

# **The intra-industry trade of the Visegrad Countries: the case of automotive industry**

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## **Abstract**

The paper investigates the development of the intra-industry trade (IIT) in automotive trade of four Visegrad Countries (the Czech Republic, Hungary, Poland and Slovakia) in the period 2000-2009. A rapid growth of the automotive trade in those countries has influenced changes of trade pattern, especially an increase of the IIT intensity. Changes of IIT indices are presented in the automotive trade (divided into motor vehicles trade and parts and accessories trade) of the analysed countries with their major trading group partners. The high degree of fragmentation of production processes in the analysed industry creates larger possibility for the IIT development than in other industries. During the analysed period, the IIT indices in the automotive trade were 10-12 p.p. higher than ones in total trade. A special attention will be paid to changes of the IIT pattern for the automotive industry, which differed from the IIT pattern for the total trade. Those differences have resulted mainly from specialisation of those countries in the individual kind of automotive output (e.g. in small cars) and domestic demand for manufactured motor vehicles and parts and accessories.

**Keywords:** intra-industry trade, automotive industry, Visegrad Countries

**JEL Classification:** F14, F15

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## 1. Introduction

In the recent years, the foreign trade of the Visegrad Countries (the Czech Republic, Hungary, Poland and Slovakia) increased rapidly. This growth was driven, first of all, by dynamic foreign direct investment inflows, connected with the fragmentation of production process. As a result, significant changes of the trade patterns occurred, especially the growth of the intra-industry trade. The industry, in which these changes could be observed very clearly, is the automotive industry<sup>1</sup>. It plays a very important role in the economies of the analysed countries in terms of output, trade flows and employment. The automotive industry is characterised by a large degree of modularisation of production process, which facilitates the fragmentation. Thus, sharing of production process creates new trade flows among plants, which are usually located in different countries. A large share of these flows has an intra-industry trade character.

The aim of the paper is to investigate the development of the intra-industry trade (IIT) in the automotive industry of the Visegrad Countries (VC) in the last decade (2000-2009). A special attention will be paid to the decomposition of the intra-industry trade into horizontal and vertical IIT. Some authors state that the latter is a good indicator to measure the intensity of fragmentation.

The structure of the paper is as follows. The first two sections give us the theoretical framework about the intra-industry trade and a brief survey of the empirical studies on the IIT. Section 4 discusses the data and methodology of IIT measurement. Sections 5 and 6 present the recent trends in the FDI in the automotive industry and automotive trade of the Visegrad Countries. Section 7 contains an analysis of the IIT development in the automotive industry. A special attention is paid to the IIT pattern. The final Section 8 contains conclusions.

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<sup>1</sup> In this section, the notion of the automotive industry is defined as the manufacture of motor vehicles, trailers and semi-trailers (division 34, ISIC Rev. 3). The correspondence table ISIC Rev. 3 – SITC Rev. 3 was applied to data on automotive trade. Such data comprise the following commodity groups according to SITC Rev. 3: 713.2, 713.9, 781, 782, 783, 784, 786.22, 786.29, 786.3, 786.83, 786.89. At the same time, on account of the Lack of detailed data, figures on foreign direct investment concern the whole transport equipment industry (divisions 34 and 35 in ISIC Rev. 3). It should be pointed out that in the countries in question the automotive industry represents the main part of the transport equipment sector.

## 2. Theoretical framework

The phenomenon of intra-industry trade was firstly noticed in trade among the members of the European Economic Community (EEC). First papers covering the issue of simultaneous export and import within the same industry were issued by Verdoorn (1960), Balassa (1966) and Grubel (1967). Only later the revelation of IIT was researched in relations between various other countries.

The crucial step in the evolution of IIT-theory was the publication of Grubel and Lloyd (1975). The authors presented the first definition of this phenomenon, some methods of its measurement and the first division of intra-industry trade into two types of product group: functionally homogenous and differentiated products. In fact, the IIT in homogenous goods is of marginal importance<sup>2</sup>.

The last publication stimulated an enormous interest in intra-industry trade. The evidence of IIT was contrary to the classical trade theory associating trade between two countries with their differences in factor endowments. The pioneering works, which tried to explain a nature of this phenomenon, were considerations of Krugman (1979, 1983), Lancaster (1980) and Helpman (1981). Their works brought a theoretical framework associating IIT with monopolistic competition and product differentiation. On the supply side, it's driven by increasing returns to scale (IRS) and on the demand side it's driven by different consumer preferences and their love of variety.

Generally, the theoretical literature for explaining the IIT is classified roughly into two groups, namely vertical and horizontal intra-industry trade theory. Finger (1975), Lipsey (1976), Falvey (1981), Falvey and Kierzkowski (1987), Shaked and Sutton (1984) and Flam and Helpman (1987) introduced the vertical differentiation model. In their models, intra-industry trade among different quality goods could be explained by traditional theories of comparative advantage and as a result by the differences of factor intensity between two countries. The relative labour-abundant countries have comparative advantage in labour-intensive products (lower quality varieties) and relative capital-abundant countries have comparative advantage in capital-intensive products. So, the first countries will export the labour-intensive varieties and the latter countries will export the capital-intensive varieties. Some VIIT models consider also a process of product fragmentation. In these approaches, intra-industry trade includes simultaneous export (import) of parts and accessories and import

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<sup>2</sup> It includes border trade, periodic trade, re-export and trade induced by governments.

(export) of final goods or simultaneous export and import of parts and accessories within the same industry. This type of VIIT is also fully explained by the patterns of factor intensity or technological level of two countries – Jones and Kierzkowski (1990), Arndt and Kierzkowski (2001) and Cheng and Kierzkowski (2001).

Contrary to VIIT, horizontal intra-industry trade cannot be explained by the traditional theories of comparative advantage. HIIT models have been analyzed under monopolistic competition derived from the existence of economies of scale in the differentiated product industry. Theory explains that HIIT consists of exchange of varieties of goods with similar qualities and various other features that could be important for consumers (i.e. country of origin, colour, taste, type of packing, etc.). There are two types of theoretical explanations: favourite variety approach and love of variety approach. Both models are based on the monopolistic competition and product differentiation. In the former (neo-Hotelling models), different consumers have different preferences for alternative varieties of a given commodity and each consumer prefers one variety to all others – Lancaster (1980) and Helpman (1981). In the latter (neo-Chamberlinian models), consumers are assumed to endeavour to consume as many different varieties of a given product as possible and gain welfare from the amount of variety – Krugman (1979, 1980) and Dixit and Norman (1980).

From the point of view of this analysis, of crucial importance is the separation of intra-industry trade into trade with horizontal and vertical differentiated products, according to the methodology of such separation suggested by Hine, Greenway and Milner (1994). Such an approach allows to understand better the nature of IIT phenomenon. We should mention that HIIT is more likely between countries with similar factor endowments and may assume identical factor intensity. In turn, VIIT is more typical between developing and developed economies than between developed countries.

### **3. Review of empirical studies**

The empirical literature on the determinants of intra-industry trade is extremely detailed<sup>3</sup>. As was above mentioned, the first studies on the intra-industry trade concerned the trade among EEC countries. Only in the 1990s analyses were conducted to investigate both,

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<sup>3</sup> Generally speaking, we could classify these empirical analyses into studies that consider only *country-specific* variables, only *industry-specific* variables and finally, studies that consider both types of variables. Detailed separation of the studies you can find in: R. Pittiglio, *The intra-industry trade for a high-income country: new empirical evidence for Italy*, Working Paper No. 211, University of Dundee, October 2008.

changes in IIT of the Visegrad Countries and determinants of IIT growth in these countries. The changes of the IIT intensity in the total trade of the Visegrad Countries were analysed in details by J. Caetano and A. Galego (2006), J. Firdmuc and M. Djablik (2003), H. Gabrisch and M.L. Segnana (2002, 2003), H. Gabrisch (2006), Y. Kandogan (2003), B. Hoekman and S. Djankov (1996), B. Kamiński (2001), I. Ferto and K.A. Soos (2006), while only in case of CEFTA countries – Cernosa (2005), only in case of Poland – J. J. Michałek, K. Śledziwska-Kołodziejaska (2000), A. Cieślik (2003), E. Czarny and K. Śledziwska (2008, 2009), E. Molendowski (2007), A. Klimek (2006) and E. Kawecka-Wyrzykowska (2009). Some authors analyses determinants of the IIT intensity in total trade of the Central and Eastern Europe Countries, so also in the Visegrad Countries, e.g. J. Caetano and A. Galego (2006), J. Firdmuc and M. Djablik (2003), H. Gabrisch and M.L. Segnana (2002, 2003), C. Aturupane, S. Djankov and B. Hoekman (1999), H. Gabrisch (2002) and Y. Kandogan (2003). Contrary to the analyses of the IIT in total trade of the Visegrad Countries, this problem in the automotive industry was investigated only by several authors, e.g. E. Kawecka-Wyrzykowska (2009), B. Kamiński (2001) and Ł. Ambroziak (2009).

