The Role of FDI in Quality-based Competitiveness: the Case of Czech Republic[1]

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Abstract

The paper evaluates the qualitative aspects of the Czech Republic position in the global economic flows in terms of their knowledge intensity. The stress is being put on structural characteristics of value-added, FDI and R&D and innovation activities indicating the change of competitive advantage towards the increasing role of internal innovation capacity and unique product and processes. This change, however, may not be fast enough to compensate for weakening cost-based competitiveness. Despite the increasing share of FDI companies in domestic R&D activities, their average knowledge intensity remains low. The prevailing competitive strategy relies on adoption of foreign technology knowledge to local needs, possibly with minor adjustments.

Keywords: *technology intensity, FDI, value chain fragmentation*

Introduction

Due to its external openness, Czech economy has been getting more involved in the globalization process that is characterized by an increase in the mobility of production factors, including technology knowledge. The paper looks into details of the structural characteristics of quality-based competitive advantage from the perspective of industries, trade flows, foreign direct investment activities and regions. As for industry-related competitive advantage and economic structure, attention is given to performance in terms of technology and knowledge intensities. The industry level is also exploited in the assessment of key characteristics of innovation activities of Czech companies, with a special attention focused on the differences between manufacturing and services (innovation modes, R&D

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intensity, cost structure and innovation intensity, results, motivation and barriers of innovation activities). In terms of foreign direct investment, attention is especially given to its role in domestic R&D activities (their share in expenditure and employment) and in innovation outputs (in comparison with local companies). At the regional level, focus is aimed at assessing economic performance as both a prerequisite for and result of competitiveness, with a special regard to innovation performance evaluated in terms of R&D activities, technology-intensive value added and the level of foreign direct investment.[2]

The comparative advantage and specialization of the individual economies are traditionally understood from the point of view of the trade of final products or industrial structure of exports. Nonetheless the existing global fragmentation of the production chain needs a new approach to international trade analysis (see Jones, 2000, and Arndt, Kierzkowski, 2001). The fragmentation of the production chain enables spatial allocation of the production according to the factor intensity of the individual stages of the production chain and not according to the average factor intensity of the final product. The development of the global production systems leads to repetitive including of the intermediate products (intra-industry trade) and thus to the high growth rates of both exports and imports without corresponding growth of the value added. The intra-industry trade is often accompanied by the intra-firm trade among foreign affiliates of the multinational corporations. The theory of the multinational firms is traditionally explained by OLI-theorem, which specifies three main factors necessary for any investments abroad: the advantage of ownership, localization and internalization of production (see Dunning, 1988 and 1993).

1. Structural Characteristics of Globalization

The nature of global economic activity has a significant impact on the increasing mobility and range of migrating *production factors* that increasingly include, besides industrial production and physical capital, the flows of services, R&D and human capital that result in flows of skilled workforce and investment in technology and expertise. Together with the changing technology, production, investment and trade flows, the share of *emerging* markets in the global output has been increasing. By 2015, China will have become the second strongest

[2] For the survey of key theoretical starting points related to the knowledge-based competitiveness see e.g. Kaderabkova (2004, 2005, 2006), Kaderabkova et al. (2006), Rojicek (2006), WEF (2006), UNCTAD (2005, 2006). The comprehensive empirical background has been presented above all in the annual survey publications of OECD (2005, 2005a, 2006, 2006a). Methodology of innovation performance analysis has been included e.g. in the papers of Arundel, Hollanders (2005) underlying the publication of Innovation Scoreboard.

world economy, with India increasing its economic power as well. Production factors will always be directed into the countries with the highest economic or social return that is dependent on their structural characteristics – i.e. the quality of physical and human capital, market size, growth potential, transport costs and barriers preventing the entry. The current emerging economies show a *high production* in skilled human capital and R&D expenditure (although from a significantly lower base when compared to developed countries). Therefore, in the not so far future, these countries will be, due to their strengthening domestic knowledge base, able to compete against more developed countries in a *wide range of products,* i.e. not only in low value added segments of products and services where their production costs are markedly lower.

1.1. Foreign Direct Investment

Since the 90s, the development of global economy has been characterized by foreign direct investment (FDI) flows growing faster than world trade. Even though the position of the developed countries, i.e. the USA and EU, remains most important, the share of *emerging markets* has quickly become more significant (China's share went up from 2% in 1990 to 10% in 2004). Unlike in the past, they are not used just as locations for cheap production but they also attract an ever increasing share of investment in *high-quality activities*, i.e. research, development and innovation activities. Together with the growing importance of trade and services, also the importance of FDIs has been increasing in this sector. Foreign companies play a bigger role in the R&D performance in the host economies. FDIs are important for the *parent company* since they provide for a more efficient production, access to new markets and adoption of new technology. From the macroeconomic perspective, FDIs help restructure economies according to the changing comparative advantage. The majority of FDIs from EU countries go to the OECD countries, but the share of emerging economies increases as well. Differences in the FDI development are also apparent within the EU, with the old EU countries losing FDIs in favour of the new members.

2. International Division of Labour

The growth of trade flows as a result of globalization has initiated a discussion on the impacts of *international division of labour and production*. An increasingly important role of emerging markets (especially India and China) in EU trade stresses the differences in the relative factor endowment among trade partners. These differences subsequently influence industry specialization, thus

affecting the labour and investment demand in the individual member states.[3] Specific attention is given to the influence of globalization on individual industries within the EU and on the demand for groups of (differently skilled) employees and to the ability of the qualification supply to react to the changes in the qualification demand structure.

2.1. International Context

Developed countries have steadily shown a long-term growth of trade openness (the share of trade in GDP). A new trend is presented by the growth of *inter-industry trade* within the EU from the beginning of the new millennium (and since 1996 in the USA) that was significantly decreasing in the previous period.[4] This is in part due to the increased importance of trade in raw materials (especially oil imports) but this trend also significantly impacts manufacturing. The change is attributed especially to the increased importance of trade among countries with different factor endowments – i.e. with different levels of economic development and, subsequently, trade specialization. The available empirical studies have shown so far that the fears of globalization negatively impacting the labour market are groundless – the impact on the total employment seems to have the opposite effect. However, the impact on particular industries or skills should be examined, particularly in combination with their regional concentration.

