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IZVIRNI ZNANSTVENI ČLANEK – ORIGINAL SCIENTIFIC PAPER

CENTRAL EUROPEAN COUNTRIES AND THE SMOOTH ADJUSTMENT HYPOTHESIS

Srednjeevropske države in hipoteza gladkega prilagajanja

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Abstract

This paper analyses bilateral trade between the Czech Republic, Poland, and Slovenia as Central European Countries (CEC-3) and the 15 European member states (EU-15). The study briefly presents a modified theory of customs unions; discusses results of the measurement of vertical intra-industry trade between the Czech Republic, Poland and Slovenia in trade with the EU-15; and identifies other important factors that define vertical intra-industry trade between the CEC-3 and EU-15 members. The aim of this paper is to test the smooth adjustment hypothesis (SAH), which predicts that a high level of total intra-industry trade is positively related to low adjustment costs.

The traditional theory of customs unions supposes that members of customs unions or other regional trading arrangements have different relative factor endowments, which—under free trade conditions—results in inter-industry specialisation. Consequently costs of adjustments are smaller in the case of more developed member countries and greater in the case of less developed member countries. The modified theory of customs unions predicts that reduced trade barriers within the union will lead countries to intra-industry specialisation, which will have important implications for the short-run costs of adjustment—namely, the costs of adjustment will be smaller for all members of the customs union irrespective of their stage of development. Although the modified version of customs unions theory assumes that the SAH is valid, this paper confirms the view of many other authors that this hypothesis is doubtful.

Keywords: Intra-industry trade; Czech Republic, Poland; Slovenia; European Union.

Izvleček

Ta prispevek obravnava bilateralno trgovino med Češko Republiko, Poljsko in Slovenijo kot srednjeevropskimi državami (CEC-3) in petnajstimi državami članicami Evropske unije (EU-15). Članek na kratko predstavi modificirano teorijo carinske unije, predstavi rezultate merjenja vertikalne znotrajpanožne trgovine med Češko, Poljsko in Slovenijo v bilateralni trgovini s članicami EU-15 in predstavi še nekatere druge pomembne dejavnike, ki določajo vertikalno znotrajpanožno trgovino med CEC-3 in EU-15. Temeljni namen prispevka je preverjanje hipoteze gladkega prilagajanja, ki predpostavlja, da je višja raven skupne znotrajpanožne trgovine pozitivno povezana z nizkimi stroški prilagajanj.

Tradicionalna teorija carinske unije domneva, da imajo članice carinskih unij ali drugih regionalnih združenj različno razmerje med proizvodnimi dejavniki, ki v pogojih svobodne trgovine pripelje do medpanožne specializacije. Na ta način predpostavlja manjše stroške prilagajanj za razvitejše države in večje stroške prilagajanj v primeru manj razvitih držav članic unije. Modificirana različica teorije carinske unije pa predpostavlja, da bo liberalizacija trgovine med članicami pripeljala do znotrajpanožne specializacije, ki bo imela pomembne implikacije na kratkoročne stroške prilagajanj: nižje stroške prilagajanj za vse članice carinske unije ne glede na njihovo raven razvitosti. Če torej modificirana različica teorije carinske unije domneva veljavnost hipoteze gladkega prilagajanja, pa ta prispevek potrjuje mnenje mnogih drugih avtorjev, ki dvomijo v njeno veljavnost.

Ključne besede: znotrajpanožna trgovina; Češka, Poljska; Slovenija; Evropska unija

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1 Theory of Customs Unions and the Smooth Adjustment Hypothesis (SAH)

In the 1960s and 1970s the first empirical studies were conducted to examine the increase of intra-industry trade between member states of customs unions. Among early empirical studies dealing with the measurement of intra-industry trade, it is worth mentioning Verdoorn (1960), who studied the change in trade flows between Belgium and Luxembourg (Benelux), and Balassa (1966), who studied the trade in goods of six founding members of the European Economic Community. The authors of these studies assumed that trade liberalisation between the customs unions will lead to intra-industry trade specialisation and, over a short period, to relatively low adjustment costs.