#### 4. Measurement and data

The intra-industry trade in this paper is measured by the Grubel-Lloyd (GL) index which is based on the concept of “trade overlap” and represents the share of the absolute value of intra-industry trade in trade turnover in a particular industry  $i$ , that is:

$$GL_{i,t}^{kk'} = \frac{(X_{i,t}^{kk'} + M_{i,t}^{kk'}) - |X_{i,t}^{kk'} - M_{i,t}^{kk'}|}{(X_{i,t}^{kk'} + M_{i,t}^{kk'})} = 1 - \frac{|X_{i,t}^{kk'} - M_{i,t}^{kk'}|}{(X_{i,t}^{kk'} + M_{i,t}^{kk'})}$$

where  $X_{i,t}^{kk'}$  and  $M_{i,t}^{kk'}$  refer to country  $k'$ 's exports and imports respectively, to/from country  $k$  over one particular year  $t$ , in a particular industry  $i$  (here: 4-dig. HS). This measure takes values between zero (exclusive inter-industry trade) and one (exclusive intra-industry trade).

GL indices can be aggregated across  $N$  industries, as a trade-weighted average of the industry indices:

$$GL_i^{kk'} = \sum_{i=1}^N w_{i,t}^{kk'} GL_{i,t}^{kk'} = 1 - \frac{\sum_{i=1}^N |X_{i,t}^{kk'} - M_{i,t}^{kk'}|}{\sum_{i=1}^N (X_{i,t}^{kk'} + M_{i,t}^{kk'})} \quad \text{and} \quad w_{i,t}^{kk'} = \frac{X_{i,t}^{kk'} + M_{i,t}^{kk'}}{\sum_{i=1}^N (X_{i,t}^{kk'} + M_{i,t}^{kk'})}$$

or can be aggregated across  $K'$  partner countries and across  $N$  industries:

$$GL_t^k = 1 - \frac{\sum_{k'=1}^{K'} \sum_{i=1}^N |X_{i,t}^{kk'} - M_{i,t}^{kk'}|}{\sum_{k'=1}^{K'} \sum_{i=1}^N (X_{i,t}^{kk'} + M_{i,t}^{kk'})}$$

or can be aggregated across  $K'$  partner countries, across  $K$  reporter countries and across  $N$  industries:

$$GL_t = 1 - \frac{\sum_{k=1}^K \sum_{k'=1}^{K'} \sum_{i=1}^N |X_{i,t}^{kk'} - M_{i,t}^{kk'}|}{\sum_{k=1}^K \sum_{k'=1}^{K'} \sum_{i=1}^N (X_{i,t}^{kk'} + M_{i,t}^{kk'})}$$

where  $w_{i,t}^{kk'}$  denotes share of trade in product  $i$  in the total trade between  $k$  and  $k'$  trading partners,  $N$  could be denote a number of industries in the total trade (here: total automotive trade, motor vehicles trade and trade in parts and accessories) between  $k$  and  $k'$  trading partners,  $K'$  – a total number of trading partners or group of trading partners (here: EU-15, EU-12, extra EU-27) and  $K$  – a number of reported (analyzed) countries (here: the Visegrad Countries).

According to the Greenaway, Hine and Milner (1994) methodology, the total intra-industry trade has been divided into its two types – horizontal and vertical intra-industry trade using the so-called “product similarity criterion”. This criterion is based on the ratio between the unit value in exports and the unit value in imports in trade between two trading partners. Horizontal IIT is defined to exist for trade in industry  $i$  between two trading partners that satisfies the criterion:

$$1 - \alpha \leq \frac{UV_{i,t}^{kk',x}}{UV_{i,t}^{kk',m}} \leq 1 + \alpha,$$

and vertical IIT when such criteria are satisfied:

$$\frac{UV_{i,t}^{kk',x}}{UV_{i,t}^{kk',m}} \leq 1 - \alpha \text{ or } \frac{UV_{i,t}^{kk',x}}{UV_{i,t}^{kk',m}} \geq 1 + \alpha,$$

where  $x = \frac{UV_{i,t}^{kk',x}}{UV_{i,t}^{kk',m}}$  - relative unit values of exports and imports (the ratio between exports and imports unit value);  $\alpha$  - dispersion factor. The parameter  $\alpha$  is arbitrarily fixed. In general,  $\alpha$  assumes the value 0.15<sup>4</sup>.

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<sup>4</sup> Some authors assume the value of 0.25, i.e. Fontagne, Freudenberg (1997).

The above-presented methodology is based on the assumption that differences in quality are reflected in price differences (with prices as unit values of analyzed goods). The relation price-quality is supported by the idea that in a perfect information context a certain variety of a product can only be sold at a higher price if its quality is superior. However, even in a context of imperfect information, the quality will always reflect on the prices<sup>5</sup>.

According to the presented methodology, in this paper the intra-industry trade will be divided into four types of trade:

- a) VIIT low quality – low quality vertical intra-industry trade when  $x < 0.85$ ; it means that unit value of exports is relatively lower than unit value of imports (country  $k$  exports low-quality goods and imports high-quality ones);
- b) HIIT – horizontal intra-industry trade when  $0.85 \leq x \leq 1.15$ ; it means that country  $k$  exports and imports goods within the same industry, which are the same price (quality) but differ in some other features, such colours, country of origin, etc.
- c) VIIT high quality – high quality vertical intra-industry trade when  $x > 1.15$ ; it means that unit value of exports is relatively high in comparison with unit value of imports (country  $k$  exports high-quality goods and imports low-quality ones);
- d) IIT not allocated – it means that relative unit value of exports and imports is impossible to be computed. There can be some reasons of it, i.e. lack of export quantity, lack of import quantity, lack of both export and import quantity. This phenomenon is in the recent years more visible.

All trade data used for this paper are taken from the World Integrated Trade Solution (WITS) database, jointly developed by the World Bank and UNCTAD. The underlying information source is the United Nation Statistical Division's Commodity Trade data base (COMTRADE). I retain all bilateral imports and exports in value terms (current US dollars).

The IIT indices were computed at the four-digit HS in years 2000-2009. Then the indices were aggregated across industries (to the level of the automotive sector) and across trading partners (to the EU-15, EU-12, non-EU countries or to the trade with all partners) and sometimes also across reporter countries (to the level of the VC-4).

## 5. Foreign direct investment in the automotive industry

The automotive industry ranks among the sectors characterised by the highest degree of internationalisation of production processes. First investment activities by a foreign

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<sup>5</sup> Stiglitz 1987

corporation in the analysed Visegrad Countries date back to the early 1960s. A large-scale inflow of foreign direct investment to the VCs was observed in the 1990s. The transition to market economies was accompanied by a growing demand for foreign capital, in connection with changes in the type of ownership of industrial enterprises. In the yearly 1990s, FDI inflows to these countries mostly concerned takeovers of existing plants by foreign investors with the view of restructuring and joint venture investment. Simultaneously, the analysed countries joined the process of production fragmentation. Central and Eastern Europe as an investment destination offered multinational corporations a number of advantages, such as workforce skills, relatively low labour costs and favourable tax system for new investors. Investment inflows to the VCs were also driven by economic cooperation of those countries with the European Union, initiated in the 1990s, and prospects for future EU membership. Apart from Western European corporations (Italian Fiat, German Volkswagen, French Renault), foreign investors also included South Korean Daewoo (joint venture with *Fabryka Samochodów Osobowych* – FSO in Żerań and in Lublin) and Hyundai, Japanese Toyota and in 2005 an Ukrainian car manufacturer, UkrAVTO (the FSO factory in Żerań).

Table 1. Foreign direct investment in the automotive industry in the Visegrad Countries (as of the end of 2008)

	Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Stock of inward FDI in EUR million	VC	5,666	7,588	7,949	10,387	13,038	16,197	19,388	23,099	22,198
	Czech Republic	1,519	2,192	2,272	3,408	3,345	4,740	5,700	7,229	7,189
	Poland	2,349	2,422	2,280	2,761	4,397	4,979	5,753	7,019	5,302
	Slovakia	137	141	149	457	908	1,622	2,252	2,356	2,661
	Hungary	1,661	2,833	3,248	3,762	4,387	4,856	5,683	6,495	7,046
Share of FDI in manufacturing in %	VC	16.8	18.1	17.3	20.2	19.9	21.2	22.8	22.7	22.8
	Czech Republic	17.1	19.0	17.4	22.7	19.9	24.2	26.1	25.3	25.6
	Poland	16.5	14.7	13.9	16.7	18.4	17.7	17.7	17.3	14.8
	Slovakia	6.4	5.9	5.3	9.5	13.0	16.9	20.5	20.8	20.0
	Hungary	19.6	24.4	23.9	24.7	24.6	25.1	29.0	30.1	34.9

Source: Own calculations based on WIIW data.

As of the end of 2008, the stock of foreign direct investment in the automotive industry in the Visegrad Countries was nearly EUR 22.2 billion, i.e. 7.7% of total inward FDI in those countries and 22.8% of foreign investment in manufacturing (Table 1). By the end of



2008, the Czech Republic and Hungary attracted similar investment (a little above EUR 7 billion). The automotive industry in those countries was also the largest recipient of foreign direct investment (in Hungary, it accounted for nearly 35% of FDI in manufacturing and in the Czech Republic nearly 26%). An increase of the stock of inward FDI in Hungary in 2008 has resulted from investment plans of Daimler to allocate the production of Mercedes in Hungarian Kecskemet.