In comparison to intra-industry trade, the development of inter-industry trade may be connected to higher adjustment costs incurred as a result of the affected industries within the EU losing their comparative advantage. The increased trade importance of China and India and the related change in industry specialization of their comparative advantage provokes fears in developed countries of decreased demand for *less skilled labour force,* followed by an increase in the unemployment rate of this particular group and a decrease in relative wages (increased income inequality). These fears may be substantiated in companies that relocate their activities to cheaper locations using to a large extent unskilled labour force (outsourcing), e.g. assembly of parts, and, on the other side, increase the extent of activities performed by skilled employees (technology development and design). Nevertheless, from a long-term perspective, it may be expected that Chinese tech-

[3] Differences in factor endowment mean that more developed countries show a relative redundant supply of quality-intensive factors – such as skilled workforce, high-technology – with the less developed countries tending to provide cheaper and less skilled workers and adapted, less demanding technology. Factor endowment thus directs industry specialization of production or competitive advantage of a particular country toward high or low tech products (economic activities).

[4] Inter-industry trade (IIT) is carried out among different industries. The opposite is the intra-industry trade when products are traded within the same industry (commodity group), either as final products (horizontal or vertical IIT) or in different processing stages (vertical IIT).

nology level will improve and this may result in a repeated change in the nature of trade with the EU countries, shifting from traditional (labour-intensive) products toward technology more sophisticated segments (in EU imports, the share of these segments has already increased significantly over the past five years).[5]

However, the impacts of globalization on the labour market need to be examined in a more comprehensive way, taking into account *static and dynamic effects* of the specialization development in the EU and its current less developed trade partners (including the linkages among these effects). The decrease in the demand for less skilled labour in manufacturing in the EU may be softened by its growth in the non-tradable sector (i.e. services). An important improvement in the educational attainment in developing countries may change the focus of their specialization (the sources of comparative advantage) in favour of quality more intensive activities. On the other hand, a higher external openness increases competition, supporting innovation performance. New technology requires higher skills, thus lowering the demand for less skilled labour. It also needs to be considered that among the various EU countries, there are significant (*structural*) *differences* in the labour market characteristics that may make the identification of globalization impact on unemployment and wages (groups with different qualification levels) more difficult. Nevertheless, this identification is necessary for corresponding adjustment of the related policies that condition their effectiveness. Initially, the position of Czech economy is assessed according to the structure and competitive advantage of foreign trade in respect to the position within the EU market, geographic concentration, industry specialization and quality characteristics of technology and factor intensities. A special attention is given to the influence of foreign investment on the position of Czech economy within the multinational value chain.

2.2. The Structure and Competitiveness of Foreign Trade

After the EU accession, the foreign *exchange of goods* in all the new members in Central and Eastern Europe became more intensive. However, the Czech Republic was the only country that had a positive trade balance in 2005 (Hungarian trade balance become positive in 2006). Also significant was the shift in the competitiveness reflected in the increased share of Czech exports in EU-27 im-

[5] The increase in the share of office equipment, telecommunication appliances, electric and electronic instruments in the total Chinese export is a result of a strong FDI inflow in the development of capital and technology intensive industries over the past five years. The main reason for this development is the transfer of the final (labour-intensive) stage from developed countries, with Chinese value added remaining relatively low. The increasing level of the local knowledge base in combination with a high FDI inflow will significantly speed up technology transfer, support the development of internal innovation capacities, thus contributing to narrowing the Chinese technology gap.

ports – reaching up to 2.7% compared to 1.4% in 1999. Rather than the actual EU accession itself, the international trade in the Czech Republic was more influenced by long-term structural changes related to the former FDI inflows with significant export-enhancing focus. FDIs also negatively affect the trade balance by importing investment goods and production components. In general, in the first stage of FDI, the pro-import influence is predominant, with exports growing gradually afterwards. In many cases, local manufacturers replace foreign component imports and further soften the influence of FDI on imports. Currently, the main investment importing stage has ended and the pro-export effect starts to become apparent.

2.3. Quality of Trade Structure

In terms of competitiveness within the global market, the position of any given country in the international trade needs to be considered, i.e. the *quality intensity of the value chain*. Comparative advantages and specializations of national economies have been traditionally perceived in terms of trade in final products or industry focus of exports. However, *territorial fragmentation* enables to locate production according to factor intensities of individual stages of the production chain rather than the average factor intensities of the final products. Due to their comparative advantage in the production of labour- or material-intensive components or the assembly of final products, less developed countries may therefore get more intensively involved in the international division of labour even when it comes to producing high-tech products. From 1995 the export structure of new (more developed) EU members shifted strongly in favour of *medium-high-tech* industries. This applies mostly to engineering, electric technologies and the production of transport vehicles. These industries are able compete in quality as documented by the current growth of export prices and the EU-15 market share (see e.g. Landesmann and Wörz, 2006).

The characteristics of specialization and geographic focus of trade linked to the intensity of integration into the multinational value chain have an important effect on the development of *intra-industry trade* (see Table 1). Within the multinational chain, products in different production stages are exchanged within the same industry. An increase in the intra-industry trade in manufacturing between 1995 and 2003 is apparent in the majority EU countries. In the Czech Republic, the major increase was recorded in high-tech industries, especially in the production of office equipment. On the other hand, the intra-industry trade in medium-high-tech industries was already high in 1995, and subsequently tended to gradually decrease.

T a b l e 1

The Development of Share of Intra-industry Trade in Manufacturing[6]

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Hungary	75.0	73.1	78.1	77.0	75.8	78.2	80.6	83.8	83.5
Czech Republic	74.1	79.7	80.6	82.3	80.1	79.5	81.5	83.3	83.0
Slovakia	..	..	74.9	75.3	75.5	74.3	77.2	78.2	76.8
Poland	62.4	61.4	61.0	60.4	61.4	68.5	72.0	74.1	75.6

Note: The share of inter-industry trade may be expressed as the difference between the above number and 100%.
Source: OECD, STAN Database (10. 5. 2007); own calculations.