The traditional theory of customs unions proposed that the welfare of the union as a whole—and of the world—is greater the more competitive or similar the member countries are in terms of the lists of tradable commodities produced before the union and the more complementary or dissimilar they are in terms of spread production costs of these commodities among member countries. On the other hand, this theory supposed that members of the customs unions or other regional trading arrangements have different relative factor endowments, which under free trade conditions results in inter-industry specialisation. The traditional theory of customs unions predicts that liberalisation of trade among member countries increased pressures on the governments to concentrate production on a narrow range of industries according to its comparative advantage. Consequently, costs of adjustment are smaller in the case of more developed member countries and greater in the case of less developed member countries.

Grubel and Lloyd (1975) suggested the following modification to the customs union theory: The welfare of the union is greater the more competitive or similar the lists are from the member countries' tradable differentiated goods produced before the union and the more that production of these countries' differentiated goods is subject to the economy of scale. Reduced trade barriers within the union will lead firms to intra-industry specialisation in the production of lines for which they have a cost advantage. At the least, intra-industry trade among member states will have important implications for the short-run costs of adjustment. Although the traditional theory of customs unions expected inter-industry specialisation after the removal of tariff barriers and also emphasised relatively greater costs of adjustment in the case of less developed member countries, Grubel and Lloyd's modification predicted intra-industry specialisation as well as emphasised the relatively smaller costs of adjustment for all members of customs unions.

Yet Grubel and Lloyd's (1975) approach to this theory has several shortcomings. Their modification is based on the observation of pairs of relatively developed countries (i.e., Belgium and Luxemburg for the Benelux Union, French and Germany for the EEC, and the United States and Canada for NAFTA). Their approach excludes the possibility that there also exist less developed customs union member countries. Other authors have argued that an increase in intra-industry trade (IIT) or two-way trade does not necessarily entail changes in the production structure of the observed country (Greenaway & Milner, 1986). In short, although the standard Grubel and Lloyd index *per se* shows the share of intra-industry trade of the particular industry in the total trade of the same industry, only in combination with the unit value (UV) index does it represent a useful methodology for measuring IIT specialisation.[1]

Brülhart (1994) presented a similar index measuring marginal intra-industry trade (MA_i) based completely on the standard Grubel and Lloyd index. Brülhart supposed that his index for measurement of marginal intra-industry trade reveals the structure of the change in import and export flows. Thus, Brülhart's work involved the so-called smooth adjustment hypothesis (SAH), which assumed that high levels of marginal intra-industry trade were positively related to low adjustment costs. Although Brülhart supposed that the SAH is valid, many other authors have voiced doubts about the hypothesis; meanwhile, whereas Brülhart supposed that the MA_i index reveals the intra-industry specialisation, other authors assumed that this index is similar to the standard Grubel and Lloyd index, making it of limited use for the measurement of intra-industry trade specialisation.

2 Greenaway, Hine, and Milner's methodology

One of the tasks of this analysis is also to measure horizontal and vertical intra-industry trade for each of the manufacturing industries at the five-digit level of SITC by using Greenaway, Hine, & Milner's (1994, 1995) methodology. This methodology supposes a calculation of the Grubel and Lloyd (1975) index:

$$(1) \qquad B_i = \frac{\left[\left(X_i + M_i\right) - \left|X_i - M_i\right|\right] * 100}{(X_i + M_i)}, \qquad (0 \le B_i \le 100)$$

where B_i represents the Grubel and Lloyd index for a particular industry i at the five-digit level of SITC, X_i represents exports of that particular industry, and M_i represents imports of that particular industry. The intra-industry trade at the aggregate level[2] is measured by using the similar index $\overline{B_i}$ (Grubel & Lloyd, 1975) for the weighted average.