A large recipient of FDI in the automotive industry was also Poland, but the stock of inward FDI in this industry declined visible during 2008. It was an effect of the financial and economic crisis of 2008-2009. But it's undoubtedly that major automotive investment has been made outside Poland for years. The last large investment project in the Polish automotive industry was Toyota's investment of nearly EUR 500 million in the production of engines and gear boxes in Wałbrzych and Jelcz-Laskowice in 2002. Leaving Poland out of major investment by automotive corporations in recent years seems to be a vital problem for the automotive industry as it reduces its development opportunities for more than a decade.

## **6. Trade in the automotive products**

The dynamic inflow of foreign direct investment into the automotive industry of the Visegrad Countries, and then growth of the output of motor vehicles and parts and accessories thereof have created trade flows in the analysed countries. It has occurred at every stage of production process and has reflected in trade data. The production in the automotive industry is characterised by a high level of the import-intensity in exports, which can account for a large part of the automotive output<sup>6</sup>. The cooperation between South Korea's car assembly plants of KIA and Hyundai on Czech-Slovak borderland is a good example for interdependences between foreign direct investment and trade flows. A part of gear boxes production from Hyundai's plant in Nosovice (the Czech Republic) was used in the near car assembly plant, and the rest of ones were exported to the Kia Motors' assembly plant in Žilina (Slovakia), where there were produced Kia Cee'd. While engines produced by Kia Motors in Žilina were used in its own assembly plant and were also exported to Hyundai's plant in Nosovice.

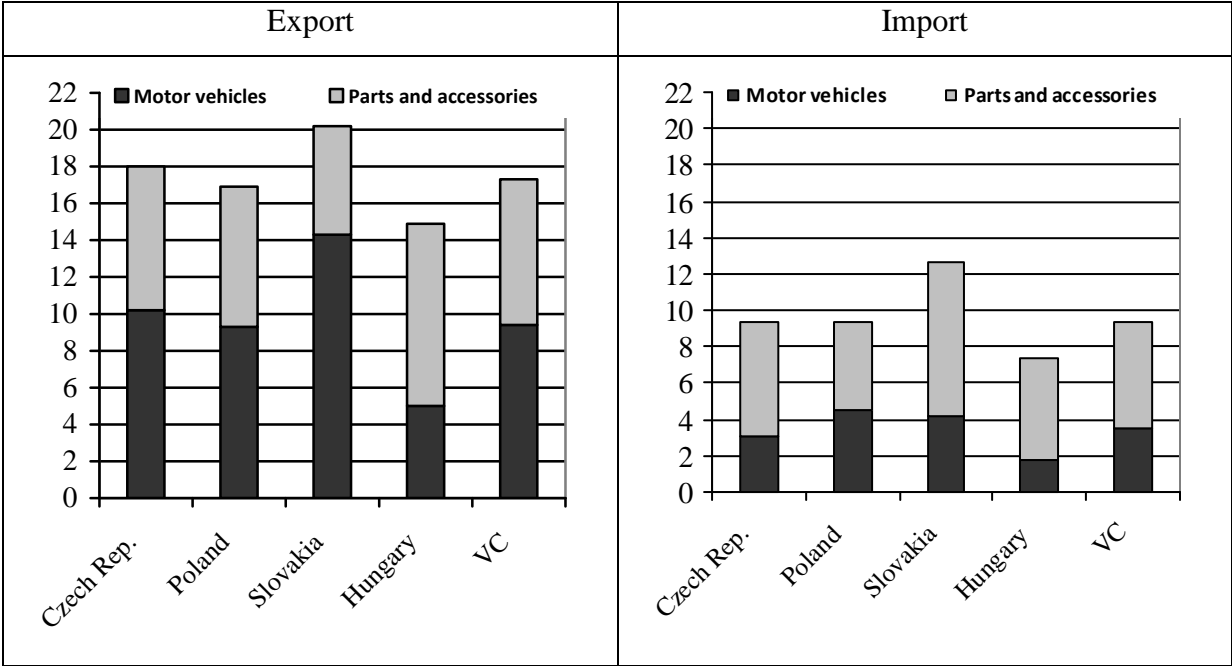
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<sup>6</sup> As example, in 2009 in the Czech Republic and Poland above 95% of car production was exported, mainly to the EU-15.

The increasing production of motor vehicles and parts and accessories thereof was accompanied by a dynamic rise of automotive exports and imports of the Visegrad Countries. In years 2000-2008, the value of automotive exports and imports increased nearly five times. In 2009, there took place a rapid collapse of trade turnover in automotive products in the VC. The scale of the drop was significantly larger in imports (fall by 39% in comparison to the previous year) than in exports (fall by 24% in comparison to the previous year). The better performance of exports resulted mainly from the introduction of vehicle scrapping schemes by many European countries, which have been a market for the VC's automotive exports.

The analysis of the importance of the automotive products in exports and imports of the Visegrad Countries in 2009 (graph 1) allows for some conclusions. First, the share of the automotive products in exports was higher than in imports and amounted to, respectively, 17.3% and 9.4%. Second, the larger significance have automotive products in the Slovak Republic, and the smallest – in Hungary. Third, motor vehicles were more important in automotive exports (except for Hungary), while parts and accessories – in automotive imports. It means that generally the Visegrad Countries are a platform of car assembly for the international automotive company. This phenomenon concerns especially the Slovak Republic, which has specialised in pro-export production of motor vehicles

Graph 1. Share of the automotive products in exports and imports of individual Visegrad Countries in 2009 in %

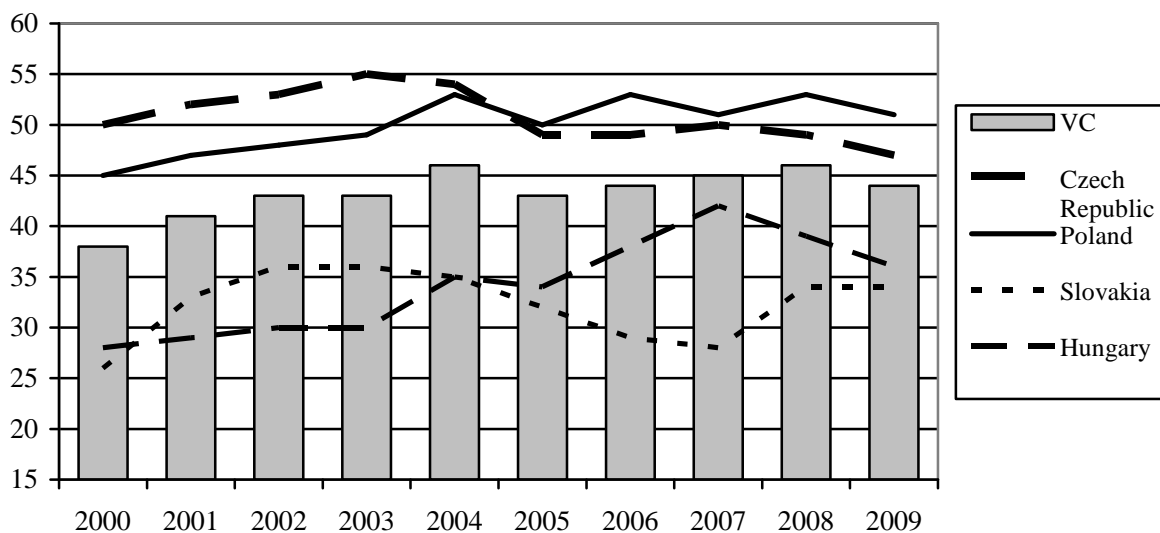


Source: Own calculations based on WITS-Comtrade data.

## 7. Empirical analysis of the developments on horizontal and vertical IIT

Before the accession of the Visegrad Countries to the EU an importance of the intra-industry trade in automotive products in those countries was gradually increasing (graph 2). In 2004, above 46% of their automotive trade had an intra-industry character. In 2005, there took place a decline of IIT shares in total automotive trade, and then renewed their increase to 2008, reaching the level from the accession year. The fall of the intra-industry trade intensity in 2009 resulted from the finance and economic crisis.