Comparative industry advantage may be expressed as a *contribution to trade balance* where it is perceived as a net trade concept (including imports), see Table 2. In this concept, the total trade deficit is divided among commodities based on their share in the trade total. In 2005, the highest contribution in the Czech Republic came from the group of medium-high-tech industries, especially the automotive industry (its contribution is the highest of all industries). Between 1995 and 2005, the contribution of high-tech industries to trade balance relatively grew, yet it still remained negative, as was the case in the majority of EU countries (with the worst results in the production of TVs, radio and pharmaceutical products).

Between 1995 and 2005, the *export-import ratio of manufacturing* (relative trade balance) grew in the Czech Republic from 89% to 109%. This share is the highest in medium-high-tech industries, especially in machinery and transport vehicles. In these industries, the Czech Republic and Hungary have the highest export-import ratio of EU countries. Between 1995 and 2005, the export-import share in high-tech industries in the Czech Republic grew considerably, from 35% up to 85%.

T a b l e 2

Indicators of Comparative Advantage of the Czech Republic in Terms of Technology Intensity

	HT		MHT		MLT		LT	
	1995	2005	1995	2005	1995	2005	1995	2005
Contr. to trade balance	–5.3	–2.1	–1.9	3.3	4.2	– 0.9	3.0	–0.3
Export/import ratio	34.9	85.3	80.4	127.1	124.0	100.9	115.6	104.6

Note: Technology intensity in manufacturing: HT – high-tech, MHT – medium-high-tech, MLT – medium-low-tech, LT – low-tech.
Source: CZSO (30. 6. 2007).

[6] $IIT^{k}_{tot\ manuf.} = 100 \times \left\{1 - \left[\sum_i \left|\left(EXPO^{k}_{i} - IMPO^{k}_{i}\right)\right| \Big/ \sum_i \left(EXPO^{k}_{i} + IMPO^{k}_{i}\right)\right]\right\}$, where EXPO and IMPO are the total exports and imports of goods at current prices. The industrial breakdown used is based upon the International Standard Industrial Classification (ISIC) Revision 3.

Between 1995 – 2005, the relative trade to production indicators in the Czech Republic were growing (see Table 3). This applies both to the share of *export in production* and the *import penetration* indicator.[7] The share of export in production of the domestic manufacturing grew from 41% to 60%. Similarly, the import penetration grew from 44% to 58%. While the export/production ratio shows the importance of foreign trade for a given industry, the import penetration indicator expresses the share of imports in domestic demand, thus reflecting the competitiveness of local products against imported goods. Higher import penetration implies weaker competitiveness of the domestic products to the imported ones. High values of both indicators reflect the intensity of trade in intermediate goods.

T a b l e 3
Internationalization of Production and Trade in the Czech Republic Based on Technology Intensity

		Export share			Import penetration		
		1995	**2005**	**change**	**1995**	**2005**	**change**
Manufacturing		41	60	*19*	44	58	*14*
HT	Computers, office equipment	106	96	*-10*	101	95	*-6*
	Pharmaceuticals	34	60	*26*	63	82	*19*
	Aerospace	90	82	*-8*	87	91	*4*
	Electronics-communication	63	93	*30*	80	94	*14*
	Precision instruments	45	65	*20*	72	72	*0*
MHT	Electrical machinery	53	79	*26*	54	74	*20*
	Chemicals	79	72	*-7*	82	80	*-2*
	Other transport equipment	61	53	*-8*	47	44	*-3*
	Motor vehicles	57	71	*14*	56	57	*1*
	Machinery and equipment	49	92	*43*	61	91	*30*
MLT	Fabricated metal products	37	49	*12*	29	39	*10*
	Non-metallic mineral products	45	44	*-1*	27	29	*2*
	Petroleum refining	13	25	*12*	17	45	*28*
	Shipbuilding	97	73	*-24*	93	45	*-48*
	Rubber and plastics	52	50	*-2*	58	52	*-6*
	Basic metals	46	52	*6*	41	58	*17*
LT	Food, beverages, tobacco	12	18	*6*	14	22	*8*
	Textiles, clothing, leather	61	88	*27*	54	89	*35*
	Paper and printing	32	40	*8*	37	42	*5*
	Wood and furniture	43	32	*-11*	19	19	*0*
	Other manufacturing industry	38	63	*25*	32	50	*18*

Source: OECD, CZSO (30. 6. 2007); own calculations.

[7] Export share in production shows the importance of the foreign market for a given industry in a country. This indicator may change over time as supply and demand conditions change in foreign and domestic markets. Import penetration is defined as the proportion of a country's domestic consumption accounted for by imported goods. The import penetration rate is measured as the ratio between imports and domestic demand. It shows to what degree domestic demand D is satisfied by imports. Domestic demand (D) is measured as the sum of domestic consumption by households (C), investment demand by firms (I) and government consumption (G): $D = C + I + G$. Because total *GDP* (Y) is the sum of domestic consumption and net exports ($X - M$), ($Y = D + X - M$), domestic demand is also computed as $D = Y - (X - M)$. Hence, the import penetration rate equals $M/D = M/(Y - X + M)$.

The highest share of export in production in high-tech industries was recorded in 2005, reaching 87% in high-tech and 77% in medium-high-tech industries. Since 1995, the ratio has grown by 30 and 20 percentage points respectively, indicating a high increase in the importance of foreign markets for high-tech industries. The share of import in domestic demand for high-tech products between 1995 and 2005 grew from 79% to 88%. It also grew similarly in all other industries. When looking into details of individual industries with medium-high and high technology intensity, it is apparent that office equipment and machinery and equipment have the highest share of production for export (95%).