The methodology introduced by Greenaway et al. (1994, 1995) also supposes the separation of total IIT ($\overline{B_i}$) into the corresponding shares of horizontal IIT (HB_i) and vertical IIT (VB_i):

$$(2) \qquad \overline{B_i} = HB_i + VB_i$$

1 See the next section: Greenaway, Hine, and Milner's methodology.

2 Total intra-industry trade at the level of the economy.

Following this methodology, the unit value index (*UV*) is calculated for exports and imports of each of the manufacturing industries at the five-digit level of SITC.[3] Horizontal IIT is defined as a ratio between the unit value of exports $\left(UV_i^x\right)$ and the unit value of imports $\left(UV_i^m\right)$ for a particular industry *i*—or, $\left(UV_i^x / UV_i^m\right)$. More specifically, horizontal IIT is defined (HB_i) when the unit value index (*UV*) is inside the range of ± 15%:

$$(3) \qquad 0{,}85 \le \frac{UV_i^x}{UV_i^m} \le 1.15$$

When the unit value index (*UV*) is outside the ± 15% range, vertical IIT (VB_i) is defined for the particular industry at the five-digit level of SITC. It is also possible to introduce a supposition that horizontal IIT (HB_i) is widely defined or, more precisely, that the unit value index (*UV*) is defined inside the range of ± 25%. It is obvious that widely defined horizontal IIT simultaneously introduced narrowly defined vertical intra-industry trade. Therefore, in Table 1, the first option is included (± 15).

Thus, the share of vertical IIT (VB_i) is separated into the dependent shares of VBI_i and $VBII_i$ using the following two options:

$$(4) \qquad VB1_i: \frac{UV_i^x}{UV_i^m} > 1.15(1.25) \text{ and}$$

$$VB2_i: \frac{UV_i^x}{UV_i^m} < 0.85(0.75),$$

where VBI_i represents the share of vertical IIT when the ratio between the unit value of exports $\left(UV_i^x\right)$ and the unit value of imports $\left(UV_i^m\right)$ is greater than 1.15 (or 1.25), and $VBII_i$ represents the share of vertical IIT when the ratio between the unit value of exports $\left(UV_i^x\right)$ and the unit value of imports $\left(UV_i^m\right)$ is smaller than 0.85 (or 0.75). It is assumed that the relative quality of each product at the five-digit level of SITC is best defined by the achieved relative price for the same product; that the relative share of $VB1_i$ represents trade in vertically differentiated products of higher quality, which are sold at a higher average price; and that $VB2_i$ represents trade in vertically differentiated products of lower quality, which are sold at a lower average price.

In this way the methodology presented by Greenaway et al. (1994, 1995) introduces important distinctions between horizontal and vertical product differentiation. Horizontal differentiation arises when different varieties of a product are of similar quality; vertical product differentiation arises when varieties of a product are differentiated by quality. Accordingly, vertical product differentiation is related more to the traditional theory[4] of international trade whereas horizontal product differentiation is related to new theories of international trade that suppose horizontal product differentiation.

3 The results of the measurements of vertical intra-industry trade

Table 1 shows the results of measurements of vertical intra-industry trade (*VB*) and the average level of intra-industry trade at the aggregate level ($\overline{B_i}$) for the Czech Republic, Poland, and Slovenia from 1999 to 2011. The results for the Czech Republic and Slovenia are in line with expectations. From the very beginning (i.e., since 1993, following the secession of Slovakia), the Czech Republic has shown a relatively higher average level of intra-industry trade compared with all other Central European countries. Slovenia has generally maintained second place. Surprising results are shown for Poland, which in 2008 revealed an average level of intra-industry trade similar to Slovenia.

These results reaffirm the supposition that the average level of intra-industry trade is a consequence of trade liberalisation between the CEC-3 and EU-15 and of the integration of the CEC-3 in bilateral trade with more developed countries of the EU-15, rather than the result of economic development of the CEC-3. If the level of development of the observed countries (measured by GDP per capita) had influenced intra-industry trade most strongly, then the order of these countries would be slightly different. Country size differences also play a role. The Czech Republic is five times the size of Slovenia (measured by population), and Poland is the largest Central European country.