Graph 2. The IIT indices in automotive trade in the Visegrad Countries (as a whole) in years 2000-2009, in %



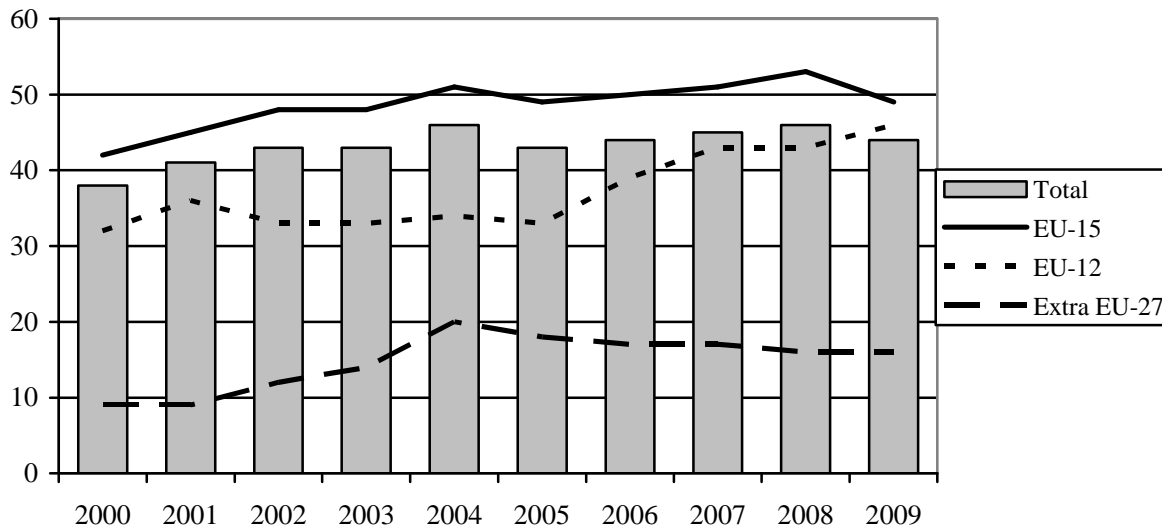
Source: Own calculations based on WITS-Comtrade data.

Visible differences in a development of the intra-industry trade in the automotive industry in individual Visegrad Countries existed. In the analysed period, the highest IIT indices were recorded in the Czech Republic and Poland (about 45-55%), the lowest – in the Slovak Republic and Hungary (about 25-40%). In years 2000-2003, the importance of the intra-industry trade was growing in all analysed countries. After the EU accession, the tendencies in the IIT development were different. The share of the intra-industry trade with the automotive products in the Czech Republic was gradually declining (47% in 2009), but in Poland it varied from 50% to 55%. In Hungary, the IIT intensity increased to 2007, and then

the downward tendency was noticed. The different situation took place in the Slovak Republic – a fall of the IIT indices to 2007 and then their dynamical growth.

Taking the IIT indices in the VC's automotive trade with their major trading partners group into account, the highest level of the IIT intensity was noticed in trade with the EU-15 (49% in 2009) and the other new EU Member States (46% in 2009), and the lowest – with the non-EU countries (16%). The share of the IIT in the VC's automotive trade with the EU-15 was gradually increasing during the period 2000-2008 (graph 3). Despite not big fall in 2009, the IIT index was still 7 p.p. higher than at the beginning of the analysed period. Visible growth of the IIT indices in the automotive trade of the Visegrad Countries with the EU-12 took place in years 2005-2009 (increase by 13 p.p.). It was a result of dynamic development of the intra-firm trade in the Visegrad Countries after their accession to the EU in 2004. This type of trade has mainly an intra-industry character. In trade with the non-EU countries, the share of the two-way trade of the automotive products increased in years 2000-2004 by 11 p.p., and then it was gradually declining (the fall by 4 p.p. in years 2004-2009).

Graph 3. The IIT indices in the automotive trade in the Visegrad Countries (as a whole) with the major trading partners group in years 2000-2009, in %

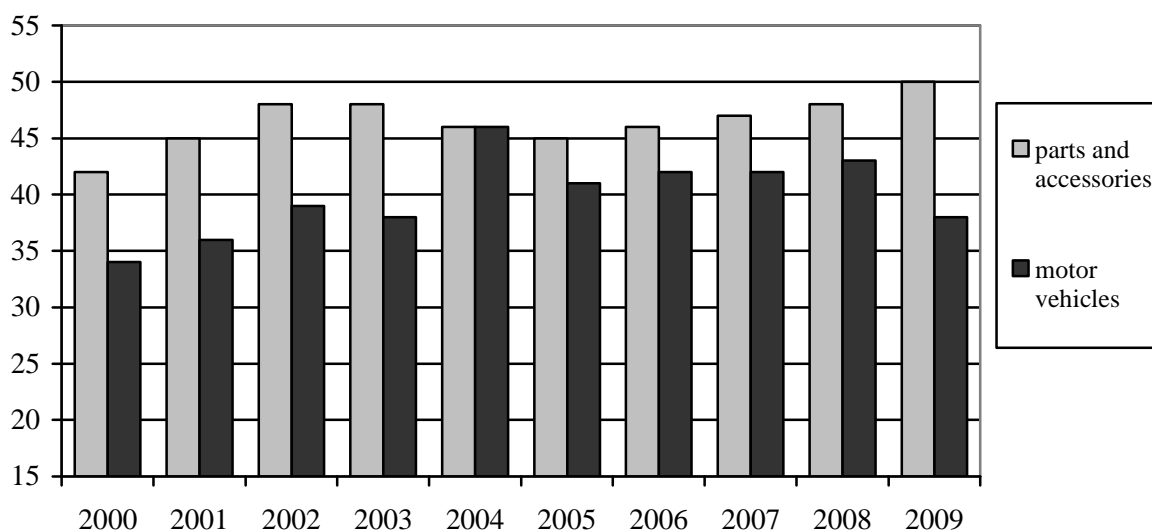


Source: Own calculations based on WITS-Comtrade data.

Except for 2004, the IIT intensity in trade with automotive parts and accessories in the Visegrad Countries (as a whole) was larger than in trade with motor vehicles (graph 4). It resulted from some matters. First, the economic development level of the analysed countries was similar, thus a penchant of consumers for purchasing differentiated goods (cars of

different brands) was also similar. A domestic car output and a scale of domestic demand for the imported vehicles were the main factors influencing the level of the IIT intensity. When the vehicle output in a given country is significant larger than the demand of its residents for the imported ones, the IIT intensity in this product group is relatively low. A good example may be the Czech and the Slovak Republics (graph 4). In 2009, in these countries there were manufactured respectively 967 thousand and 461 thousand cars, and the number of new registered vehicles amounted respectively to 215 thousand cars and 102 thousand cars. The IIT indices in trade in motor vehicles were higher in Poland – in the analysed period they varied about 50%. It resulted from scale of Poland’s automotive market, and thus from the larger demand of consumers for the imported vehicles. In the presence of similar vehicle output in the Czech Republic and Poland (819 thousand items in 2009), the number of new registered vehicles in 2009 in Poland exceeded 400 thousands items. Second, higher IIT indices in trade of automotive parts and accessories than in trade of motor vehicles were an effect of larger possibilities to become intermediate products different. The scale of these abilities depends on some factors, i.e. on a number of different automotive firms owned car assembly plants (or plants used to produce parts and accessories) in a given country and on number of car brands produced by a given automotive firm in a given country. The modularisation of car production makes possible to fragmentate this process into separated parts, which can be allocated in different countries.

Graph 4. The IIT indices in trade of motor vehicles and automotive parts and accessories in the Visegrad Countries (as a whole) in years 2000-2009, in %



Source: Own calculations based on WITS-Comtrade data.

It's worth to mention that sometimes higher IIT indices can be a result of false trade data aggregation. The theoretical literature pays attention to this problem<sup>7</sup>. The definition of industry is a key concept from the point of view of the IIT analysis. Only correct definition of industry allows us a reliable measurement of this phenomenon. However, there is a difficult task. In practice, the solution of this problem relies on a choice of right trade data classification (HS or SITC classification) and right level of their aggregation. Sometimes the adopted data aggregation level, so grouping products into given sets, doesn't cover a range of products belonging to individual industries. The higher the number of products in a separated data aggregate is, the higher is the probability that intra-industry trade occurs. In case of the automotive parts and accessories, especially numerous set is a subheading 8708 HS, which is treated as an industry. In this group there are e.g. bumpers, safety seat belts, brakes, gear boxes, drive-axles, road wheels, suspension systems, radiators, silencers, clutches, steering wheels. As an example, for a given country a simultaneously export of gear boxes and import of suspension systems will be registered for the intra-industry trade.

Big changes of the IIT indices in trade in motor vehicles of the individual Visegrad Countries may suggest that the two-way trade in final goods is more susceptible to fluctuation of an economic activity (trade turnover) than trade in automotive parts and accessories (graph 4). In 2009, almost 38% of trade in motor vehicles in the analysed countries (it means 5 p.p. less than in 2008 and 8 p.p. less than in 2004) had an intra-industry character. The highest level of the IIT indices were noticed in Poland (48%) and Hungary (39%), while the lowest – in the Czech and Slovak Republics (about 30%) – graph 5.