On the contrary, the share of production for export in low-tech industries is significantly lower when compared to high-tech industries. This is most apparent in the food industry, reaching approximately 18%. When compared internationally, the share of export in production for manufacturing in the Czech Republic was relatively high in 2005, significantly above the EU average. This share was higher in almost all industries, with the relatively highest difference in comparison to the EU average in medium-high-tech industries and engineering in particular.

2.4. Technology Intensity of Trade

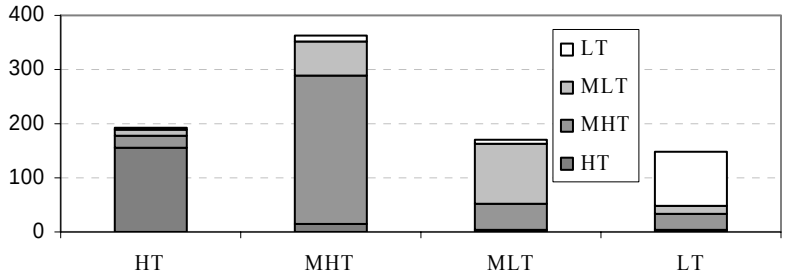
The analysis of trade in terms of technology intensity shows whether individual industries and their groups and the economy as a whole tend to import medium-low-tech products that are then transformed into products with a higher technology intensity or vice versa.[8] Figure 1 shows that high-tech products have the highest share in high-tech industry imports (more than 80%). This share is the highest for office equipment and computers, reaching approximately 95%, and the lowest for the pharmaceutical industry (approximately 50%). Additionally, these industries are known for their high import intensity of exports, exceeding 100% for some industries (this indicator is again lower for the pharmaceutical industry). The import to export ratio exceeding 100% may be caused by distorted prices during trading, a higher share of indirect exports or by import of investment goods.

When looking at the *detailed structure* of high-tech imports, the high share of assembly activities with very low domestic value added is clearly apparent. The

[8] For the analytical purposes, year 2003 was chosen since the product import and export matrixes structured according to industry and commodity classifications are available. It is the last year when the data from customs statistics were collected. After the Czech entry into the EU, the method of data collection has changed from customs declarations to statistic surveys. Even though the quality of data according to commodity classification remains quite high, the data concerning imports and exports for individual industries lose their documentary value as a result of a massive increase in indirect imports and exports (i.e. transactions through intermediaries).

high import-intensity of exports also means that even strong export performance of the given industries has basically no influence on the improvement of trade balance. Within the group of *medium high-tech industries,* the core of the Czech manufacturing, medium-high-tech products represent three quarters of imports, and 20% of imports fall in the medium-low and low-tech product category. The import intensity is lower than in the case of high-tech products (71% on average). The highest share of medium-low-tech products in exports, almost one quarter, is represented by the automotive industry. Therefore, this industry is located in a *higher stage* of the value chain. The import intensity of exports reaches only 67%. The automotive production has (in comparison to the volume of foreign trade) significantly positive influence on the trade balance total.

F i g u r e 1
Imports by Technology Intensity in the CR (2003, in mld CZK)



Note: HT – high-technology intensity, MHT – medium-high-tech, MLT – medium-low tech, LT – low-tech.
Source: CZSO, Database of foreign trade (1. 10. 2006); own calculations.

The *product approach* provides a more detailed analysis of the importance of high-tech industries in foreign trade. It defines technology intensive industries by three to five-digit codes of the SITC classification. As is apparent from the Table 4, between 1999 and 2005, the share of high-tech products in total exports almost doubled from 6.4% to 12.2%, followed by a slight decrease in 2004. IT exports increased tenfold, i.e. most significantly. Electronics and telecommunications were the second most important group of exported products, with approximately a quadruple increase.

The imports of high-tech products were growing more slowly and their share in the total goods imported grew from 12.4% to only 15.9% between 1999 and 2003. Then, similarly to exports, this share slightly decreased. The largest group of high-tech products is represented by electronics and telecommunications, followed by information technology (6.4% and 4.7% respectively of the imported goods total in 2003). More than 40% of the high-tech product value included the

processing trade in 2003. This means that the assembly took place in the Czech Republic and the completed products were reexported. This applies mainly to electronic parts and information technologies.

T a b l e 4

Export and Import of High-tech Products in the Czech Republic – Direct and Indirect (Processing) Trade Shares (%)

	Export				Import			
	direct		indirect		direct		indirect	
	1999	2005	1999	2005	1999	2005	1999	2005
Total high-tech	6.40	12.20	3.8	5.9	12.4	14.30	17.5	3.6
Aerospace	0.36	0.35	0.3	54.1	0.62	0.90	2.3	1.3
Comp., office equipment	0.87	6.18	1.6	2.0	2.84	4.53	16.5	2.1
Electronics, telecommun.	1.26	3.19	1.4	7.9	4.24	5.14	23.3	4.7
Pharmacy	0.26	0.17	0.0	0.1	0.84	0.69	0.1	0.0
Scientific instruments	0.51	0.77	0,3	9,0	1.32	1.27	13.0	4.0
Electrical machinery	1.50	0.61	0.2	3.0	0.58	0.44	64.9	16.4
Chemistry	0.38	0.20	0.0	1.5	0.68	0.70	12.1	3.7
Non-electrical machinery	0.98	0.57	20.1	11.0	1.19	0.58	5.3	3.5
Armament	0.31	0.13	2.7	0.2	0.06	0.06	2.9	0.0

Note: Shares of high-tech trade in total trade, shares of high-tech indirect trade in direct trade. Data on the total exports and exports after processing are not consistent. Indirect trade is defined as the part of foreign trade, which is only processed in the domestic economy and exported afterwards.

Source: CZSO, Database of foreign trade (1. 11. 2005); own calculations.

3. Internationalization of Research and Development

The benefits of FDI to the host economy and their role in economic and technology catch-ups may be differentiated as exogenous (short-term) and endogenous (medium to long-term). *Exogenous benefits* include transfers (improved and redirected production processes, new equipment and machinery, new products, capital imports, new production methods, new corporate functionalities) related to localized effects for foreign affiliates (an improved linkage between the costs and quality of products, increased production factor efficiency, accelerated upgrading and restructuring).

