# Horizontal and Vertical Intra-Industry Trade between the Former CEFTA Countries and the European Union

## Stanislav Černoša

This paper analyses the production structure or intra-industry trade specialization (IIT) of the Czech Republic, Hungary, Poland, Slovenia and Slovakia in foreign trade with EU member states from 1995 to 2001 at the five-digit level of the SITC. The results confirmed that former CEFTA countries in general showed IIT specialization in the production of vertically differentiated products of lower quality either at the aggregate level of the manufacturing sectors (i. e. SITC 5–8) or at the level of the twenty chosen manufacturing activities (i. e. divisions 17–36 of the ISIC) and that differences also exist between IIT specializations of these countries.

*Key Words:* intra-industry trade, horizontal and vertical intra-industry trade, CEFTA countries
*JEL Classification:* F14

## Introduction

The fact is that the Czech Republic, Hungary, Poland, Slovenia and Slovakia as former CEFTA countries are less developed measured by GDP per capita[1] than Austria, Belgium, France, Germany and Great Britain as relatively developed EU member states. If we use other economic indicators such as openness and GDP growth rate, than the position of former CEFTA countries is somewhat better in comparison with advanced countries. But differences between GDP per capita income of former CEFTA countries and developed EU states are crucial for better understanding of the correlation between the stage of development of each observed country and its intra-industry specialization.[2] It is also well known that the EU is the main foreign trade partner of the former CEFTA member countries.[3] Therefore, the analysis of the foreign trade in European transition countries provides a good opportunity for better understanding of the determinants of intra-industry trade specialization of these countries. The purpose of this paper is to verify the production structure or

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intra-industry specialization that former CEFTA countries revealed in trade with EU member states at the aggregate level of the manufacturing sectors (i. e. SITC 5–8) in 1995, 1998 and 2001 and at the level of the twenty chosen manufacturing activities (i. e. divisions 17–36 of the ISIC) in 2001. In this way we test the hypothesis that five former CEFTA countries showed predominant specialization in the production of vertically differentiated products of lower quality in their foreign trade with EU member states.

The previous study (Černoša 2005a) also analysed the production structure in Slovenia from 1994 to 2003 and revealed predominant specialization of this country in the production of lower quality products. A similar study (Černoša 2005b) verified intra-industry trade specialization for Slovenia and Czech Republic in comparison with Germany and Austria in 1998 and showed that both Central European countries were specialized in the production of lower quality products, while Germany and Austria were simultaneously specialized in the production of vertically differentiated products of higher quality. The empirical study by Aturupane, Djankov and Hoekman (1999) also analysed the determinants of horizontal and vertical intra-industry trade of eight Central and Eastern European States in foreign trade with the European Union from 1990 to 1995. [4]

Thus in the present study, the observed years 1995, 1998 and 2001[5] were chosen in order to be able to compare the results of the measurements of horizontal and vertical intra-industry trade of this analysis with those obtained in the previous studies cited above. It is common knowledge that production structure or IIT specialization is relatively stable and that methodology for the measurement of horizontal and vertical IIT is based on unit value index ($UV$).[6] Thus Greenaway, Hine, and Milner (1994; 1995) in their fundamental studies use statistical data for only one observed year as basis for the measurement of horizontal and vertical IIT.[7] In this way, we suppose that the present study clearly represents significant production structure or predominant IIT specialization of the Czech Republic, Hungary, Poland, Slovenia and Slovakia as former CEFTA countries at the beginning of the twenty-first century.

If the new theory of international trade supposes intra-industry trade in horizontally or vertically differentiated products between two countries, then the theory of comparative advantage supposes inter-industry trade in homogeneous products between two countries. During the 1980s, different models of the new theory of international trade were

developed. Thus, for example, Helpman and Krugman's book (1985) presented several theories that supposed trade with horizontally differentiated products. One of the basic messages of this book was that the traditional theory of comparative advantage is still alive and well, and that it had lost only its monopoly position. While during the last twenty years many other authors deepened the theoretical background of the new theory of international trade, the traditional theory of comparative advantages survived in different modifications. Thus one of the important messages of this paper is that it is still possible to explain trade between less developed CEFTA member countries and EU member states with the modified version of the Heckscher-Ohlin model, which is a significant representative of the theory of comparative advantage.

The paper is structured as follows. The first section presents the theoretical background for the new theories of international trade. The second section presents the methodology for the measurement of horizontal and vertical intra-industry trade, while the third section empirically tests the production structure of each of the observed economies at the aggregated level. Similarly, the fourth section verifies intra-industry trade specialization for twenty manufacturing activities (divisions ISIC 17–36) of observed countries trading with the EU in 2001. The final part of this paper presents concluding comments.

### The Theoretical Background

Research on two-way trade in similar products in the 1960s and the 1970s was mainly focused on the empirical estimation of the phenomenon of intra-industry trade (IIT). Thus Grubel and Lloyd (1975) empirically confirmed that intra-industry trade is a real phenomenon and that the levels of intra-industry trade grow faster within the trade between developed countries which are members of custom unions or other regional trading arrangements, than in the trade of the developed countries with other countries. One of the important distinctions made in theoretical literature is a distinction between horizontal and vertical product differentiation. The former arises when different varieties of the product are of a similar quality and the latter when varieties of the product are differentiated by quality. Thus vertical product differentiation is related more to the traditional theory[8] of international trade and its modified version, while horizontal product differentiation is related to the new theories of international trade, which supposes horizontal product differentiation.[9] All of this is well known, but it was empirically under researched due to

difficulties connected with disentangling vertical and horizontal intra-industry trade.[10] Therefore, the majority of studies investigated intra-industry trade exchange between highly developed economies. These works on IIT, which estimated regression models for developed countries, have generally found more support for the importance of country specific effects (i. e, GDP per capita) as opposed to industry specific factors (Greenaway, Hine, and Milner 1995). Trade between former CEFTA countries and EU member states should be driven by differences in factor endowments and also differences in technologies. Accordingly, the Aturupane, Djankov and Hoekman (1999) study estimated a regression model and empirically confirmed that vertical IIT of the former Central European countries is positively associated with product differentiation, economy of scale, labour intensity of production and foreign direct investment (FDI).[11]