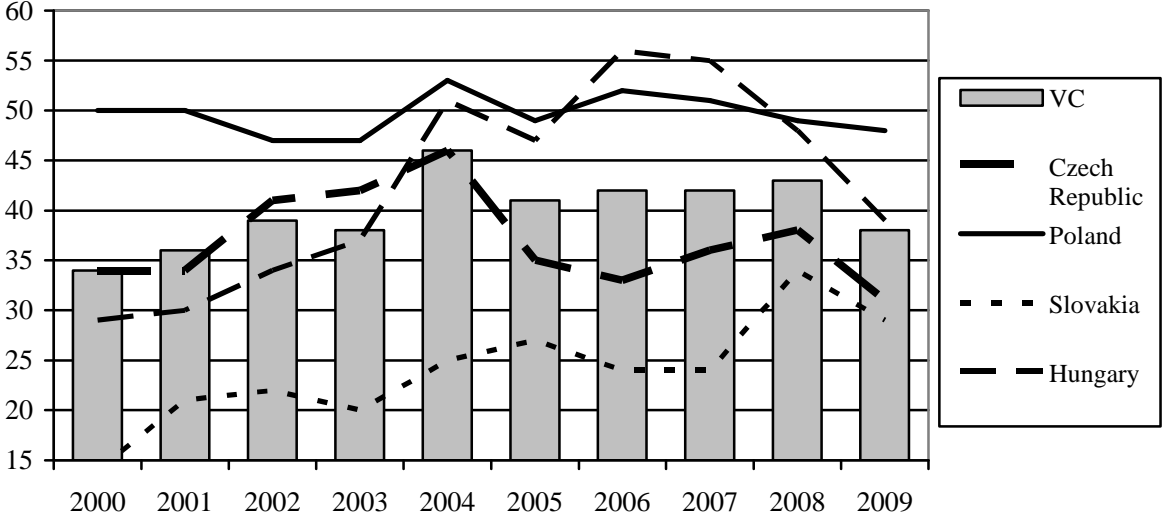
In the analysed period, the IIT indices in trade of automotive parts and accessories in the Czech and Slovak Republics were significantly higher than ones in motor vehicles trade; in Hungary – they were lower, but in Poland both indices oscillated about the level of 50% (graph 6). It's worth to mention that the share of the intra-industry trade in total automotive parts and accessories trade in the Czech Republic was especially large. During the period of 2000-2009, it fluctuated between 60% and 70% and 20-30 p.p. higher than that was one for the motor vehicles. On the one hand, it has resulted from a large scale of motor car assembling, and then from a necessity to provide domestic plants with imported parts and accessories. On the other hand, it has been an effect of well developed industry manufacturing automotive parts and accessories. The domestic output of these products often exceeded the domestic demand and a part of this output could be exported. Next, the decreasing importance of the

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<sup>7</sup> See E. Czarny, *Problem agregacji w teorii handlu wewnątrzgałęziowego oraz badaniach empirycznych*, "Bank i Kredyt", No. 3/2003.

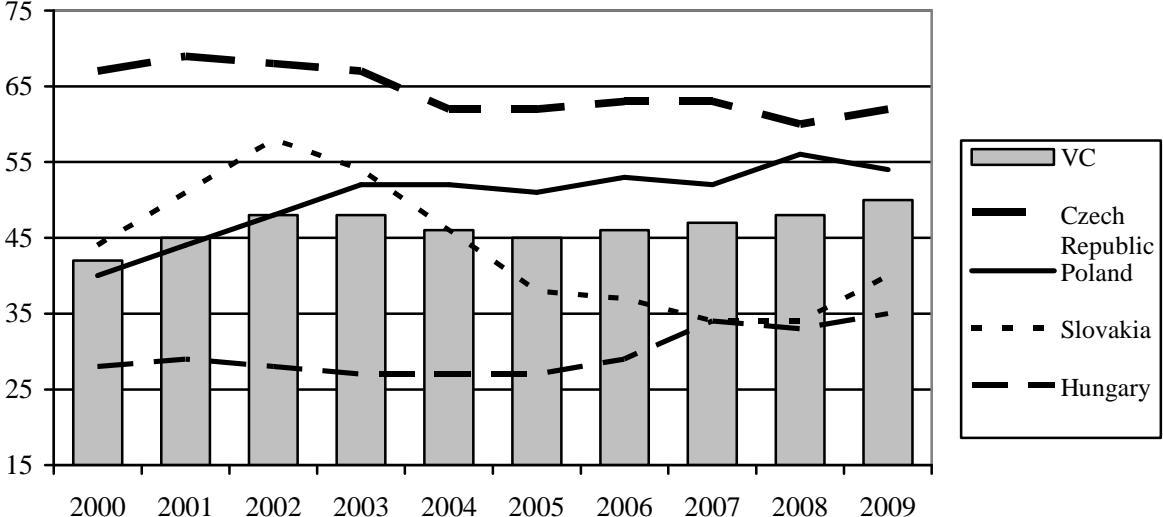
IIT in trade of parts and accessories in the Slovak Republic has resulted mainly from the increasing comparative advantages in export of motor vehicle. It has had an effect in dynamic increase of automotive parts and accessories import, and then in a growth of an inter-industry trade.

Graph 5. The IIT indices in trade in motor vehicles in the Visegrad Countries in years 2000-2009, in %



Source: Own calculations based on WITS-Comtrade data.

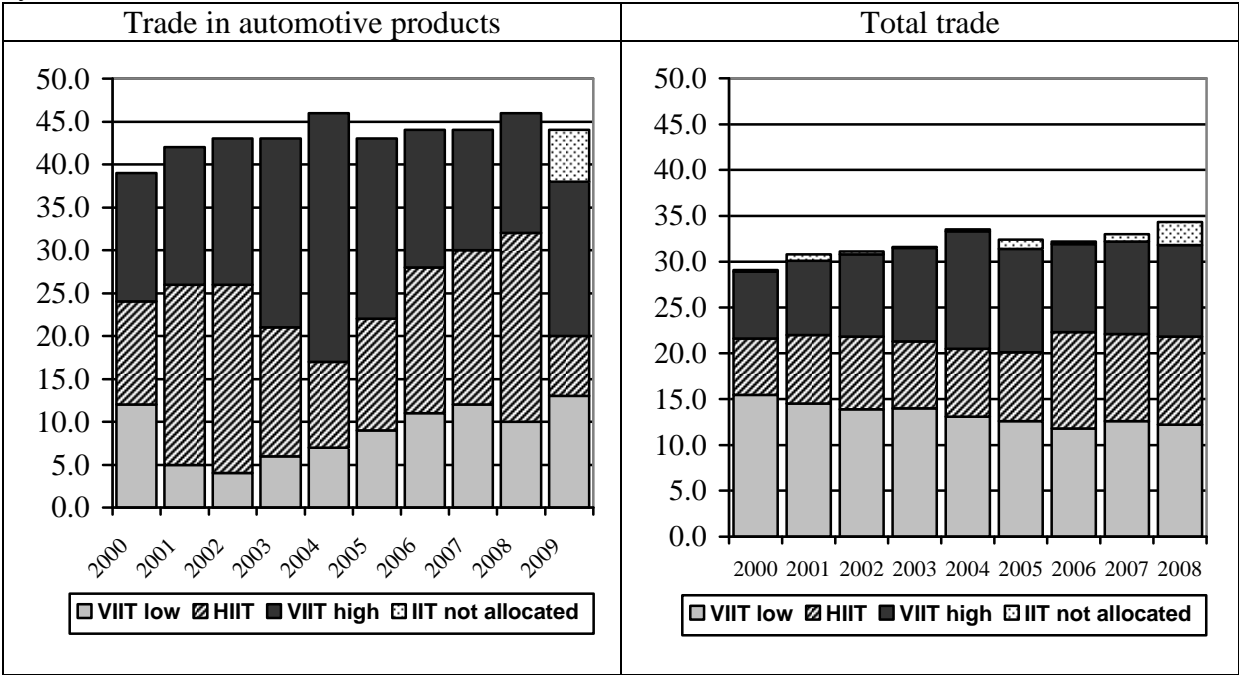
Graph 6. The IIT indices in trade of automotive parts and accessories in the Visegrad Countries in years 2000-2009, in %



Source: Own calculations based on WITS-Comtrade data.

In the period of 2000-2009, in the automotive trade of the Visegrad Countries (as a whole) the intra-industry trade in vertically differentiated products dominated (graph 7). It meant that the differences between the unit values in exports and the unit values in imports were crucial, so they indicated that traded products differed in quality<sup>8</sup>. The majority of this trade was the vertical intra-industry trade of high quality products. The share of the high quality VIIT in total automotive trade of the Visegrad Countries had been gradually increasing in years 2000-2004, and then it was systematically declining after 2005. The opposite tendency described the changes in the horizontal intra-industry trade development, whereas the importance of the low quality VIIT was still decreasing. The IIT patterns have to be carefully interpreted. Defects in export and import quality in 2009, especially in Hungarian and Slovakian automotive trade, caused that the IIT pattern in 2009 was distorted. It has made us difficult to draw conclusions.