Industrial tradition is the next important factor that influenced the level of intra-industry trade of the CEC-3. The Czech Republic was included in the industrial revolution earlier and more intensively than Slovenia and Poland. Hence, the Czech Republic was more developed compared to Austria in the interwar period.[5] However, the socialist period had a great impact on economic development.[6]

3 Unit value index (*UV*) is defined as a ratio of the values (in national currency) and the quantities (in kilograms or tonnes) of the particular industry *i*.

4 The Heckscher-Ohlin model is a typical representative of the traditional theory of comparative advantage.

5 Measured by GDP per capita.

6 During the socialist period, the Czech Republic was a supplier of machinery and industrial equipment in trade with the much larger Soviet Union.

Table 1*: Intra-industry Trade of the Central European Countries at the Aggregate Level*

	Czech Republic				
	$\overline{B_i}$	*HB*	*VB*	*VB1*	*VB2*
1999	**29,50**	3,38	26,13	*9,18*	*16,95*
2003	**28,92**	3,89	25,03	*9,35*	*15,68*
2004	**31,97**	4,06	27,91	*11,51*	*16,40*
2008	**34,17**	4,38	29,78	*13,65*	*16,13*
2011	**31,72**	4,39	27,33	*12,21*	*15,12*
	Poland				
	$\overline{B_i}$	*HB*	*VB*	*VB1*	*VB2*
1999	**22,33**	2,65	19,67	*6,61*	*13,07*
2003	**24,40**	3,31	21,09	*7,57*	*13,52*
2004	**29,89**	4,05	25,84	*9,82*	*16,02*
2008	**30,62**	4,18	26,44	*10,9*	*15,55*
2011	**26,73**	4,11	22,62	*9,83*	*12,78*
	Slovenia				
	$\overline{B_i}$	*HB*	*VB*	*VB1*	*VB2*
1999	**25,38**	3,34	22,03	*8,90*	*13,13*
2003	**28,49**	4,09	24,41	*9,63*	*14,78*
2004	**28,14**	4,52	23,62	*9,30*	*14,31*
2008	**31,55**	4,66	26,89	*10,18*	*16,71*
2011	**30,86**	4,62	26,25	*10,59*	*15,66*

Source: EUROSTAT (2012) and author's own calculations.

Note: $\overline{B_i}$ — share of total intra-industry trade, *HB*—share of horizontal intra-industry trade, *VB*—share of vertical intra-industry trade, *VB1*—share of vertically differentiated products of higher quality; *VB2*—share of vertically differentiated products of lower quality.

Austria is now one of the most advanced countries in the EU-15, while the Czech Republic is less developed in comparison with Slovenia. Nevertheless, the Czech Republic was in a better situation in the early 1990s than Slovenia due to its long industrial tradition and clear definition of national economic interest.[7] Thus, the industrial tradition of the Czech Republic, clearly defined economic interest, and intensive domestic and foreign investments are the factors that contributed to the increased involvement in trade of vertically differentiated products with the EU-15 in the 1990s.

It is also important to focus on the vertical intra-industry trade of the Czech Republic compared to Slovenia. In this respect the ratio between *VB1*, which represents the production and export of vertically differentiated products of higher quality, and *VB2*, which represents the production and export of vertically differentiated products of lower quality, is important. The Czech Republic in the observed period achieved a structural shift in the right direction—that is, increased production and exports of vertically differentiated products of higher quality—while Slovenia in this period unfortunately made a structural shift in the opposite direction.

Slovenia had a fairly good position in 1999, and had the best ratio between exports of vertically differentiated products of higher quality and exports of vertically differentiated products of lower quality compared to both the Czech Republic and Poland. This position is the result of the inherited production structure of Slovenia from the pre-1991 period, which at the end of the 1990s still had comparative advantages. The absence of a coherent industrial policy, the absence of a coherent policy for the stimulation of foreign direct investment, and the lack of intensive and planned investments primarily in industrial production generally caused Slovenia to experience a worsened production structure in the period from 1999 to 2008 in comparison with the Czech Republic and Poland.