Since many analyses[12] confirmed that the share of vertical IIT was larger than the share of horizontal IIT for the observed CEFTA countries, intra-industry trade in vertically differentiated products of these countries can be explained using the Falvey model (1981). The Falvey model is based on some presumptions of the Heckscher-Ohlin model, but it also includes a modification with the new presumptions. While the Heckscher-Ohlin model supposes trade in homogeneous products and inter-industry trade between two countries, the Falvey model supposes trade in vertically differentiated products and IIT. The Falvey model also supposes that IIT between two countries occurs at least in one industry, in which the home country produces and exports its own specific range of differentiated products and imports other types or a range of vertically differentiated products from a neighbour country. So the Falvey model supposes that the manufacturing industry of each country is best defined by capital[13] and that each industry is no longer assumed to produce a single homogeneous output, but instead can produce a range of products using as inputs labour and its own industry specific capital. Therefore, the manufacturing industry of each country has different endowments of capital ($K$) and labour ($L$).

The different endowments result in different factor prices in two countries with the foreign price of labour being relatively low and the domestic price of capital being relatively low. It is assumed that the higher capital-labour ratio results in a higher quality of the vertically differentiated products. As a consequence of the assumption that a higher capital-labour ratio results in a higher quality, the capital abundant country will

export relatively high quality products, while the labour-abundant country will export relatively low quality products. The direction of trade is also determined by this model and provides an explanation of ɪɪᴛ in vertically differentiated products between developed countries and less developed states.[14]

## Methodology

Horizontal and vertical intra-industry trade of the five observed ᴄᴇꜰᴛᴀ countries was measured by using the Greenaway, Hine and Milner (1994; 1995) methodology. There also exists an alternative methodology for the measurement of horizontal and vertical intra-industry trade proposed by Fontagne and Freudenberg (1997), which is not useful for the measurement of multilateral trade[15] of the five observed countries. Nielsen and Lüthje (2002) also showed that the methodology introduced by Greenaway, Hine and Milner is more appropriate for the measurement of horizontal and vertical intra-industry trade than the alternative methodology mentioned above.[16]

The method introduced by Greenaway, Hine and Milner also supposes the separation of total ɪɪᴛ or, better said, disentangling of $\overline{B_i}$ on the belonging shares of horizontal ɪɪᴛ ($HB_i$) and vertical ɪɪᴛ ($VB_i$):

$$\overline{B_i} = HB_i + VB_i. \tag{1}$$

Following this methodology, the unit value index ($UV$) is calculated for exports and imports of each manufacturing industry at the five-digit level of the sɪᴛᴄ.[17] Horizontal ɪɪᴛ is defined as a ratio between the unit value of exports $UV_i^x$ and the unit value of imports $UV_i^m$ for a particular industry $i$ or, to put it differently, $UV_i^x / UV_i^m$. More specifically, horizontal ɪɪᴛ is defined ($HB_i$) when the unit value index ($UV$) was inside the range of ± 15%:

$$0.85 \leq \frac{UV_i^x}{UV_i^m} \leq 1.15. \tag{2}$$

When the unit value index ($UV$) was outside the ±15% range, vertical ɪɪᴛ ($VB_i$) is defined for the particular industry at the five-digit level of the sɪᴛᴄ. The share of vertical ɪɪᴛ ($VB_i$) is separated on the dependent share of $V_1$ and $V_2$ using the following condition:

$$V_1: \quad \frac{UV_i^x}{UV_i^m} > 1.15 \quad \text{and} \quad V_2: \quad \frac{UV_i^x}{UV_i^m} < 0.85, \tag{3}$$

where $V_1$ represents the share of vertical ɪɪᴛ when the ratio between the unit value of exports $UV_i^x$ and the unit value of imports ($UV_i^m$) is greater

than 1.15, and $V_2$ represents the share of vertical IIT when the ratio between the unit value of exports $UV_i^x$ and the unit value of imports $UV_i^m$ is smaller than 0.85. It is assumed that the relative quality of each product at the five-digit level of the SITC is best defined by the achieved relative price for the same product and that the relative share of $V_1$ represents trade in vertically differentiated products of higher quality, which are sold at a higher average price, and that $V_2$ represents trade in vertically differentiated products of lower quality, which are sold at a lower average price. Černoša (2005b) showed that the Greenaway, Hine, and Milner methodology (1994; 1995) is able to capture adjustment cost. In short, since the Greenaway, Hine and Milner methodology for measurement of horizontal and vertical intra-industry trade is grounded on unit value index ($UV$), it is able to capture adjustment costs.