The subsequent development stage brings about *endogenous impacts* in terms of adoption of the knowledge transferred from the parent company to the foreign affiliates (technology, know-how, best practices) and diffusion of new processes and knowledge spillovers into the local companies. There are also indirect effects in the host economy (development of more complex activities with higher value added) as well as direct effects (vertical links to local suppliers and other producers, increased level of spillovers and diffusion of new processes). The

extent and intensity of spillovers are decisively influenced by the prevailing type of innovation strategies in the foreign affiliates especially distinctive in terms of motivation and intensity of internal research activities (see UNCTAD, 2006).

3.1. International Context

New EU members attract an increasing amount of investment in activities intensive in *higher skills* (e.g. precision engineering, design, research and development), often requiring upgrading of the existing equipment and leading to the focus on export-oriented manufacturing, especially in the automotive and engineering industries. New members have also seen an increasing amount of investment from EU-15 small and medium-size enterprises due to reducing political and economic risks after the enlargement. The main motives for investing in the new members have not changed much so far. These include high growth rates as well as favourable future forecasts (thus enabling market expansion), low unit labour costs (increasing efficiency), with the wages reaching one fifth of the EU-15 level with one third productivity,[9] lower corporate taxes (20% on average as compared to 31% in EU-15).[10] EU accession may also support improvement of the business environment (institutional framework).

On the other hand, investors in new members still perceive persisting risks (see the survey in Kearney, 2005). These include underdeveloped infrastructure, high level of corruption and inevitable weakening low-cost advantage as a result of the increasing average income level. Economic and social costs of adjusting to the proposed EU reforms may be significant. New regulatory restrictions at the Communities level may decrease relative tax or labour cost advantages of new members for foreign investors and redirect them further to East and South (including the latest EU enlargement to Romania and Bulgaria).

3.2. Fragmentation of Multinational Value Chain

The importance assigned to the (multinational) value chain structure reflects the position of EU members with less developed knowledge base combined with the strong presence of FDI business sector. While assessing the competitive advantage of these countries, the geographic fragmentation of the value chain must be considered, when different (qualitatively distinctive) segments are located in different countries. Less developed countries mostly host segments exploiting

[9] According to some estimates, the average wages in the new members will still be at 40 – 60% of the EU-15 level in 2020 (see UNCTAD, 2005, p. 87).

[10] The assessment of the tax burden must be more comprehensive and include other characteristics as well – e.g. the tax base, specific tax modes, see below.

the advantages of low cost inputs. Location in countries at a similar or higher level of knowledge development is more motivated by the access to specific assets (e.g. new technology).[11] The quality of factor endowment (factor intensity) together with the level of technology capacities thus affect the depth of trade specialization as well as the motivation for the FDI inflows as a (possibly) important source of technology transfer.

As to the value chain structure differentiated in terms of input quality intensity, the production segment is usually the least developed. It can be based on imported technology, employing the staff trained for simple operational tasks (e.g. automated assembly lines). On the other hand, the complete chain includes not just the production itself but also the R&D activities and other knowledge-intensive segments. However, they usually remain located in the home country of foreign investors where the knowledge base has already been appropriately developed.

The value chain fragmentation brings about a number of effects as to the *sources and direction of the competitive advantage*. As it has already been mentioned, the role of intra-industry trade becomes more significant. In this type of trade, similar products are exchanged, especially products in different production stages within multinational chains (as it is reflected in increasing volume of intra-company trade). If production costs increase, the pressure for moving labour-intensive segments into cheaper locations becomes stronger. Catching-up economy must therefore be able to replace them by activities that are more technology and skill intensive.

Such a transition, however, may be quite time and resource demanding. Specialization in *assembly of imported parts* (typical for countries with the advantage of relatively cheap labour force), even in industries classified as medium-high and high-technology intensive, has rather a very limited effect on technology capacity improvement in the host economy. The technology and skill intensities of these activities remain low, mostly not exceeding the averages in other industries. Their statistical export performance therefore do not as much reflects the ability to produce high-tech products but rather the specifics of (low-cost based) comparative advantage in the global production system. When foreign subsidiaries still develop their own R&D activities, the scope of knowledge spillovers in the host economy need to be assessed, as they are strongly affected

[11] International production theories examine the motivations leading companies to expand their activities abroad (i.e. answer questions how, where and when). The reasons are divided based on the advantages they seek (in the OLI paradigm), whether they are unique assets as an income source (ownership advantage), possibility to internalize advantages resulted from the undertaken transactions exploiting economies of scale (internationalization advantage) or by making advantage of a particular location (localization advantage).

by the linkages to the national innovation system and its key agents. These linkages mostly depend on a (relatively) small knowledge gap between domestic and foreign sectors, high level of human capital and the presence of technologically competent universities closely linked to the businesses.

3.3. Foreign Investment in Knowledge-intensive Activities

According to the World Investment Report (see UNCTAD, 2005), multinational companies dominate global R&D activities in both parent and host economies. Within the internationalization process, the newest trend is a fast increase in research activities of foreign subsidiaries in less developed countries in Asia and, to a lesser degree, in other regions, including the new EU members.

A survey conducted as a part of the *FDI Confidence Index* focused on location preferences of foreign investors in R&D, based on groups of countries and the most important decision-making factors. Almost a half of global investors (48%) plan to increase R&D expenditures within the next three years, with only 3% planning their decrease. Almost three quarters of these increased expenditures will be directed to emerging countries of Asia and Eastern Europe, especially from North America and Western Europe (thus negatively affecting their domestic R&D expenditures). Poland and Russia are considered the most attractive countries for R&D investments in Eastern Europe. From the global perspective, both China and India lead the chart, leaving others far behind. (More than 40% of respondents plan to invest in these two countries).