7 After 1992, the Czech Republic completely shifted to bilateral trade with the EU-15 in a relatively short time.

The Czech Republic and Poland in comparison with Slovenia have a clearly defined industrial policy. This policy precisely defines which industries will represent a vital interest of the country and which industries will be the subject of foreign direct investment. The assumption is that the Slovenian political elite in the second half of the 1990s and in all subsequent years of observation completely trusted the modified version of the theory of a customs union, which predicts intra-industry specialisation and relatively small costs of adjustment for all members of customs unions. In this way, the Slovenian government believed in the validity of the smooth adjustment hypothesis and did not thoroughly undertake a systematic restructuring of its inherited production structure.

The final result of such efforts is clearly demonstrated in 2008 and settled in the time of economic recession from 2008 to 2011. Although the Czech Republic radically changed its production structure in the period from 1999 to 2011 in the direction of increasing exports of vertically differentiated products of higher quality, Slovenia at the same time increased exports of vertically differentiated products of lower quality. In this way Slovenia in 2008 had a similar ratio between the *VB1* and *VB2* as the Czech Republic in 1999, while the Czech Republic in 2008 had a similar proportion between the VB1 and VB2 as Slovenia in 1999.

If we take a closer look at the Polish production structure in 2008, we find that Poland—the largest Central European country—also very elegantly overtook Slovenia. Thus, the Polish ratio between the share of vertically differentiated products of higher quality and the share of vertically differentiated products of lower quality is favourable compared to Slovenia.[8] However, the real structural shift was achieved by this country during the economic recession after 2008, when the financial crisis reduced demand in the EU-15. As a result, in 2011 Poland had a completely similar production structure as well as ratio between the share of vertically differentiated products of higher quality and the share of vertically differentiated products of lower quality as the Czech Republic.[9]

In this way, the relatively higher share of horizontally differentiated products remains the only advantage of Slovenia in bilateral trade with the EU-15 compared with the other two Central European countries, while the share of vertically differentiated products of higher quality represents an advantage in the case of Czech and Polish exports to the EU-15. Nevertheless, the Czech Republic and Poland have an undoubted advantage in comparison with Slovenia: the production of vertically differentiated products in terms of economies of scale.

4 Major factors of intra-industry trade of the CEC-3

Table 2 shows the differences in the gross capital formation per worker, or differences in capital intensity between the CEC-3and the EU-15. Specifically, the table shows differences between the capital intensity of the CEC-3 and the average capital intensity of the EU-15. The traditional theory of comparative advantage assumes that the capital intensity of production of each particular country also predicts the amount of the adjustment costs of the same country after joining the customs union. In this way this table predicts substantially different costs of adjustment for each particular Central European country: Due to the highest level of gross capital investment per worker, Slovenia should have a significantly lower cost for structural adjustment than the Czech Republic or Poland.

However, since industrial production is not linked exclusively to the intensive use of only two factors of production (i.e., the capital and labour ratio: *c*/*w*), a higher ratio between the capital invested and the cost of hired labour requires even more intensive involvement of other factors, such as the inclusion of new technologies, new patents, increased investment in staff education, and professional training of other co-workers. Therefore, a large imbalance in gross capital investment per worker between Slovenia and the other two Central European countries raises an interesting question: How is it possible that this country drastically deteriorated its production structure by an increased share of vertically differentiated products of lower quality in exports as shown in Table 1 while simultaneously showing the highest gross capital investment per worker in Table 2?

Generally, the gross capital formation by definition consists of outlays in addition to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements; plant, machinery, and equipment purchases; the construction of roads and railways; and investments in facilities including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales. Therefore the answer to the question presented above is linked to the specific Slovenian structure of gross capital formation (formerly gross domestic investment).