Graph 7. The IIT patterns in automotive trade and total trade of the Visegrad Countries in years 2000-2009(8), in %



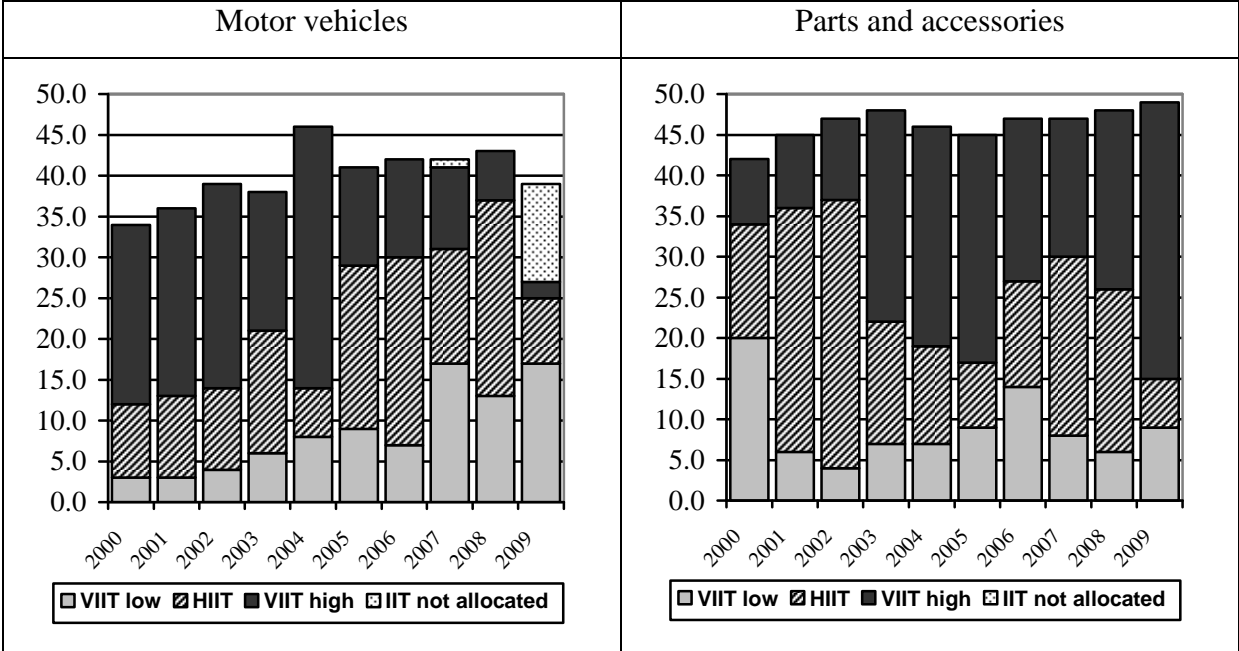
Source: Own calculations based on WITS-Comtrade data.

<sup>8</sup> According to the Greenaway, Hine and Milner (1994) methodology, the total intra-industry trade has been divided into its two types – horizontal and vertical intra-industry trade using the so-called “product similarity criterion”. This criterion is based on the ratio between the unit value in exports and the unit value in imports in trade between two trading partners.



The IIT indices in the automotive trade were 10-12 p.p. higher than ones in total trade of the Visegrad Countries as a whole (during the period of 2000-2008) – graph 7. The IIT patterns in the automotive trade and in total trade were also different. Taking the period of the VC membership in the EU into account, one may say that an upward trend characterised the horizontal IIT both in automotive and total trade. In case of the VIIT in the automotive trade, the intensity of the high quality VIIT products was declining, but the low quality VIIT was increasing. The opposite tendency characterised changes in the IIT pattern in total trade of the Visegrad Countries.

Graph 8. The IIT patterns in trade in motor vehicles and automotive parts and accessories in the Visegrad Countries (as a whole), in %



Source: Own calculations based on WITS-Comtrade data.

From the analysis of the IIT pattern in the automotive industry in the VC, taking the division into motor vehicles and automotive parts and accessories into consideration, there have resulted some conclusions. First, the ratio between the unit values in exports of motor vehicle and the unit values in their imports has been gradually declining (except for 2004). The Visegrad Countries (as a whole) exported the motor vehicles of a relatively worse and worse quality. It could be resulted from e.g. a progressive specialisation of the analysed countries in production and export of small cars (also called as city cars). The unit values in their sale were lower than ones with engine of a larger cylinder capacity. A dynamic development of small cars output caused that a share of bigger motor vehicles in total motor

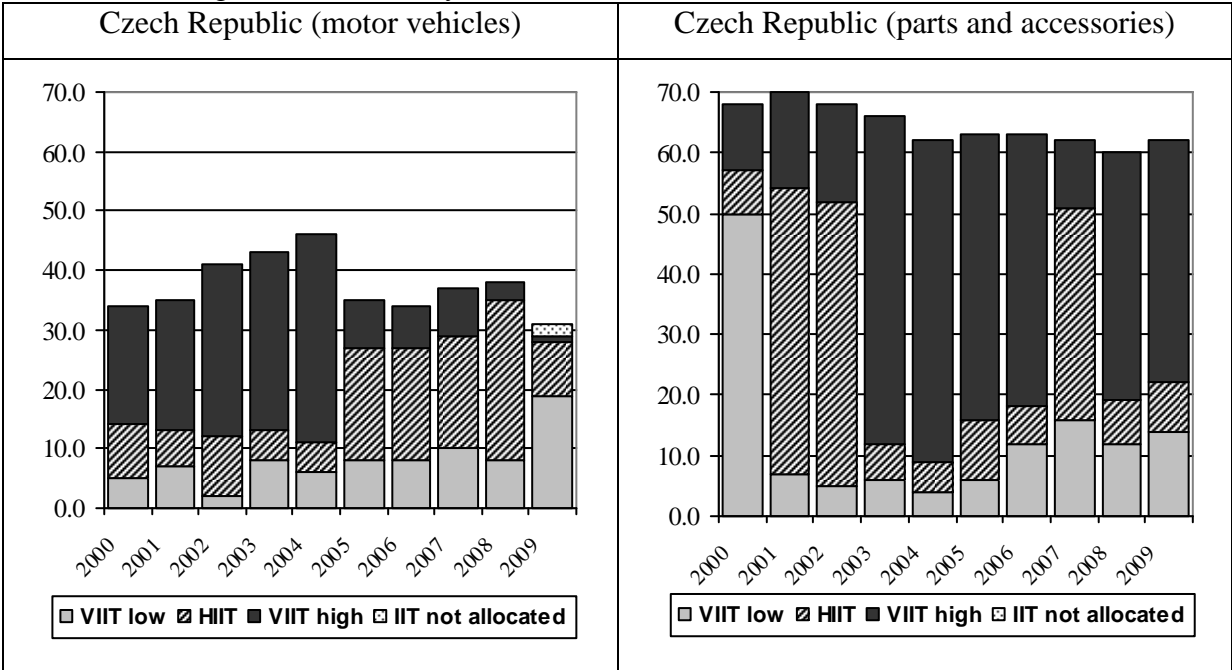
vehicle exports of the VC was decreasing, and as a result the relative unit values of exports were systematically declining. Second, a high import-intensity of the automotive exports in the Visegrad Countries has caused that there exist mutual interdependences between unit values in exports and imports. The specialisation in output of small cars has involved a drop of unit values in imports of automotive parts and accessories, used in car assembly plants of the analysed countries. As a result, the relative unit values in exports of parts and accessories have been growing, what there has appeared in increase of the high quality VIIT.