## Results of the Measurements at the Aggregate Level

It is widely recognized that the average levels of horizontal and vertical intra-industry trade show the production structure of the observed country or intra-industry trade specialisation of that country. The horizontal and vertical intra-industry trade is measured for each manufacturing industry (of sections SITC 5–8) at the five-digit level of SITC[18] for the Czech Republic, Hungary, Poland, Slovenia and Slovakia in 1995, 1998 and 2001. The statistical data at the five-digit level of SITC were used in order to be able to compare the results with those obtained in the previous studies.[19] Statistical data were obtained from COMEXT, Eurostat's trade database, where the EU was the reporter for both import and export flows.[20] Table 1 shows average levels of total, horizontal and vertical intra-industry trade for the Czech Republic's, Hungarian, Polish, Slovenian and Slovakian trade with EU in 1995, 1998 and 2001 at the aggregate level (SITC sectors 5–8), using the Greenaway, Hine, and Milner methodology.

Table 1 shows that the Czech Republic showed the highest levels of IIT trade in the observed period and that Slovenia and Hungary simultaneously revealed higher average levels of IIT than Poland and Slovakia. These results of the measurement of total intra-industry trade for former CEFTA countries were similar to the results of IIT levels in the trade between Eastern Europe and the EU from 1990 to 1995 (Aturupane, Djankov, and Hoekman 1999). The cited study also revealed the highest level of total IIT for the Czech Republic (42.5% in 1995), followed by IIT level of Slovenia (37.0% in 1995) and Hungary (33.0% in 1995), while

TABLE 1    Average levels of total, horizontal and vertical intra-industry trade
of observed countries in 1995, 1998 and 2001

| Country | Year | Total | Horizontal | Vertical | $V_1$ | $V_2$ |
|---|---|---|---|---|---|---|
| Czech Republic | 1995 | 43.21 | 5.88 | 37.34 | 6.78 | 30.56 |
| | 1998 | 54.42 | 7.89 | 46.53 | 10.60 | 35.94 |
| | 2001 | 53.75 | 8.26 | 45.49 | 9.89 | 35.60 |
| Hungary | 1995 | 31.82 | 4.64 | 27.18 | 8.10 | 19.08 |
| | 1998 | 30.88 | 4.50 | 26.38 | 7.86 | 18.52 |
| | 2001 | 37.33 | 5.44 | 31.89 | 9.50 | 22.39 |
| Poland | 1995 | 22.21 | 2.55 | 19.67 | 3.75 | 15.92 |
| | 1998 | 25.78 | 3.64 | 22.14 | 5.18 | 16.96 |
| | 2001 | 34.10 | 5.53 | 28.57 | 7.57 | 21.00 |
| Slovenia | 1995 | 33.27 | 5.16 | 28.11 | 7.99 | 20.12 |
| | 1998 | 40.43 | 6.65 | 33.77 | 10.28 | 23.49 |
| | 2001 | 36.92 | 5.87 | 31.05 | 10.03 | 21.02 |
| Slovakia | 1995 | 24.33 | 2.64 | 21.69 | 3.59 | 18.10 |
| | 1998 | 26.58 | 3.78 | 22.8 | 4.47 | 18.33 |
| | 2001 | 30.97 | 4.36 | 26.61 | 6.50 | 20.11 |

NOTES    $V_1$ – trade in vertically differentiated products of higher quality; $V_2$ – trade in
vertically differentiated products of lower quality.

SOURCES    Eurostat 2002 and own calculations at the five-digit level of SITC.

Poland and Slovakia both showed the lowest level of total intra-industry
trade (approximately 28% in 1995). This study used Eurostat's statisti-
cal database from 1990 to 1995 at the six-digit level of EU's Combined
Nomenclature,[21] while the present study used statistical data at the five-
digit level of SITC from 1995 to 2001.[22]

While the summary statistics of the above mentioned study did not
reveal significant changes in the average levels of total IIT for the chosen
CEFTA countries in the period from 1990 to 1995, the present study has
found that average levels of total, horizontal and vertical IIT of Hungary,
Poland and Slovakia gradually grew from 1995 to 2001, while in the case
of the Czech Republic and Slovenia these levels rapidly increased from
1995 to 1998, and then decreased or remained relatively stable from 1998
to 2001. In this way, the present study only captured the effects of the in-
tegration process on the territory of Europe. Thus the levels of total IIT of
the five observed CEFTA countries increased after year 1995 due to trade

liberalization between the EU and these countries in the mid 1990's. The following paragraphs will show that the present study included complete methodology for the measurement of horizontal and vertical IIT.[23]

To be more precise, total intra-industry trade of each of the observed countries in table 1, was disentangled into horizontal and vertical components using relative unit values of exports and relative unit values of imports. Horizontal IIT was defined as the simultaneous export and import of five-digit SITC products, where the unit value of exports relative to the unit value of imports was within the range of ±15%. Where unit values of exports relative to the unit value of imports were outside of that range, IIT was considered to be vertical. Using the Greenaway, Hine and Milner methodology, vertical IIT was separated into $V_1$ and $V_2$. Thus, $V_1$ represents the share of vertical IIT, where the ratio between the unit value of exports and the unit value of imports is greater than 1.15, and vice versa, $V_2$ represents the share of vertical IIT, where the ratio between the unit value of exports and the unit value of imports is smaller than 0.85. It is assumed that the unit value index as an indicator of quality gives us perfect information that the products sold at higher prices must be of higher quality and that products sold at lower prices must be of lower quality. It is further assumed that the relative share of $V_1$ represents trade of the observed CEFTA countries in vertically differentiated products of higher quality, which are sold at a higher average price, and the relative share of $V_2$ represents trade in vertically differentiated products of lower quality, which are sold at a lower average price.