T a b l e 5

Shares of Foreign Investors Planning to Change Regional Focus of R&D Expenditures, 2005 (%)

	Asia (excl. Japan)	Eastern Europe	North America	Western Europe	Latin America	Japan	Mid. East, Africa
Increase	50	22	20	18	10	9	7
Decline	3	2	18	23	3	5	3

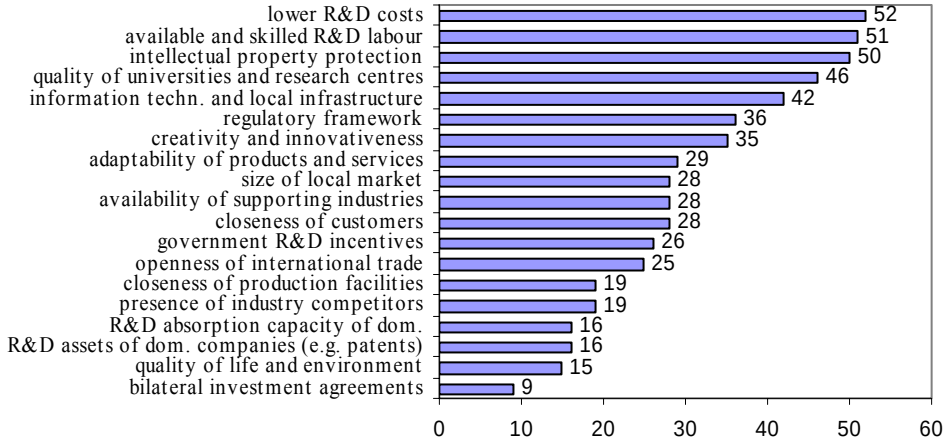
Source: Kearney (2005), p. 8.

Investors assess the factors affecting the location of research and development investments ranked according to their importance. More than half of them stress the following three: lower R&D costs, availability and quality of domestic workforce for R&D activities and a corresponding level of intellectual property protection.

Figure 2 shows the importance of individual determinants of R&D investment location factors.

F i g u r e 2

Determinants of Foreign Investment in R&D (2005,% of respondents)



Source: Kearney (2005), p. 9.

T a b l e 6

Position of the Czech Republic and the Key Determinants of its Innovation System

	R&D activities	CR	EU-27
R&D expenditure	R&D expenditure in% of GDP	1.42	1.84
	- Percentage financed by business sector	54.1	54.5
	- Percentage financed by government sector	40.9	34.8
	- Percentage financed by abroad	4.0	8.5
Human resources for R&D[1]	Number of researchers in% of employees	0.73	0.92
	Business sector	0.26	0.36
	Government sector	0.17	0.10
	Higher education sector	0.30	0.45
	Ph.D. graduates of science and technology fields[3]	0.6	0.6
Intersectoral linkages	Business R&D financed by government	15.2	10.6
	University R&D financed by businesses	0.6	6.7
	Government R&D financed by businesses	9.4	6.1
Scientific output	Scientific publications per 1000 inhabitants	0.646	1.021
Innovation output	Share of innovative companies	41.5	35.9
	Number of European Patent Office applications per mil. inhabitants	10.4	112.3
Venture capital in% of GDP[2]	Start-up stage	0.000	0.022
	Expansion stage	0.007	0.116
Environment	Intellectual property protection	3.9	4.8

Note: [1] Data for EU-25. [2] Data for EU-15 [3] Per 1,000 inhabitants aged 25 – 34. Data for the latest available year.

Source: EUROSTAT – Science and Technology Database, 16. 10. 2007; Kadeřábková et al. (2007).

In comparison with the EU average, the Czech Republic weaknesses in the key indicators of the *national innovation system* (see Table 6) include especially the availability of human resources for R&D, intensity of links between the

business sector and universities (and the intensity of their R&D activities) and in science and innovation output and the exploitation of venture capital. The relative expenditures on R&D as well as the protection of intellectual property are also lower.

3.4. Knowledge-intensive Activities of Foreign Companies

The importance of FDI subsidiaries for knowledge-intensive activities in the Czech Republic has been steadily increasing (see Table 7). By 2004 they had already reached almost one half of R&D expenditures of the business sector. Out of the total new patent applications submitted to the European Patent Office (EPO) by Czech inventors in 2002, 55% were owned by foreign entities, i.e. they were carried out at subsidiaries of foreign companies. Based on the structure of manufacturing FDI at the end of 2004, medium-low-tech industries tend to slightly prevail (52.3%). Foreign companies have a significant part in the trade in high-tech products.

T a b l e 7

The Role of FDI Sector in the Czech Republic Manufacturing Industry in Terms of Technology Intensity, 2002 (in% of total business sector)

	High	Medium-high	Medium-low	Low
Export	91.3	77.7	56.9	49.3
Import	88.0	84.5	48.5	64.1
Employment	47.0	41.3	26.0	20.9
Value added	48.8	52.3	35.8	42.3

Source: CNB, FDI Statistics; OECD – AFA Database, 1. 8. 2007.

The participation of foreign subsidiaries in R&D activities (see Table 8) is especially strong in manufacturing. The share of foreign subsidiaries in manufacturing R&D expenditures rose up to 65%, and up to 50% for researchers in 2004 (with the share in value added at 50%, and the share in employees at 33%). The share of foreign subsidiaries in R&D expenditures and the number of researchers are strongly industry-specific. The most apparent is the presence of foreign subsidiaries in the automotive industry (up to 95% of R&D expenditures and 83% or researchers in 2002) that belongs to the group of medium-high-tech industries. In this industry group, the R&D share of FDI companies significantly exceeds their share in value added.

When comparing the individual industries in terms of their *R&D intensity* in the Czech Republic, its still quite low level becomes apparent in international comparison, reaching only one third when compared to developed countries (see Table 9). The R&D intensity in the automotive industry (and, to a lesser degree in other transport equipment) comes at least closer to the value justifying its

classification as a medium-high-tech industry. The most extreme contrast between these two viewpoints is apparent in the office and computer equipment (classified as high-tech industries in developed countries), in respect to which the R&D intensity in the Czech Republic reaches the values comparable to food or wood industries. To conclude, we may say that in terms of R&D intensity there are yet no industries in the Czech Republic reaching high-tech intensity.