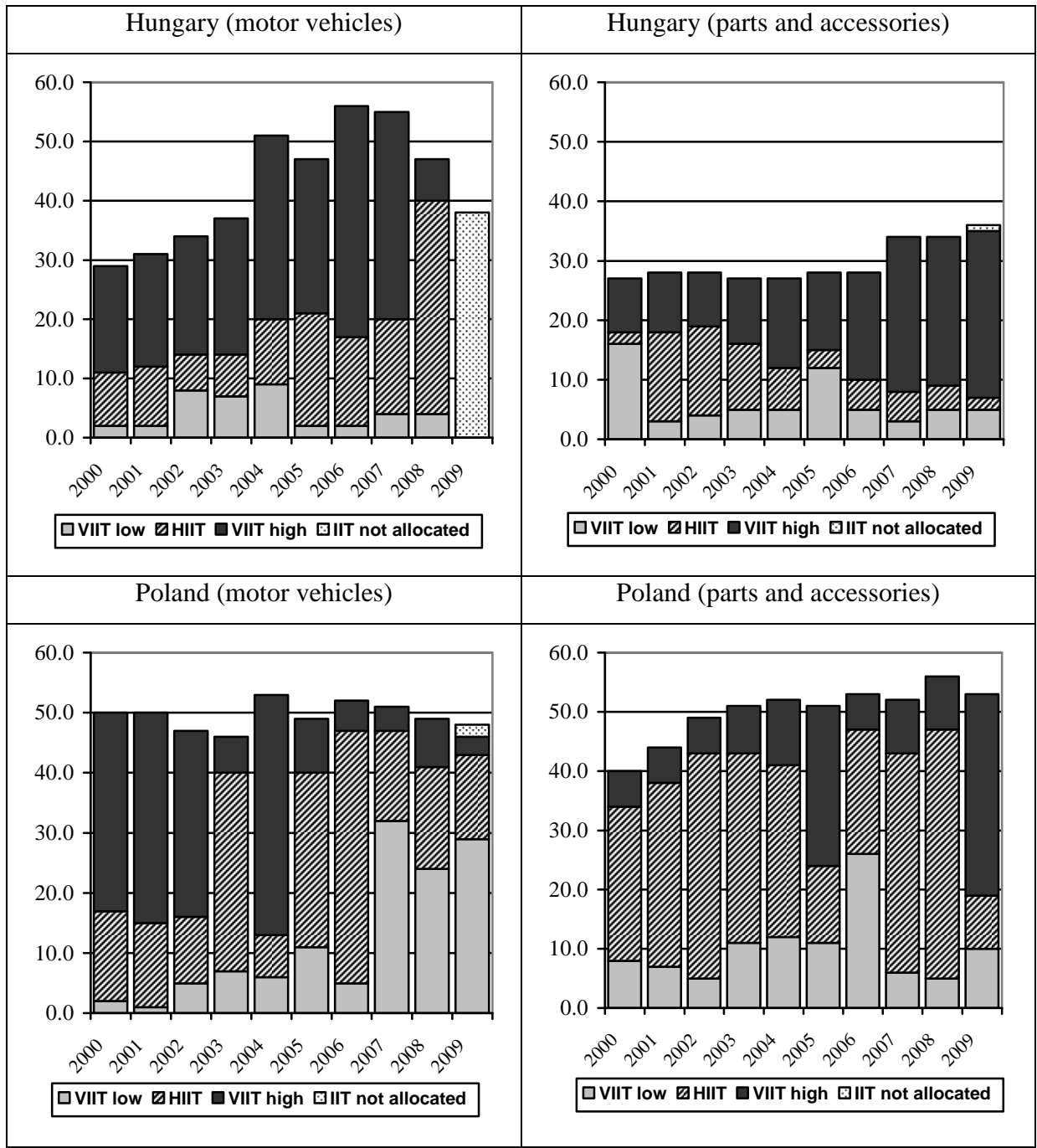
The above mentioned problems are visible in case of individual examples. In PSA and Toyota assembly plant in Kolin (the Czech Republic) there are produced such models as Toyota Aygo, Citroën C1 and Peugeot 107. The basic version of these models is equipped with engines of cylinder capacity not exceeding  $1 \text{ dm}^3$  ( $998 \text{ cm}^3$ ). In 2006, small motor cars amounted to 20% of the Czech exports of passenger cars and light commercial vehicles, and in 2008 – above 25% of such exports. Changes in foreign sales of manufactured cars, and as a result changes in exports unit values were easy to observe in the IIT of motor vehicles and automotive accessories in the Czech Republic (graph 9). The share of the high quality VIIT in trade in motor vehicles in years 2004-2005 decreased by 27 p.p. (to the level of 8%). It's worth to mention that in 2002-2003 the importance of the high quality VIIT of automotive parts and accessories rapidly increased (by 38 p.p. to the level of 54%). It resulted from launching production in Kolin and necessity to import parts and accessories used to assembly small cars (the fall of unit value in imports of parts and accessories, and then the growth of relative unit value in exports of parts and accessories). A similar situation took place in Poland, but a scale of the phenomenon was smaller than in the Czech Republic (graph 9). A drop of the relative unit values in exports of motor vehicle was more visible than growth of the relative unit values in exports of parts and accessories. In the recent years, the importance of motor vehicles with engines of a cylinder capacity above  $1.5 \text{ dm}^3$  in Poland's automotive exports systematically declined to the advantage of small cars (with engines of cylinder capacity below  $1.5 \text{ dm}^3$ ). Examples of the former were vehicles produced in Opel's plant in Gliwice, e.g. Opel Zafira B, Opel Astra Classic II, Opel Astra IV and Opel Astra III Sedan, and of the latter – e.g. Fiat 500, 600, Panda oraz Ford Ka II, which were produced in Fiat's plant in Tychy.

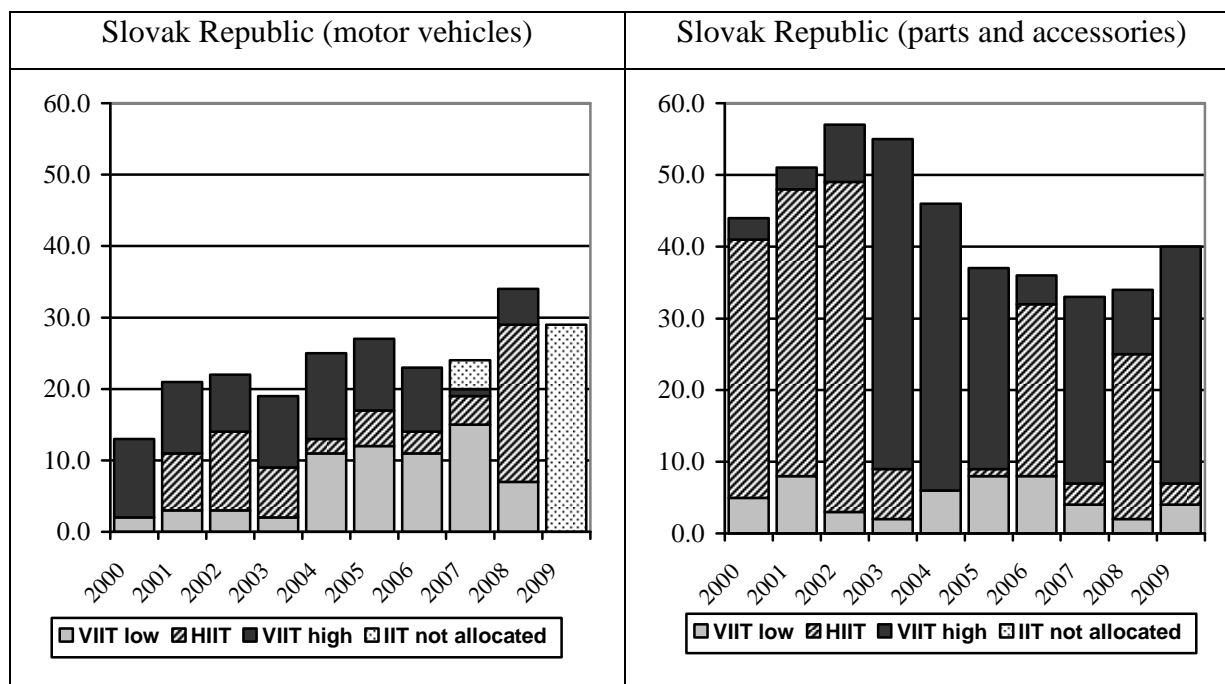
Next, the IIT patterns in trade in motor vehicle and automotive parts and accessories in Hungary were similar to each other – there were the high quality VIIT registered. Although the share of small cars (with engines of a cylinder capacity below  $1.5 \text{ dm}^3$ ) was increasing in

Hungarian automotive exports, still about 50-60% accounted for middle and big vehicles (with engines of a cylinder capacity above 1.5 dm<sup>3</sup>). There were e.g. Audi TT and Audi A3 Cabriolet (produced in Győr) and Suzuki Splash, Swift and SX4 (produced in Esztergom). The specialisation in these products causes that Hungary exports mainly cars of better quality (of a higher price) and imports mainly cars of a worse quality (of a lower price). A large share of the high quality VIIT in automotive parts and accessories may result from Hungarian specialisation in manufacturing of gear boxes and parts thereof, a large part of which is exported. The gear boxes produced in Győr for Audi and Volkswagen brands and in Opel's plant in Szentgotthard were characterised for middle and large cylinder capacity (above 1.5 dm<sup>3</sup>). The unit values in exports of gear boxes and parts thereof were higher than unit values in Hungarian imports of these products. In addition, relatively high exports unit values in case of parts and accessories was an effect of higher prices in exports than in imports of some automotive parts, e.g. road wheels, clutches and parts thereof and brakes.

Graph 9. The IIT patterns in trade in motor vehicles and automotive parts and accessories in individual Visegrad Countries in years 2000-2009, in %







Source: Own calculations based on WITS-Comtrade data.

## 8. Conclusions

Dynamic inflows of foreign direct investment to the automotive industry of the Visegrad Countries in the recent years has stimulated foreign trade of the automotive products. It has reflected in changes of the trade pattern, mainly in decrease of the inter-industry trade. The share of the intra-industry trade in total trade of the VC was gradually increasing during the period of 2000-2004. After the VC's accession to the EU, the changes of the IIT intensity were rather modest. In 2009, nearly 45% of automotive trade in the analysed countries had an intra-industry character. It was 10 p.p. higher than in total trade of the VC. It resulted from high degree of fragmentation of production processes, and therefore from higher possibilities to develop the intra-industry trade in the automotive industry than in the other ones. These possibilities were especially high in case of the automotive parts and accessories. As an example, the IIT indices in trade of parts and accessories in the Czech Republic was 20-35 p.p. higher than ones for the motor vehicles.

