC; Notes

53**- Dyeing, tanning and colouring materials**; 54- Medicinal and pharmaceutical products; 57- Plastics in primary forms; **58**- Plastics in non-primary forms; **61**- Leather, leather manufactures, and dressed fur skins**; 65**- Textile yarn, fabrics, made-up articles**; 67**- Iron and steel; **68**- Non-ferrous metals; **78- Road vehicles (including air-cushion vehicles); 79- Other transport equipment; 83**- Travel goods, handbags and similar containers related products; **84**- Articles of apparel and clothing accessories; **88- Photographic apparatus, equipment and supplies and optical goods; watches and clocks

Table2: IIT for Selected Slovenian Subsections

Intra-industry trade in 1999									
Subsectors specialized in products of higher qu					Subsectors with relatively high share of horizonta				
SITC	GL-TOTAL	HORIZ	**VERT1**	VERT2	SITC	GL-TOTAL	**HORIZ.**	VERT1	VERT2
75	17,73	0,92	**9,48**	7,34	67	25,80	**5,18**	7,56	13,06
79	57,07	8,92	**26,75**	21,40	68	37,92	**7,58**	7,58	22,75
83	65,94	2,44	**58,61**	4,88	85	27,22	**5,00**	13,89	8,33
84	52,63	6,82	**37,89**	7,93					
85	27,22	5,00	**13,89**	8,33					
Intra-industry trade in 2008									
Subsectors specialized in products of higher qu					Subsectors with relatively high share of horizonta				
SITC	GL-TOTAL	HORIZ	**VERT1**	VERT2	SITC	GL-TOTAL	**HORIZ.**	VERT1	VERT2
53	21,93	2,27	**9,83**	9,83	51	12,66	**2,89**	3,62	6,15
54	50,78	6,19	**22,29**	22,29	55	33,24	**6,53**	8,31	18,4
79	43,15	9,71	**22,65**	10,79	56	56,73	**21,27**	7,09	28,36
84	38,33	5,41	**20,33**	12,58	57	39,4	**9,34**	10,93	19,13
					62	43,75	**8,75**	12,19	22,81
					64	39,44	**7,72**	8,74	22,97
					67	25,96	**7,42**	8,52	10,02
					68	35,53	**7,11**	7,67	20,75
					75	36,19	**7,13**	12,06	17,00
					79	43,15	**9,71**	22,65	10,79
					85	38,82	**7,76**	12,7	18,35

Source: Eurostat and author's calculations at the five-digit level of SITC; Notes

***51-** Organic chemicals; **53- Dyeing,** tanning and colouring materials; **54- Medicinal and pharmaceutical products; 55-** Essential oils and resinous and perfume materials; **56-** Fertilizers (other than those of group 272); **57-** Plastics in primary forms; **58-** Plastics in non-primary forms; **61-** Leather, leather manufactures, and dressed fur skins; **62-** Rubber manufactures; **64-** Paper, paperboard and articles of paper pulp; **67-** Iron and steel; **68-** Non-ferrous metals; **75- Office machines and automatic data-processing machines; 79- Other transport equipment; 83-** Travel goods, handbags and similar containers related products; **84- Articles** of apparel and clothing accessories; **85-** Footwear*

Table 3: Regression Results

	Trade Relations								
Specifications	CEC-2 with EU-15								
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Constant	19,873	23,269	23,392	**13,574**	**16,845**	**21,832**	13,949	19,085	25,187
	(0,56)***	(0,62)***	(0,57)***	**(0,67)*** **	**(0,42)*** **	**(0,67)*** **	(0,32)***	(0,46)***	(0,35)***
GDPD	0,356			**0,439**			0,469		
	(0,03)***			**(0,05)*** **			(0,02)***		
GDPD1		0,152			**0,778**			0,407	
		(0,04)***			**(0,13)*** **			(0,03)***	
RCS			-0,447			**2,126**			0,198
			(0,05)***			**(0,34)*** **			(0,05)***
GINID	0,370	0,443	0,314	**0,173**	**0,218**	**152**	0,143	0,196	0,101
	(0,07)***	(0,08)***	(0,07)***	**(0,07)** **	**(0,08)*** **	**(0,08)***	(0,03)***	(0,05)***	(0,04)**
RESD	0,467	0,465	0,501	**0,088**	**0,07**	**0,106**	0,098	0,141	0,17
	(0,06)***	(0,07)***	(0,06)***	**(0,04)** **	**,(0,05)**	**(0,05)** **	(0,03)***	(0,04)***	(0,04)***
FDID	0,318	0,401	0,332	**0,064**	**0,103**	**0,08**	0,07	0,127	0,189
	(0,04)***	(0,04)***	(0,04)***	**(0,03)** **	**(0,03)*** **	**(0,03)** **	(0,02)***	(0,03)***	(0,03)***
DIST	-2,400	-2,439	-2,384	**-1,993**	**-2,378**	**-2,014**	-0,227	-0,425	-0,427
	(0,10)***	(0,13)***	(0,11)***	**(1,8)*** **	**(0,18)*** **	**(0,17)*** **	(0,06)***	(0,11)***	(0,08)***
Residuals							1,001	0,965	0,999
							(0,02)***	(0,03)***	(0,02)***
Observations	300	300	300	**300**	**300**	**300**	300	300	300
Adj. R-squared	0,761	0,669	0,742	**0,95**	**0,934**	**0,935**	0,951	0,873	0,924
Chi-Square				**887**	**794**	**801**			
Pooled Method	GLS	GLS	GLS	**FE**	**FE**	**FE**	FEVD	FEVD	FEVD