As such, Table 2 only reflects the decision of the Slovenian ruling political elite to give priority to investments in road infrastructure and other forms of gross domestic investments. This decision has a marked effect in all the years of observation from 1999 to 2011. Due to a lack of investments in the fixed assets which directly influence the country's production structure (e.g., plant, machinery, and equipment purchases) and the extensive investments in road infrastructure and other forms of investments (which by definition also represent fixed assets), Slovenia made a structural shift in the wrong direction in 2008 and 2011 compared to the base year of 1999 (see Table 1, the ratio between VB1 and VB2).

Table 3 shows the differences in investment in R&D expenditures as a percentage of gross domestic product among the Central European countries and the EU-15, indicting the technological differences between the CEC-3 and EU-15. The table shows that, during the observed years, the EU-15 increased their investments in research and development by approximately 20 per cent. Poland is the only Central European country that reduced its share of investment

8 The shares of vertical intra-industry trade (*VB*) and the average levels of total intra-industry for Poland from 1999 to 2008 are taken from Cernosa and Moczulski (2010).

9 A decrease in the average level of intra-industry trade as shown in Table 1 in 2011 is the result of the economic recession, which had a decisive impact on bilateral trade between the CEC-3 and EU-15.

Table 2*: Gross Capital Formation per Worker: Differences between the CEC-3 and EU-15*

Gross capital formation per worker (in constant 2000 U.S. dollars)													
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
EU-15	10809	11165	10891	10628	10804	11107	11353	11778	12047	11871	9108	8163	8408
CZ	2932	3262	3497	3651	3596	3951	3875	4231	4626	4491	4028	4267	4200
PL	2392	2442	2087	1962	2036	2342	2340	2749	3413	3493	3042	3272	3272
SI	5500	5655	5408	5529	6239	6559	6533	7312	8472	8493	5964	5955	5955
Rank													
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
EU-15	1	1	1	1	1	1	1	1	1	1	1	1	1
CZ	0,27	0,29	0,32	0,34	0,33	0,36	0,34	0,36	0,38	0,38	0,44	0,52	0,50
PL	0,22	0,22	0,19	0,18	0,19	0,21	0,21	0,23	0,28	0,29	0,33	0,40	0,39
SI	0,51	0,51	0,50	0,52	0,58	0,59	0,58	0,62	0,70	0,72	0,65	0,73	0,71

Source: World Bank (2012), ILO (2012), and author's own calculation.

Note: EU-15–average gross capital formation per worker of the EU-15; CZ–Czech Republic; PL–Poland; SI–Slovenia.

Table 3: *Research and Development Expenditure Differences between the CEC-3 and EU-15*

R&D expenditure differences													
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
EU-15	1,81	1,82	1,89	1,91	1,90	1,88	1,90	1,95	1,97	1,97	2,15	2,13	2,13
CZ	1,14	1,21	1,20	1,20	1,25	1,25	1,41	1,54	1,59	1,59	1,53	1,61	1,61
PL	0,69	0,64	0,62	0,56	0,54	0,56	0,57	0,56	0,57	0,57	0,68	0,74	0,74
SI	1,39	1,41	1,52	1,49	1,29	1,42	1,46	1,59	1,48	1,48	1,86	1,92	1,92
Rank													
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
EU-15	1	1	1	1	1	1	1	1	1	1	1	1	1
CZ	0,63	0,66	0,64	0,63	0,66	0,66	0,75	0,79	0,81	0,81	0,71	0,76	0,76
PL	0,38	0,35	0,33	0,29	0,28	0,30	0,30	0,29	0,29	0,29	0,31	0,35	0,35
SI	0,77	0,77	0,80	0,78	0,68	0,75	0,77	0,82	0,75	0,75	0,86	0,90	0,90

Source: Unesco (2012) and author's own calculation.

Note: EU-15—average R&D expenditures of the EU-15; CZ—Czech Republic; PL—Poland; SI—Slovenia.

in research and development in 2008, while Slovenian investments in research and development remained at the same level until 2008. After 2008, Slovenia increased its investments in research and development, while the Czech Republic increased its investments in research four years earlier. The Czech Republic was aware of how important increased investments in research and development were after joining the EU.