Table 2 shows the relative[24] shares of horizontal IIT and vertical IIT, and relative shares of $V_1$ and $V_2$ in total intra-industry trade of the Czech Republic, Hungary, Poland, Slovenia and Slovakia in 1995, 1998 and 2001. The numbers confirmed that the shares of vertical IIT are larger than the shares of horizontal IIT of the observed CEFTA countries. Therefore, the share of vertical IIT represented approximately five sixths of total IIT of Slovenia and Poland in 2001, and approximately six sevenths of total IIT of the Czech Republic, Hungary and Slovakia. The previous study (Černoša 2005b), which measured horizontal and vertical intra-industry trade (on multilateral basis) for Slovenia and the Czech Republic in comparison with Germany and Austria in 1998, also showed that the share of vertical IIT represented approximately three quarters of total IIT of Germany, four fifths of total IIT of Austria and five sixths of IIT of Slovenia and Czech Republic in 1998.

A similar empirical study by CEPII (Fontagne, Freudenberg, and

TABLE 2 Relative shares of horizontal and vertical intra-industry trade in total intra-industry trade of observed countries in 1995, 1998 and 2001

| Country | Year | Horizontal | Vertical | $V_1$ | $V_2$ |
|---|---|---|---|---|---|
| Czech Republic | 1995 | 13.60 | 86.40 | 15.69 | 70.71 |
| | 1998 | 14.50 | 85.50 | 19.47 | 66.03 |
| | 2001 | 15.37 | 84.63 | 18.41 | 66.22 |
| Hungary | 1995 | 14.58 | 85.42 | 25.45 | 59.97 |
| | 1998 | 15.42 | 84.58 | 25.88 | 58.70 |
| | 2001 | 14.67 | 85.33 | 27.84 | 57.49 |
| Poland | 1995 | 11.47 | 88.53 | 16.87 | 71.66 |
| | 1998 | 14.12 | 85.88 | 20.09 | 65.79 |
| | 2001 | 16.23 | 83.77 | 22.19 | 61.58 |
| Slovenia | 1995 | 15.52 | 84.48 | 24.00 | 60.48 |
| | 1998 | 16.46 | 83.54 | 25.43 | 58.11 |
| | 2001 | 15.89 | 84.11 | 27.17 | 56.94 |
| Slovakia | 1995 | 10.87 | 89.13 | 14.74 | 74.39 |
| | 1998 | 14.24 | 85.76 | 16.80 | 68.96 |
| | 2001 | 14.08 | 85.92 | 20.99 | 64.93 |

NOTES $V_1$ – trade in vertically differentiated products of higher quality; $V_2$ – trade in vertically differentiated products of lower quality.

SOURCES Eurostat 2002 and own calculations.

Peridy 1997), which by contrast measured horizontal and vertical intra-industry trade for 12 EU member states on bilateral basis from 1980 to 1994 recorded that horizontal IIT of Germany, France and Great Britain represented between one quarter and one fifth of total IIT of these countries from 1980 to 1994, that the less developed members of the EU simultaneously showed lower levels of horizontal IIT, that vertical intra-industry trade $V_1$ of Germany, France and Great Britain was greater than vertical intra-industry trade $V_2$ in the observed period, and that the less developed members of the EU simultaneously showed inverse proportion between vertical IIT $V_1$ and vertical IIT $V_2$. The authors of the cited study argued that in the case of EU member states two-way trade in vertically differentiated products is more significant than two-way trade in similar, or better said, horizontally differentiated products (Fontagne, Freudenberg, and Peridy 1997, 54).

The relative shares of horizontal and vertical intra-industry trade in

table 2 confirmed that vertical intra-industry trade also prevailed in to-tal intra-industry trade of five former CEFTA countries. Thus in Hungary, Poland, Slovenia and Slovakia the relative shares of vertical IIT $V_1$, which show specialization in the production of vertically differentiated products of higher quality, were increasing from 1995 to 2001, while in the Czech Republic the increase was recorded only from 1995 to 1998. The summary statistics also shows that Slovenia and Hungary revealed approximately the same proportion between the share of $V_1$ and $V_2$ and that during the observed period both countries expressed the lowermost proportion between the share of $V_1$ and $V_2$, while Poland, Slovakia and the Czech Republic simultaneously recorded a relatively lower share of $V_1$. In this way, it was empirically confirmed that former CEFTA countries due to the predominant share of vertical intra-industry trade of lower quality – $V_2$ – showed predominant specialization in the production of vertically differentiated products of lower quality.

### The Results of the Measurements for Twenty Division of the ISIC

While in the previous section we presented the results of the measurement of horizontal and vertical intra-industry trade of five former CEFTA member states at the aggregate level of the manufacturing sectors (SITC 5–8), in this section we present the results of the measurements at the two-digit level of ISIC for the same countries. While the Standard International Trade Classification (SITC, rev. 3) is in concordance with International Standard Industrial Classification (ISIC, rev. 3; see http://unstats.un.org/unsd/cr/registry/) the same statistical data at the five-digit level of SITC were used as a basis for calculations in both analyses. The statistical data at the five-digit level of SITC were regrouped in concordance with the chosen divisions at the two-digit level of ISIC (see http://europa.eu.int/comm/eurostat/ramon/). In this way, twenty divisions[25] were formed, which represent the following manufacturing activities at the two-digit level of the International Standard Industrial Classification:

Code 17  – Manufacture of textiles

Code 18  – Manufacture of wearing apparel; dressing and dyeing of fur

Code 19  – Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear

Code 20  – Manufacture of wood and cork products, except furniture; manufacture of straw and plaiting materials