*Notes: Standard errors are shown in the parentheses; *; **: *** - statistically significant at the 10, 5 and 1 per cent level, respectively; GLS - generalized least squares; FE - fixed effects estimator; FEVD - fixed effects vector decomposition method; CEC-2 – Poland and Slovenia; EU-15 – core EU-15 members.*

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DIST	-2,400	-2,439	-2,384	**-1,993**	**-2,378**	**-2,014**	-0,227	-0,425	-0,427
	(0,10)***	(0,13)***	(0,11)***	**(1,8)*** **	**(0,18)*** **	**(0,17)*** **	(0,06)***	(0,11)***	(0,08)***
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Chi-Square				**887**	**794**	**801**			
Pooled Method	GLS	GLS	GLS	**FE**	**FE**	**FE**	FEVD	FEVD	FEVD

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							(0,02)***	(0,03)***	(0,02)***
Observations	300	300	300	**300**	**300**	**300**	300	300	300
Adj. R-squared	0,761	0,669	0,742	**0,95**	**0,934**	**0,935**	0,951	0,873	0,924
Chi-Square				**887**	**794**	**801**			
Pooled Method	GLS	GLS	GLS	**FE**	**FE**	**FE**	FEVD	FEVD	FEVD

*Notes: Standard errors are shown in the parentheses; *; **: *** - statistically significant at the 10, 5 and 1 per cent level, respectively; GLS - generalized least squares; FE - fixed effects estimator; FEVD - fixed effects vector decomposition method; CEC-2 – Poland and Slovenia; EU-15 – core EU-15 members.*

Table 3: Regression Results

	Trade Relations								
Specifications	CEC-2 with EU-15								
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Constant	19,873	23,269	23,392	**13,574**	**16,845**	**21,832**	13,949	19,085	25,187
	(0,56)***	(0,62)***	(0,57)***	**(0,67)*** **	**(0,42)*** **	**(0,67)*** **	(0,32)***	(0,46)***	(0,35)***
GDPD	0,356			**0,439**			0,469		
	(0,03)***			**(0,05)*** **			(0,02)***		
GDPD1		0,152			**0,778**			0,407	
		(0,04)***			**(0,13)*** **			(0,03)***	
RCS			-0,447			**2,126**			0,198
			(0,05)***			**(0,34)*** **			(0,05)***
GINID	0,370	0,443	0,314	**0,173**	**0,218**	**152**	0,143	0,196	0,101
	(0,07)***	(0,08)***	(0,07)***	**(0,07)** **	**(0,08)*** **	**(0,08)* **	(0,03)***	(0,05)***	(0,04)**
RESD	0,467	0,465	0,501	**0,088**	**0,07**	**0,106**	0,098	0,141	0,17
	(0,06)***	(0,07)***	(0,06)***	**(0,04)** **	**,(0,05)**	**(0,05)** **	(0,03)***	(0,04)***	(0,04)***
FDID	0,318	0,401	0,332	**0,064**	**0,103**	**0,08**	0,07	0,127	0,189
	(0,04)***	(0,04)***	(0,04)***	**(0,03)** **	**(0,03)*** **	**(0,03)** **	(0,02)***	(0,03)***	(0,03)***
DIST	-2,400	-2,439	-2,384	**-1,993**	**-2,378**	**-2,014**	-0,227	-0,425	-0,427
	(0,10)***	(0,13)***	(0,11)***	**(1,8)*** **	**(0,18)*** **	**(0,17)*** **	(0,06)***	(0,11)***	(0,08)***
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CONCLUDING REMARKS

- While theory supposes that two-way trade in different quality products is predominately vertical, this paper tests the country-specific hypothesis by introducing a few suppositions in the augmented version of the gravity model.
- The results of the estimation show that intra-industry trade between Poland and Slovenia as the two selected Central European countries and the core European Union member states is governed by determinants which explain trade with vertically differentiated products.
- Thus the important finding of this analysis is that country size differences, income inequality differences, technological differences, and foreign direct investment differences represent the main determinants which defined trade with vertically differentiated products.