T a b l e 8

Business Sector R&D Expenditures (in CZK million), the Number of Researches (FTE) and the Share of Foreign Affiliates (FDI) in the Czech Republic (%)

	Expenditure				Researchers			
	2003		2005		2003		2005	
	total	affil.	total	affil.	total	affil.	total	affil.
Manufacturing	**12 513**	**59.0**	**17 145**	**66.1**	**3 440**	**43.5**	**5 070**	**43.1**
High technology	2 251	36.6	3 396	54.6	865	27.4	1 221	28.1
Medium high technology	8 430	73.4	11 176	76.7	2 024	56.2	3 054	54.5
Medium low technology	1 409	19.1	2 077	36.8	423	19.1	594	18.0
Low technology	423	25.1	496	29.2	128	32.0	201	34.6
Services	**7 055**	**24.9**	**9 324**	**28.2**	**3 088**	**16.1**	**5 162**	**20.9**
Knowledge intensive	6 077	21.3	8 565	26.0	2 761	15.4	4 922	20.4
High technology	4 942	19.5	6 775	24.6	2 292	13.0	3 919	25.6
R&D	3 257	7.2	4 267	9.7	1 563	4.2	2 098	7.2
Business services	697	45.9	1 054	31.5	267	46.1	492	41.1
Financial services	25	36.0	284	77.5	4	50.0	48	24.2

Source: Czech Statistical Office, R&D Statistics Database.

Based on the *actual R&D intensity*, only pharmaceutical industry and the aforementioned automotive industry and possibly other transport appliances could be placed in the medium-high-tech group in the Czech Republic. All other manufacturing industries fall under the medium-low or low-tech category. In this adjusted definition of technology groups, the share of medium-high and high-tech industries in Czech exports would reach only 18.6% in 2003 (in comparison with the reported value of 59.4%).

According to the survey on *innovation activities* for the period of 2002 – 2003, 41% of foreign subsidiaries (companies located in the Czech Republic with the HQ abroad) carry out innovation activities as compared to 24% of Czech companies (see Table10). In comparison to innovation performance of the total sample, foreign subsidiaries show up higher values in manufacturing, especially then in the food industry, rubber and plastics, electrical and optical appliances. As for services, innovation results of foreign subsidiaries are significantly better in all industries. However, innovation intensity in foreign subsidiaries is only slightly higher compared to the total sample.

T a b l e 9

Structure of Manufacturing Export and the R&D Intensity of Value Added, the Share of Foreign Affiliates in Value Added and in R&D Expenditures in the Czech Republic (%)

Technology intensity		NACE	Export 2003		R&D intensity 2002		Foreign affil. 2002	
			CZ	EU	OECD	CZ	V.add.	R&D
High	Aerospace and aircraft	353	0.4	3.2	27.5	..	..	1.5
	Pharmaceuticals	244	0.8	5.6	25.8	9.2	..	46.1
	Computers, office equipment	30	6.6	4.0	15.1	0.1	79.7	0.0
	Electronics-communication	32	5.2	5.6	22.4	3.6	65.8	50.2
	Precision instruments	33	1.7	3.5	11.9	2.5	33.6	30.3
Med-high	Electrical machinery	31	9.2	4.3	6.7	1.3	48.8	34.7
	Motor vehicles	34	16.8	14.8	11.7	9.5	83.8	94.8
	Chemicals excl. pharmaceut.	24	4.7	10.5	7.1	2.2	38.8	41.0
	Other transport equipment	35	1.0	0.6	7.9	4.2	25.1	4.2
	Machinery and equipment	29	13.0	11.5	5.3	2.6	27.3	30.6
Med-low	Petroleum refining	23	1.1	2.6	2.7	..	..	..
	Rubber and plastics	25	5.2	3.3	3.0	0.9	57.7	20.8
	Non-metallic min. products	26	4.3	1.8	1.3	1.1	47.8	23.9
	Shipbuilding	351	0.0	0.7	2.9	..	..	..
	Metal products	27-28	12.2	7.5	1.4	0.5	21.5	11.6
Low	Other manufactur. industry	36 – 37	4.0	2.8	1.2	0.3	27.4	9.8
	Paper and printing	20 – 22	5.3	4.9	0.3	0.1	31.1	25.3
	Food, beverages, tobacco	15 – 16	2.9	7.1	1.0	0.1	43.9	39.3
	Textiles, clothing, leather	17 – 19	5.6	5.9	1.0	0.7	22.1	26.3
Manufacturing		15 – 37	100.0	100.0	6.5	2.2	41.4	59.0

Notes: R&D intensity for OECD expressed by the median for 12 developed members in 1999.

Source: OECD (2005), p. 182, 207 – 208; CZSO – Science and technology indicators (2004), p. 269 (updated at 1. 8. 2006); OECD – AFA Database, 1. 11. 2006 (modified).

T a b l e 10

Shares of Technically Innovative Companies (TINNO), Non-technically Innovative Companies (NINNO), and Innovation Intensity (INT) in the Czech Republic, 2003 – 2005

	Total			Foreign affiliates		
	TINNO	NINNO	INT	TINNO	NINNO	INT
Total	38.3	43.7	3.3	56.9	60.6	3.6
Manufacturing	**48.8**	**49.0**	**3.8**	**62.5**	**63.1**	**3.1**
Food, beverages, tobacco	53.3	50.8	3.1	79.4	88.2	1.3
Textiles, clothing, leather	33.2	38.6	3.0	37.9	41.4	2.4
Paper and printing	36.1	40.5	2.8	44.7	44.7	2.3
Petroleum refining, chemicals	67.9	64.2	2.3	81.1	75.7	2.6
Rubber and plastics	54.1	55.4	2.4	61.3	69.9	2.5
Metal products	48.4	47.6	1.4	57.5	52.5	1.0
Machinery and equipment	66.0	61.3	3.5	74.1	75.9	3.7
Precision, optical and electrical instruments	54.3	48.9	4.0	65.0	59.1	3.7
Motor vehicles	55.7	54.9	5.3	63.6	63.6	5.6
Furniture, other manufacturing	31.8	41.4	3.0	50.0	69.2	1.9
Services	**31.0**	**40.2**	**2.5**	**51.5**	**57.3**	**3.5**
Wholesale and retail	26.1	39.0	0.8	43.5	56.5	0.1
Transport, telecommunications	35.0	44.3	2.9	53.1	67.2	4.9
Finance and insurance	60.8	61.5	2.4	71.0	63.8	2.8
Data processing and related activities	63.2	60.7	14.7	68.4	68.4	9.8
Research and development	70.0	56.7	30.7	50.0	33.3	33.0

Note: Innovation intensity (INT) is defined as the share of innovation expenditure in total sales.