Code 21 – Manufacture of paper and paper products

Code 22 – Publishing, printing and reproduction of recorded media

Code 23 – Manufacture of coke, refined petroleum and nuclear fuel

Code 24 – Manufacture of chemicals and chemical products

Code 25 – Manufacture of rubber and plastics products

Code 26 – Manufacture of other non-metallic mineral products

Code 27 – Manufacture of basic metals

Code 28 – Manufacture of fabricated metal products, except machinery and equipment

Code 29 – Manufacture of machinery and equipment NEC

Code 30 – Manufacture of office accounting and computing machinery

Code 31 – Manufacture of electrical machinery and equipment NEC

Code 32 – Manufacture of radio, television and communication equipment and apparatus

Code 33 – Manufacture of medical, precision and optical instruments, watches and clocks

Code 34 – Manufacture of motor vehicles, trailers and semi trailers

Code 35 – Manufacture of other transport equipment

Code 30 – Manufacture of furniture; manufacturing NEC

Code 31 – Manufacture of electrical machinery and apparatus NEC

Code 32 – Manufacture of radio, television and communication equipment

Code 33 – Manufacture of medical, precision and optical instruments and clocks

Code 34 – Manufacture of motor vehicles, trailers and semi-trailers

Code 35 – Manufacture of other transport equipment

Code 36 – Manufacture of furniture, manufacturing NEC

The new aggregation of twenty activities included almost all concorded manufacturing industries (sections SITC 5–8) and also a few concorded industries of raw material (sections SITC 0–4) at the five-digit level of SITC. The main goal of this time-consuming work was to measure horizontal and vertical intra-industry trade for each of the manufacturing industries that formed the twenty above listed activities for Czech Republic, Hungary, Poland, Slovenia and Slovakia.[26] While the previous section of this paper verified the production structure or intra-industry

trade specialization of the five observed former CEFTA countries in 1995, 1998 and 2001 at the aggregate level of the sectors (SITC 5–8), this section tests intra-industry trade specialization of the observed countries at the level of the twenty chosen manufacturing activities (i. e. divisions 17–36 of the ISIC) in 2001.

Table 3 shows average levels of total intra-industry trade for twenty manufacturing activities in the Czech Republic's, Hungarian, Polish, Slovenian and Slovakian trade with the EU in 2001, which were measured by using the Greenaway, Hine and Milner methodology. More precisely, the total intra-industry trade at the aggregate level of the selected twenty manufacturing activities was measured by using the Grubel and Lloyd index for weighted average.[27] The calculated mean[28] in the last row (at the bottom) of the table recorded the average total IIT for each of the former CEFTA countries in 2001 and also showed that the Czech Republic in comparison with Hungary, Poland and Slovenia achieved the highest level of total intra-industry trade and that Slovenia and Hungary simultaneously revealed higher average levels of IIT than Poland and Slovakia. The average levels of total intra-industry trade for twenty manufacturing activities of the former CEFTA countries are comparable with average levels of total intra-industry trade of these countries in 2001 at the aggregate level (see table 1). On the other side, the calculated mean[29] in the last column of table 3 shows average levels of total intra-industry trade for twenty activities in 2001.[30]

It should be emphasized again that Eurostat's trade database was used, where the EU was the reporter for both import and export flows.[31] Thus the average total intra-industry trade of twenty activities (at the two-digit level of ISIC) was measured in the Czech Republic's, Hungarian, Polish, Slovenian and Slovakian total trade with EU member states in 2001. If the particular activity recorded an average higher total intra-industry trade of former CEFTA countries, the calculated mean value of this activity (in the last column of table 3) is relatively higher. In this way, the achieved average intra-industry trade ranked twenty activities in 2001.

This ranking of activities gave the following 'top eight' activities that revealed the highest average total intra-industry trade in the observed year: (1.) manufacturing of fabricated metal products, except machinery and equipment; (2.) manufacturing of electrical machinery and equipment; (3.) manufacturing of other transport equipment; (4.) publishing, printing and reproduction of recorded media; (5.) manufacturing of machinery and equipment; (6.) manufacturing of furniture; manufacturing

TABLE 3  Average levels of total intra-industry trade for chosen manufacturing activities of observed countries in 2001 (in %)

| ISIC | CZ | H | PL | SI | SK | Mean |
|---|---|---|---|---|---|---|
| 17 | 47.81 | 35.71 | 19.05 | 29.19 | 25.43 | 31.44 |
| 18 | 53.05 | 42.63 | 28.81 | 29.34 | 16.90 | 34.14 |
| I9 | 60.07 | 25.94 | 53.18 | 57.67 | 22.18 | 43.81 |
| 20 | 36.75 | 45.50 | 42.56 | 34.24 | 25.33 | 36.88 |
| 21 | 35.72 | 20.40 | 11.04 | 42.24 | 19.84 | 25.85 |
| 22 | 83.65 | 41.35 | 40.55 | 42.82 | 42.24 | 50.12 |
| 23 | 56.67 | 46.07 | 15.17 | — | — | 39.30 |
| 24 | 30.12 | 24.32 | 20.16 | 28.39 | 20.25 | 24.65 |
| 25 | 55.42 | 47.73 | 37.07 | 45.32 | 25.11 | 42.13 |
| 26 | 52.81 | 43.63 | 43.64 | 32.29 | 23.53 | 39.18 |
| 27 | 36.93 | 40.68 | 35.54 | 36.95 | 11.40 | 32.30 |
| 28 | 67.83 | 56.15 | 57.11 | 57.24 | 58.40 | 59.34 |
| 29 | 59.26 | 45.34 | 41.13 | 49.59 | 40.96 | 47.26 |
| 30 | 51.85 | 30.44 | 5.35 | 21.22 | 43.51 | 30.47 |
| 31 | 63.99 | 53.83 | 53.39 | 48.76 | 44.48 | 52.89 |
| 32 | 30.28 | 47.92 | 28.21 | 34.02 | 39.85 | 36.06 |
| 33 | 49.23 | 38.75 | 10.38 | 45.70 | 35.40 | 35.89 |
| 34 | 41.19 | 15.31 | 36.58 | 40.54 | 29.68 | 32.66 |
| 35 | 68.55 | 55.42 | 47.62 | 39.11 | 46.68 | 51.47 |
| 36 | 45.97 | 58.44 | 29.89 | 58.18 | 41.64 | 46.82 |
| Mean | 51.36 | 40.78 | 32.82 | 40.67 | 32.25 | |