During the analysed period, the IIT pattern in the VC's automotive trade was unstable. After the accession to the EU the share of high quality VIIT was declining but the shares of the HIIT and low quality VIIT were increasing. As a result, in 2008 the IIT in vertically differentiated products accounted for a slight above 50% of the IIT. Especially low

intensity of the high quality IIT was specific for motor vehicle. It resulted mainly from a progressive specialisation of the analysed countries in production and export of small cars (also the so-called city cars). The unit values in their sale were lower than ones with engine of a larger cylinder capacity. At the same time the high quality IIT in trade of parts and accessories was growing. It was an effect of a high import-intensity of the automotive exports in the Visegrad Countries. The specialisation in output of small cars involved a drop of unit values in imports of automotive parts and accessories, used in car assembly plants. As a result, the relative unit values in exports of parts and accessories were growing, what resulted in increase of the high quality VIIT.

## Literature

Ambroziak Ł. (2009), Przemysł motoryzacyjny nowych państw członkowskich UE - czy koniec złotego okresu?, „Wspólnoty Europejskie”, no. 1. Arndt S. and Kierzkowski H. (ed.) (2001), *Fragmentation: New Production Patterns in the World Economy*, Oxford University Press, Oxford.

Aturpane Ch., Djankov S. and Hoekman B. (1997), *Determinants of Intra-Industry Trade between East and West Europe*, Policy Research Working Paper No. 1850, The World Bank.

Balassa B. and Bauwens L. (1987), *Intra-Industry Specialisation in a Multi-country and Multi-industry Framework*, Economic Journal, Vol. 97, p. 923-939.

Balassa, B. (1996), *Tariff reductions and Trade in Manufactures Among Industrial Countries*, American Economic Review, Vol. 86 (3).

Caetano J. and Galego A. (2006), *In Search for Determinants of Intra-Industry Trade within an Enlarged Europe*, Economics Working Papers 2/2006, University of Évora, Department of Economics.

Černoša S. (2007), *Horizontal and Vertical Intra-Industry Trade between the Former CEFTA*

Cheng L. and Kierzkowski H. (ed) (2001), *Global Production Networks and Trade in East Asia*, Kluwer Academic Publishers, Boston.

Cieślak A. (2003), *Handel wewnątrzgałęziowy Polski z Unią Europejską: Stan obecny i perspektywy rozwoju*, in: Michałek, J.J., Siwiński W., Socha M. (ed.), *Od liberalizacji do integracji Polski z Unią Europejską: Mechanizmy i skutki gospodarcze*, PWN, Warsaw, p. 62-76.

*Countries and the European Union*, Managing Global Transitions, vVol. 5, No. 2.

Czarny E. and Śledziwska K. (2008), *Poland's Intra-Industry Trade with the European Union at the Beginning of the 21st Century*, in: *Poland. Competitiveness Report 2008. Focus on Services*, ed. by M.A. Weresa, World Economy Research Institute, Warsaw School of Economics, Warsaw.

Czarny E. and Śledziwska K. (2009), *Poland's Intra-Industry Trade with the European Union in years 1999-2007*, in: *Poland. Competitiveness Report 2009. Focus on Human*

*Resources*, ed. by M.A. Weresa, World Economy Research Institute, Warsaw School of Economics, Warsaw.

Dixit A.K. and Norman V. (1980), *Theory of International Trade*, Cambridge University Press, Cambridge, Mass.

Falvey, R. (1981), *Commercial policy and intra- industry trade*, Journal of International Economics, Vol. 11.

Falvey, R. and Kierzkowski, H. (1987) *Product Quality, Intra-Industry Trade and (Im)Perfect Competition*, in: H. Kierzkowski (ed.), *Protection and Competition in International Trade*, Blackwell, Oxford.

Feenstra R. C. and Hanson G.H. (1997), *Foreign Direct Investment and Relative Wages: Evidence from Mexico's Maquiladoras*, *Journal of International Economics*, Vol. 43.

Ferto I. and Soos K.A. (2006), *The development of Intra-Industry Trade between the European Union and European Former Communist Countries before the 2004 Enlargement*, INDEUNIS Papers, Hungarian Academy of Sciences, Institute of Economics, February 2006.

Fidrmuc J. and Djablik M. (2003), *Intraindustry Trade Between the EU and the CEECs – The Importance of FDI in Trade Structure*, East-West Conference, November 2003, Austrian Nationalbank.

Finger, J. M. (1975), *Trade Overlap and Intra-industry trade*, *Economic Inquiry* Vol. 13, No. 4, December.

Flam, H. and Helpman E. (1987), *Vertical Product Differentiation and North-South Trade*, *American Economic Review*, Vol. 77, p. 810-822.

Gabrisch H. (2006), *Vertical intra-industry trade between EU and Accession Countries*, IHW-Discussion Paper, No. 12, July 2006.

Gabrisch H. and Segnana M.L. (2002), *Why is Trade between the European Union and the Transition Economies Vertical ?*, Discussion Paper No. 7, University of Trento.

Gabrisch H. and Segnana M.L. (2003), *Vertical and horizontal patterns of intra-industry*, Institut für Wirtschaftsforschung Halle, April 2003.

Greenaway D., Hine R.C. and Milner, C. (1994), *Country-Specific Factors and Pattern of Horizontal and Vertical Intra-industry Trade in the UK*, *Weltwirtschaftliches Archiv*, vol. 130.

Grubel H.G (1967), *Intra-Industry Specialization and the Pattern of Trade*, *Canadian Journal of Economics and Political Science*, Vol. 33, August, p. 374-388.

Grubel H.G., Lloyd P.J. (1975), *Intra-Industry Trade: the Theory and Measurement of Intra-Industry Trade in Differentiated Products*, London: Macmillan.

Helpman E. (1981), *International trade in the presence of product differentiation, economies of scale and monopolistic competition: A Chamberlin-Heckscher-Ohlin approach*, *Journal of International Economics*, Vol. 11 (3).

Helpman E. (1984). *A Simple Theory of International Trade with Multinational Corporations*, *Journal of Political Economy*, Vol. 92(3), p. 451-471.

Helpman E. and Krugman P.R. (1985), *Trade Policy and Market Structure*, Cambridge, Mass: MIT Press.

- Hoekman B. and Djankov S. (1996), *Intra-industry trade, foreign direct investment, and the reorientation of Eastern European exports*, Policy Research Working Papers No. 1652, The World Bank.
- Jones R.W. and Kierzkowski H. (1990), *The Role of Services in Production and International Trade: A Theoretical Framework*, in: Jones R.W. and Krueger A.O. et alia, *The Political Economy of International Trade*, Blackwell, Oxford, 1990.
- Kaminski B. (2001), *How Accession to the European Union has Affected External Trade and Foreign Direct Investment in Central European Countries*, Policy Research Working Paper, No. 2578, The World Bank.
- Kandogan Y. (2003), *Intra-industry Trade of Transition Countries: Trends and Determinants*, William Davidson Working Paper Number 566, May 2003.
- Kawecka-Wyrzykowska E. (2009), *Evolving pattern of intra-industry trade specialization of the new Member States (NMS) of the EU: the case of automotive industry*, European Economy. Economic Papers No. 364, March 2009.
- Klimek A. (2006), *Influence of European Integration on Intensity of Intra-Industry Trade of Poland*, paper presented on the ETSG Conference, 7-9 September 2006, Vienna.
- Krugman P. R. (1979), *Increasing Returns, Monopolistic Competition, and International Trade*, Journal of International Economics No. 9.
- Krugman P. R. (1980), *Scale Economies, Product differentiation, and the Pattern of Trade*, American Economic Review Vol. 70.
- Krugman P.R. (1983), *New Theories of Trade among Industrial Countries*, American Economic Review, Vol. 73, No. 2, p. 343-348.
- Lancaster K. (1980), *Intra-industry trade under perfect monopolistic competition*, Journal of International Economics, Vol. 10, No. 2.
- Leamer E. (1994), *Testing Trade Theories*, in: D. Greenaway and L. Alan Winters (ed.), *Surveys in International Trade*, Blackwell, Oxford.
- Linder S.B. (1961), *An Essay on Trade and Transformation*. New York: John Wiley.
- Lipsey R. (1976), *Review of Grubel and Lloyd (1975)*, Journal of International Economics, No. 6.
- Markusen J. R. (1995), *The Boundaries of Multinational Enterprises and the Theory of International Trade*, Journal of Economic Perspectives, Vol. 9, pp. 169-90.
- Michałek J.J. and Śledziewka-Kołodziejaska K. (2000), *Analiza i perspektywy rozwoju handlu międzygałęziowego i wewnątrzgałęziowego oraz zmiany strukturalne handlu Polski z Unią Europejską*, in: *Korzyści i koszty członkostwa Polski w Unii Europejskiej*, IKCHZ, Warsaw.
- Molendowski E. (2007), *Liberalizacja wymiany handlowej krajów Europy Środkowowschodniej w okresie transformacji ze szczególnym uwzględnieniem doświadczeń krajów CEFTA*, Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie, Cracow.
- Shaked, A. and Sutton J. (1984), *Natural Oligopolies and International Trade*, in H. Kierzkowski, (Ed.), *Monopolistic Competition and International Trade*, New York: Oxford University Press.
- Verdoorn P.J. (1960), *The Intra-Block Trade of Benelux*, in: E.A.G. Robinson (ed.), *Economic Consequences of the Size of Nations*, Macmillan, London.