Table 4 also shows technological differences between Central European countries and the EU-15, as indicated by the number of researchers per thousand employees. The results confirm that the Czech Republic intensively increased the number of researchers after 2004, while Slovenia and Poland maintained approximately the same number of researchers between 2004 and 2008. Tables 3 and 4 thus reflect the serious efforts of the Czech Republic to reduce the technological gap compared to the EU-15 average.[10]

10 The actual technological gap between the CEC-3 and the most advanced EU members is larger. For instance, the technological development of Germany or Austria shows the actual technological gap between these two groups of countries.

Table 4: *Differences in the Number of Researchers per Thousand Employees between the CEC-3 and EU-15*

	Number of researchers per thousand employees									
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
EU-15	6,2	6,4	6,6	6,7	7,0	7,2	7,4	7,5	7,4	7,4
CZ	2,7	2,8	3,0	3,0	3,2	3,3	4,8	5,2	5,4	5,4
PL	3,5	3,5	3,7	3,8	4,5	4,7	4,7	4,5	4,4	4,4
SI	4,5	4,9	4,7	4,6	4,7	5,2	5,2	5,5	5,7	5,6
	Rank									
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
EU-15	1	1	1	1	1	1	1	1	1	1
CZ	0,44	0,44	0,45	0,45	0,46	0,46	0,65	0,69	0,73	0,73
PL	0,56	0,55	0,56	0,57	0,64	0,65	0,64	0,60	0,59	0,59
SI	0,73	0,77	0,71	0,69	0,67	0,72	0,70	0,73	0,77	0,76

Source: OECD Factbook (2009) and author's own calculation.

Note: EU-15—average number of researchers per thousand employees of the EU-15; CZ—Czech Republic; PL —Poland; SI—Slovenia.

Table 5 shows the human capital differences between the Central European countries and the EU-15 average. In 2008, Slovenia and Poland exceeded the average number of students of the EU-15 by half, while the Czech Republic had approximately the same number of students per 100,000 inhabitants as the EU-15. The EU-15 countries invest in training of personnel in accordance with the existing demand for certain occupations in the labour market. By contrast, the Central European countries do not take into account the existing demand for occupations in the labour market and have more students per teacher than EU-15 members. More specifically, Poland and Slovenia explicitly show the structural imbalance between the number of academically trained personnel and the actual demand for them in the labour market. The upper part of Table 6 shows the foreign direct investment net inflow differences (in current U.S. dollars per capita) between the CEC-3 and EU-15. As indicated, the Czech Republic attracted foreign investments the most successfully after joining the EU in 2004, while Slovenia and Poland are entirely comparable regarding the foreign direct investments net inflows per capita. The lower part of Table 6 shows the influence of the size differences among Poland, the Czech Republic, and Slovenia in terms of the amount of foreign direct investment net inflows (in current U.S. dollars). Poland as the largest Central European country has definite comparative advantages for foreign investors. Despite its smaller size compared to Poland, the Czech Republic successfully acquired about half the level of the Polish foreign direct investment net inflows from 2004 to 2010.

All factors summarised in Tables 2 through 6 influenced the average level of vertical intra-industry trade of the Central European countries in bilateral trade with the EU-15. Although three of the Central European countries still predominantly specialise in the production of vertically differentiated products of lower quality (see Table 1), although the Czech Republic and Poland in comparison with Slovenia have more successfully adjusted their production structure to

Table 5: *Differences in Investments in Human Capital between the CEC-3 and EU-15*

	Number of students per 100,000 inhabitants										
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
EU-15	3489	3549	3635	3703	3801	3881	3923	3905	3862	3844	3882
CZ	2270	2494	2562	2809	2840	3157	3327	3333	3564	3827	4040
PL	3686	4163	4681	5032	5240	5405	5603	5677	5680	5728	5684
SI	4029	4262	4645	5028	5133	5271	5655	5772	5817	5778	5711
	Rank										
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
EU-15	1	1	1	1	1	1	1	1	1	1	1
CZ	0,65	0,70	0,70	0,76	0,75	0,81	0,85	0,85	0,92	1,00	1,04
PL	1,06	1,17	1,29	1,36	1,38	1,39	1,43	1,45	1,47	1,49	1,46
SI	1,15	1,20	1,28	1,36	1,35	1,36	1,44	1,48	1,51	1,50	1,47

Source: Unesco (2012) and author's own calculation.