NOTES    ISIC – selected divisions of the International Standard Industrial Classification signed by two-digit code; CZ – Czech Republic; H – Hungary; PL – Poland; SI – Slovenia; SK – Slovakia; mean – calculated arithmetic mean (by using equitation 6).

SOURCES    Eurostat 2002 and own calculations at the two-digit level of SITC.

of other non-mentioned products; (7.) tanning and dressing of leather; manufacturing of luggage, handbags, saddlery, harness and footwear and (8.) manufacturing of rubber and plastics products.

It is important to note that the average total intra-industry trade[32] of listed manufacturing activities is not correlated with intra-industry trade specialization of the five former CEFTA countries. This ranking of eight manufacturing activities by average total intra-industry trade only confirmed that export and import flows of these activities are relatively

balanced, while in the case of the remaining twelve manufacturing activities export and import flows are relatively lees balanced.[33] In short, if the standard Grubel and Lloyd index *per se* shows the share of intra-industry trade of the particular industry in total trade in the same industry, then only in combination with the Unit Value (uv) did the index represent a useful methodology for the measurement of intra-industry trade specialization.[34] In this way intra-industry trade specialization of twenty manufacturing activities was tested. The results of the measurements of horizontal and vertical iit for the Czech Republic, Hungary, Poland, Slovenia and Slovakia in 2001 confirmed that a great majority of the twenty chosen manufacturing activities (i. e. divisions 17–36 of the isic) showed predominant specialization in the production of lower quality products.

At the same time, the present analysis also found a few manufacturing activities at the five-digit level of isic, which showed predominant specialization in the production of higher quality products. The selection of these activities is based on the assumption (of the Greenaway, Hine, and Milner methodology) that the relative share of $V_1$ represents trade in vertically differentiated products of higher quality, which are sold at a higher average price, and that relative share $V_2$ represents trade in vertically differentiated products of lower quality, which are sold at a lower average price. Thus, if we assume that the unit value index gives us perfect information that the products sold at higher prices must be of higher quality, then the manufacturing activities – which showed a greater share of vertically differentiated products of higher quality ($V_1 \geq V_2$) – simultaneously reveal predominant specialization in higher quality products.

Table 4 shows total, horizontal and vertical intra-industry trade for selected activities in observed cefta countries, which recorded predominant specialization in the production of vertically differentiated products of higher quality $V_1$. Thus the Czech Republic has one manufacturing activity, Slovenia and Slovakia have two activities that revealed specialization in production of vertically differentiated products of higher quality in 2001, while Hungary and Poland recorded three activities that showed the predominant share of vertical intra-industry trade – $V_1$ in 2001. Remember that according to the Greenaway, Hine and Milner methodology, the relative share of $V_1$ represents trade of the observed cefta countries in vertically differentiated products of higher quality, which are sold at a higher average price, and that the relative share of $V_2$ represents trade of these countries in vertically differentiated products of lower quality, which are sold at a lower average price.

TABLE 4 Total, horizontal and vertical intra-industry trade for selected manufacturing activities of former CEFTA countries in 2001

| Country | ISIC | Total | Horizontal | Vertical | $V_1$ | $V_2$ |
| --- | --- | --- | --- | --- | --- | --- |
| Czech Republic | 23 | 56.67 | 28.33 | 28.33 | 14.17 | 14.17 |
| Hungary | 18 | 42.63 | 7.19 | 35.44 | 22.60 | 12.84 |
| | 21 | 20.40 | 6.22 | 14.17 | 6.91 | 7.26 |
| | 34 | 15.31 | 2.45 | 12.86 | 7.35 | 5.51 |
| Poland | 23 | 15.17 | 3.03 | 12.14 | 9.10 | 3.03 |
| | 32 | 28.21 | 3.94 | 24.28 | 12.47 | 11.81 |
| | 34 | 36.58 | 8.83 | 27.75 | 13.88 | 13.88 |
| Slovenia | 18 | 29.34 | 5.08 | 24.26 | 15.80 | 8.46 |
| | 19 | 57.67 | 8.24 | 49.43 | 28.84 | 20.60 |
| Slovakia | 18 | 16.90 | 3.82 | 13.09 | 6.54 | 6.54 |
| | 30 | 43.51 | 3.96 | 39.55 | 27.69 | 11.87 |

NOTES ISIC – selected divisions of the International Standard Industrial Classification signed by two-digit code; $V_1$ – trade in vertically differentiated products of higher quality; $V_2$ – trade in vertically differentiated products of lower quality.

SOURCES Eurostat 2002 and own calculation at the 2-digit level of SITC.