Source: CZSO (2006).

Conclusions

In terms of structural globalization characteristics, the export dynamics to the EU countries have increased significantly over the last few years following strong inflows of foreign direct investment to the Czech Republic. At the same time, the export structure has been changing as well, with engineering, and the automotive industry especially, gaining an ever increasing share. Pro-export effect of foreign investments started to prevail over the influence of imports of investment goods in the first stage of the FDI life cycle. The strong geographical concentration of trade on Germany may present a potential trade balance problem, as may product over-specialization in industries related to automotive production. Within EU-15 imports, machinery and transport vehicles are dominant, while the imports from the new EU members include predominantly products with lower technology intensity.

Within the last ten years, the trade structure of new EU members, including the Czech Republic, has shifted significantly in favour of technology more intensive products that represent approximately 60% of total exports to EU countries. Medium-high-tech industries (especially the automotive industry) have the highest contribution toward trade balance, with the contribution of high-tech industries still being negative, though gradually improving. These industry groups have also the highest share of products for export. However, since the predominant part of the production is assembly-based, value added remains relatively low (especially in the office and computer equipment).

The importance of foreign companies in the total R&D expenditures has been recently significantly growing especially due to changes in the ownership structure of large companies. The share of value added in knowledge-based activities still remains relatively low when compared to developed countries, both in terms of R&D intensity and quality-intensity of employment, a fact that is also reflected in low economic performance achievements (especially in production). This is predominantly the case of the industries that are traditionally classified as high-tech. The combination of a high level of foreign direct investments and the low quality of value chain requires an intensive policy support expanding the supply of domestic knowledge-intensive inputs and developing infrastructure of the national innovation system.

In terms of foreign direct investments in R&D activities, the region of Central and Eastern Europe receives very positive ratings by investors, with almost one quarter expecting an increase in R&D expenditures (however, for Asian countries almost one half expect this development). As far as the location determinants for R&D expenditures are concerned, the Czech Republic lags behind especially in the availability of human resources for research, in the intensity of linkages between

the business sector and universities, the level of scientific and innovation output and in exploitation of venture capital. Foreign companies in the Czech Republic play an increasingly important role in knowledge-intensive activities, covering almost a half of business sector R&D expenditures, with this share growing up to 65% in manufacturing (yet in services it is less than one fourth).

References

[1] A. T. Kearney/Foreign Policy (2005): The Globalization Index. A. T. Kearney & Foreign Policy <www.atkearney.com, www.foreignpolicy.com>.

[2] ARNDT, S. W. – KIERZKOWSKI, H. (eds.): Fragmentation: New Production Patterns in the World Economy. Oxford: Oxford University Press 2001.

[3] CNB (2002 – 2006): Statistics of Foreign Direct Investment. Prague: Czech National Bank.

[4] CZSO (2005 – 2006): Databases – Annual National Accounts, Regional Accounts, Foreign Trade, R&D Expenditure. Prague: Czech Statistical Office.

[5] CZSO (2006): Innovation in the Czech Republic. Prague: Czech Statistical Office.

[6] DUNNING, J. H. (1981): Explaining the International Direct Investment Position of Countries: Towards a Dynamic or Developmental Approach. Weltwirtschaftliches Archiv, *119*, No. 1, pp. 30 – 64.

[7] EC (2005): European Innovation Scoreboard. Brussels: European Commission.

[8] EUROSTAT (2005 – 2007): Databases COMEXT, Science and Technology. Luxembourg: Eurostat.

[9] HOLLANDERS, H. – ARUNDEL, A. (2005): European Sector Innovation Scoreboards, TrendChart. Brussels: European Commission.

[10] JONES, R. W. (2000): Globalization and the Theory of Input Trade. Cambridge, MA: MIT Presss.

[11] KADEŘÁBKOVÁ, A. (2004): Challenges for Entrepreneurship – Innovation and Education. Prague: Linde Publ.

[12] KADEŘÁBKOVÁ, A. (2005): Quality-intensity of the Czech Economy in International Comparison. Prague: National Training Fund.

[13] KADEŘÁBKOVÁ, A. (2006): The Czech Republic in Globalized and Knowledge-Based Economy. [Working Paper, No. 11/2006.] Prague: Centre for Economic Studies.

[14] KADEŘÁBKOVÁ et al. (2007): Competitiveness Yearbook of the Czech Republic. Prague: Linde Publ.

[15] LANDESMANN, M. – WORZ, J. (2006): CEEC's Competitiveness in the Global Context. Vienna: WIIW Research Reports.

[16] OECD (2005): Communications Outlook. Paris: OECD.

[17] OECD (2005a): Science, Technology and Industry Scoreboard 2005. Paris: OECD.

[18] OECD (2006): Information Technology Outlook 2006. Paris: OECD.

[19] OECD (2006a): Science, Technology and Industry Outlook 2006. Paris: OECD.

[20] ROJÍČEK, M. (2006): Structural Analysis of the Czech Economy. [Working Paper, No. 1/2006.] Prague: Centre for Economic Studies.

[21] UNCTAD (2005, 2006): World Investment Report 2005, 2006. New York: UNCTAD.

[22] WEF (2006): Global Competitiveness Report 2006 – 2007. London: Palgrave-Macmillan.