Note: EU-15—average number of students per 100,000 inhabitants of the EU-15; CZ—Czech Republic; PL—Poland; SI—Slovenia.

Table 6:*Foreign Direct Investment Differences between the CEC-3 and EU-15*

	Foreign direct investment net inflows in U.S. $ per capita						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
EU-15	913	1374	1529	2757	2191	1040	861
CZ	488	1140	533	1013	621	282	654
PL	338	270	513	617	388	338	232
SI	415	293	321	753	963	350	180
	Rank						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
EU-15	1	1	1	1	1	1	1
CZ	0,53	0,83	0,35	0,37	0,28	0,27	0,76
PL	0,37	0,20	0,34	0,22	0,18	0,33	0,27
SI	0,45	0,21	0,21	0,27	0,44	0,34	0,21

	Foreign direct investment net inflows in U.S. dollars						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
EU-15	12234	29845	34433	51960	31492	22735	18191
CZ	4975	11654	5465	10446	6449	2929	6788
PL	12898	10299	19599	23582	14833	12936	8861
SI	829	588	644	1515	1944	633	363
	Rank						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
EU-15	1	1	1	1	1	1	1
CZ	0,41	0,39	0,16	0,20	0,20	0,13	0,37
PL	1,05	0,35	0,57	0,45	0,47	0,57	0,49
SI	0,07	0,02	0,02	0,03	0,06	0,03	0,02

Source: OECD Factbook (2011), Unesco (2012), and author's own calculation.

Note: EU-15—average foreign direct investment net inflows of the EU-15; CZ—Czech Republic; PL—Poland; SI—Slovenia.

the advanced EU members. Specifically, the Czech Republic and Poland attracted foreign investors more successfully in the observed period from 1999 to 2011.

5 Concluding remarks

This paper rejected the smooth adjustment hypothesis, which assumes that the total intra-industry trade as measured by the standard Grubel-Lloyd index at the aggregate level of the economy is positively associated with low adjustment costs. Specifically, the results of the analysis confirmed that the vertical intra-industry trade of the Central European Countries reflects the production structure of these countries as well as the adjustment costs.

Slovenia was the only Central European country whose production structure deteriorated sharply in the observed period from 1999 to 2011. The Slovenian political elite prioritised investments in road infrastructure and other forms of public investments. By contrast the Czech Republic and Poland had a clearly defined industrial policy and gave more importance to investments in machinery, new technologies, and industrial equipment. Therefore, the Czech Republic and Poland increased production and exports of vertically differentiated products of higher quality while Slovenia unfortunately made a structural shift in the opposite direction and increased production and exports of vertically differentiated products of lower quality.

The Czech Republic made a structural shift in the right direction in light of its rapid and systematic shift to a market economy, industrial tradition, and clearly defined strategic goals. In this way, the Czech Republic showed a more favourable ratio between the vertically differentiated products of higher quality and lower quality and displayed technological advantages compared to Slovenia and Poland. This country also showed the most successful advantages of investing in human capital and simultaneously attracting foreign direct investments.

Although Poland attracted less foreign direct investment per capita compared with either the Czech Republic or Slovenia, the absolute amount of foreign direct investments in this country was much higher in comparison with Slovenia and the Czech Republic. In this way Poland displayed its comparative advantage due to its size and production in terms of economies of scale. Despite the fact that Poland less successfully invested in human capital, the absolute number

of employees represents a Polish advantage for industrial production. Nevertheless, between 2008 and 2011, Poland also showed a very similar production structure—in other words, a comparable share of vertically differentiated products of higher quality—than the slightly more developed Czech Republic.

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