The table also shows that former CEFTA countries revealed the similar intra-industry trade specialization in the production of vertically differentiated products. Thus Hungary, Slovenia[35] and Slovakia were specialized in manufacturing wearing apparel, dressing and dyeing of fur products (ISIC 18), which represent so-called traditional manufacturing activity. Similarly, Czech Republic and Poland specialized in the production of coke, refined petroleum and nuclear fuel products (ISIC 23),[36] while Hungary and Poland competed in manufacturing motor vehicles, trailers and semi-trailers (ISIC 33).[37]

We suppose that investments by foreign owned enterprises have caused Hungary and Poland to show predominant specialisation in the production of higher quality motor vehicles, trailers and semi trailers; that Poland reveals predominant specialisation in the production of higher quality radio, television and communication equipment and apparatus (ISIC 32); and that Poland shows the largest changes in the average levels of total IIT in the period from 1995 to 2001.

## Concluding Comments

The main goal of this paper to verify the production structure or intra-industry specialization of Czech Republic, Hungary, Poland, Slovenia

and Slovakia as former members of CEFTA in trade with the EU member states. In this way the first analysis tested specialization of these countries at the aggregate level of the manufacturing sectors (i.e. SITC 5–8) in 1995, 1998 and 2001. The results of the measurement of total, horizontal and vertical intra-industry trade at the aggregate level by using the Greenaway, Hine, and Milner (1994; 1995) methodology confirmed predominant specialization of the former CEFTA countries in production of vertically differentiated products of lower quality. The findings of this analysis are comparable with those of the previous studies (Černoša 2005a; 2005b).

The same statistical data at the five-digit level of SITC were also used as a basis for the calculation in the second analysis presented in this paper, which tested IIT specialization at the level of twenty manufacturing activities (i.e. divisions 17–36 of the ISIC).

This analysis also revealed the predominance of IIT specialization of the majority of the chosen manufacturing activities in the production of lower quality products – $V_2$ – and it also found a few activities in each of the five observed former CEFTA countries, which, by contrast, showed predominant specialization in the production of higher quality products. Thus, if former CEFTA countries in general showed a similar production structure either at the aggregate level of manufacturing sectors (SITC 5–8) or at the level of twenty chosen manufacturing activities (divisions ISIC 17–36), then in accordance with these results it is not possible to conclude that these countries achieved the same intra-industry specialization.

The important message of the present analysis is that the Czech Republic, Hungary, Poland, Slovenia and Slovakia as former members of CEFTA showed predominant specialization in the production of vertically differentiated products of lower quality, while developed EU member states such as Austria, Belgium, France, Germany and Great Britain simultaneously showed predominant intra-industry specialization in the higher quality vertically differentiated products.

The governments of former CEFTA countries will need to recognize that the existent production structure of the observed Central European countries at the beginning of the first decade of the 21st century is by no means comparable with predominant intra-industry trade specialization of the advanced EU member states, which in comparison with former CEFTA countries also achieved higher GDP per capita income on average.

## Notes

1 For instance, Austria has approximately one time bigger GDP per capita than Slovenia and approximately one and a half times bigger GDP per capita than the Czech Republic.

2 The difference in GDP per capita income between the observed country and the trading partner is frequently used in regression models as a proxy for differences in factor endowments. It is assumed that relative capital abundance of an observed country is reflected in its relative GDP per capita income.

3 Trade with EU represented approximately two thirds of the total trade of these Central European countries.

4 It is important to note that the Aturupane, Djankov and Hoekman study estimated a regression model meaning that only disentangled total intra-industry trade of the Eastern and Central European countries on the belonging share of horizontal and vertical intra-industry trade, while the present study disentangled total intra-industry trade of the observed former CEFTA countries on the belonging horizontal and vertical components and also separated the share of vertical intra-industry trade into two parts by using the Greenaway, Hine, and Milner methodology (1994; 1995).

5 The methodology for the measurement of the horizontal and vertical IIT also does not suppose use of statistical data for consecutive years.

6 Unit value index is defined as the ratio of the values (in national currencies) and the quantities (in kilograms or tons) of the particular industry *i*.

7 By contrast, Crespo and Fontoura (2004) use statistical data for the year 1994, 1996, 1998 and 2000.

8 The Heckscher-Ohlin model.

9 Krugman (1979), Lancaster (1980), Helpman (1981), Brander and Krugman (1983), Eaton-Kierzkowski (1984), Krugman and Venables (1990), Davis (1995), Markusen and Venables (1996) model.

10 Greenaway, Hine, and Milner (1994; 1995) developed a methodology which is based on the work of Abd-el-Rahman (1991) and which is able to identify vertical and horizontal intra-industry trade of the observed countries.

11 More precisely, the study by Aturupane, Djankov and Hoekman primarily tested an industry specific hypothesis and also found more support for the industry specific factors.

12 Aturupane, Djankov and Hoekman (1999), Černoša (2005a), Černoša (2005b), and the present analysis.

13 In other words, the range of products which a certain type of capital equipment can produce defines an industry.

14 If Černoša (2005b) showed that Germany and Austria as more de-
veloped EU members' economies were specialized in the production
of vertically differentiated products of higher quality, and Slovenia
and Czech Republic as less developed Central European economies
were specialized in the production of vertically differentiated prod-
ucts of low quality at the end of the 1990s and at the beginning of the
2000s, then Germany and Austria, due to a higher capital-labour ra-
tio, will produce and export vertically differentiated products of rela-
tively higher quality, while Slovenia and Czech Republic, due to a lower
capital-labour ratio, will produce and export vertically differentiated
products of relatively lower quality.

15 The Fontagne and Freudenberg (1997) methodology is useful only for
the observation of the bilateral trade.

16 The Greenaway, Hine and Milner methodology supposes calculation
of the standard Grubel and Lloyd (1975) index. Thus the standard
Grubel and Lloyd index is calculated:

$$B_i = \frac{[(X_i + M_i) - |X_i - M_i|] \cdot 100}{(X_i + M_i)} \quad (0 \leq GL_i \leq 100),$$

where $B_i$ represents the Grubel and Lloyd index for a particular indus-
try $i$ at the five-digit SITC level, $X_i$ represents exports of that particu-
lar industry, while $M_i$ represents imports of that particular industry.
The intra-industry trade at the aggregate level (weighted average) was
measured using the following index (Grubel and Lloyd 1975, 21):

$$\overline{B_i} = \frac{\sum_{i=1}^{n} B_i(X_i + M_i)}{\sum_{i=1}^{n}(X_i + M_i)} = \sum_{i=1}^{n} w_i \cdot B_i, \text{where the weights are}$$

$$w_i = \frac{X_i + M_i}{\sum_{i=1}^{n}(X_i + M_i)},$$

where $\overline{B_i}$ represents Grubel and Lloyd's index for weighted average at
the aggregate level, $B_i$ represents the standard Grubel and Lloyd index
for a particular industry $i$ at the five-digit SITC level, $X_i$ represents
exports of that particular industry, while $M_i$ represents imports of that
particular industry.

17 Unit value index ($UV$) is defined as a ratio of the values (in national
currencies) and the quantities (in kilograms or tons) of the particular
industry $i$.

18 The same level of aggregation was also used by Greenaway, Hine, and
Milner (1994; 1995), Greenaway, Milner and Elliott (1999) and Nielsen
and Lüthje (2002). It is important to note that alternative data clas-
sification – Combine Nomenclature (CN) – in the case of Slovenia is
available from 1996.

19 The results of the present analysis are comparable with the results
of the measurement of horizontal and vertical intra-industry trade

(on multilateral basis) for Slovenia from 1994 to 2003 at the five-digit level of sitc (Černoša 2005a) and also comparable with the measured horizontal and vertical intra-industry trade (on multilateral basis) for Slovenia and the Czech Republic in comparison with Germany and Austria in 1998 at the five-digit level of sitc (Černoša 2005b). In short, Slovenia and the Czech Republic in both studies cited above recorded relatively higher levels of total intra-industry trade in multilateral trade and also in the present analysis both showed relatively lower levels of total intra-industry in trade with eu members states.

20 Concretely, we used Eurostat's statistical data inversely, where exports of eu member states (in 000 eur and tons) to a selected cefta country were treated as imports of this country during the observed years, while imports of all eu member states from the same selected country (in 000 eur and tons) were treated as exports of this country during the observed years.

21 Where only 9 eu member states are included (Belgium, Luxembourg, Germany, France, The United Kingdom, Italy, The Netherlands, Denmark and Ireland).

22 This study observed iit of each former cefta (5) member state in foreign trade with all eu member states in 1995, 1998 and 2001.

23 While the present study following the Greenaway-Hine-Milner methodology disentangles total intra-industry trade on horizontal and vertical components and later also separates vertical intra-industry into two parts, Aturupane, Djankov, and Hoekman (1999) did only the first step.

24 Total intra-industry trade = 100.

25 Each particular division is signed by a two-digit code.

26 In short, we measured horizontal and vertical intra-industry trade of each particular manufacturing industry at the five-digit level of sitc and later repeated measurements at the aggregate level (at two-digit level of the isic).

27 Equitation $\overline{B_i}$.

28 Calculated as the arithmetic mean vertically (by columns) in table 3.

29 Calculated as the arithmetic mean horizontally (by rows) in table 3.

30 This arithmetic mean is calculated using the following equitation (Greenaway and Milner 1986, 65):

$$\overline{\overline{B_i}} = \frac{1}{n} \sum_{i=1}^{n} \overline{B_i},$$

where $\overline{\overline{B_i}}$ represents the arithmetic mean and $\overline{B_i}$ represents Grubel and Lloyd's index for weighted average at the two-digit level of isic.

31 We used Eurostats statistical data inversely, where exports of eu member states (in 000 eur and tons) to a selected cefta country were

treated as imports of this country during the observed years, while imports of all EU member states from the same selected country (in 000 EUR and tons) were treated as exports of this country during the observed years.

32  Measured by Grubel and Lloyd index.

33  Grubel and Lloyd defined intra-industry trade as the value of exports of an industry, which is exactly matched by the value of the imports of the same industry. (Grubel and Lloyd 1975, 20). Thus, the GL index showed the higher average total intra-industry trade at the aggregate level (see equitation (2) for weighted average) in the case where the relation between the exports and imports of the observed manufacturing industries is relatively balanced, and also revealed lower average total IIT at the aggregate in all cases, when the proportion between the values of the exports and imports of the observed industries is on average relatively unbalanced.

34  See Greenaway, Hine, and Milner (1994; 1995) methodology for the measurement of horizontal and vertical IIT.

35  The previous analysis (Černoša 2002) also showed that Slovenia and the Czech Republic are competitors and partners in intra-industry exchange of the same or similar products.

36  Both countries showed specialization in vertically differentiated products of higher quality in the manufacturing of refined petroleum products, which represent a sub-group of code 23 (of the ISIC).

37  This activity supposed the use of advanced technologies.

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