GREEN PAPER

ON RESEARCH, DEVELOPMENT AND INNOVATION IN THE CZECH REPUBLIC

ANALYTICAL PART

Karel Klusáček (project manager), Zdeněk Kučera, Michal Pazour

TECHNOLOGY CENTRE AS CR

Technology Centre of the Academy of Sciences of the Czech Republic
Prague, 2008

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1. Introduction – Green Paper on research, development and innovation in the Czech Republic

The policy of research, development and innovation in the Czech Republic is currently defined by the National Research and Development Policy of the Czech Republic for 2004 – 2008 (NPR&D), the National Innovation Policy of the Czech Republic for 2005 – 2010 (NIP), the Long-term Principle Research Directions (LPRD) and other general strategic documents, e.g. Strategy for Economic Growth or the National Reform Programme of the Czech Republic.

The Czech Republic has been advancing towards a knowledge based economy since 2004, when the basic conceptual documents were formed for the research and innovation policy of the Czech Republic (NPR&D and NIP). Resources from the EU Structural Funds for the period 2007 – 2013 provide an opportunity for a further shift in the transformation of the Czech Republic from a labour intensive to a knowledge intensive economy, which could further stimulate research and innovation activity in the Czech Republic. The changing conditions influence research, development and innovation policies which will form a mid-term strategic framework for the orientation of research, development and innovation in years to come.

Several minor background studies and analyses that tackle the issues of research, development and innovation have been worked out in the Czech Republic. So far, however, no broad analytical or conception work has been performed which would comprehensively assess the state of research, development and innovation in the Czech Republic and by involving wider professional public would lead to a document identifying necessary measures to be taken to increase competitiveness of the Czech Republic through intensive utilization of knowledge achieved by research and development.

The main objective of the Green Paper is to provide a comprehensive evaluation of the situation regarding research, development and innovation in the Czech Republic in an international context to initiate a wider national professional discussion in key thematic areas. For this discussion the Green Paper formulates a range of questions and themes which will lead to the preparation of a White Paper on Research, Development and Innovation in the Czech Republic. The White Paper will contain measures proposed to remove barriers to developing innovation based competitiveness of the Czech Republic and will form a resource for decision-makers and create a basis for strategic documents on research, development and innovation including the aforementioned policies. The Green Paper on research, development and innovation in the Czech Republic is divided in to two parts – a text part and an analytical part.

2. How to read the analytical part of the Green Paper

The main objective of the analytical part of the Green Paper contained in this document is to evaluate the situation in the Czech Republic in the field of a knowledge based economy in a wider context. The structure of the chapters of the analytical part of the Green Paper roughly corresponds to the structuring of the text part of the Green Paper. In the first block is assessed the macroeconomic efficiency, competitiveness and innovation efficiency of the Czech Republic (in the Macroeconomic framework block). Then there is an analysis of the inputs for research, development and innovation (human resources for research, development and innovation and funding of research, development and innovation) and the last block evaluates the outputs of R&D and innovation (publication and patent activity and innovation in the business sector). The conclusion of the analytical part of the Green Paper includes comments on the methodology, the classifications used, a list of abbreviations, and a list of data sources used.

Each block illustrates the most relevant statistical data using graphs and tables. Then there are text blocks which evaluate the situation in the Czech Republic in the given area and also other information and wider implications which are not clear from the graphs or tables.

The analysis is based on the information sources available at the time of elaborating the Green Paper at the end of 2007. Even though statistical data for Czech Republic in the research and development area was available from CZSO up to 2006, data for most European countries in international databases (e.g. Eurostat and OECD) was available only up to 2005 and in certain cases only up until 2004 (in particular data from the EU-15 and EU-25). For this reason it was not possible in most cases to compare the latest data on the Czech Republic with other countries and therefore the data for the Czech Republic from 2006 is often compared in the text with data for other countries from 2005 (or 2004).

The analytical part of the Green Paper is linked electronically with the text part of the Green Paper using hypertext links. In order for the links to work properly it is necessary to have both files (e.g. the text of the Green Paper and the analytical annex) located in the same directory (with an arbitrary title). The hypertext links are used in a similar way to those in an Internet browser. A more detailed description of how they work is included in the text part of the Green Paper.

3. Current position of the Czech Republic in the area of knowledge based economy

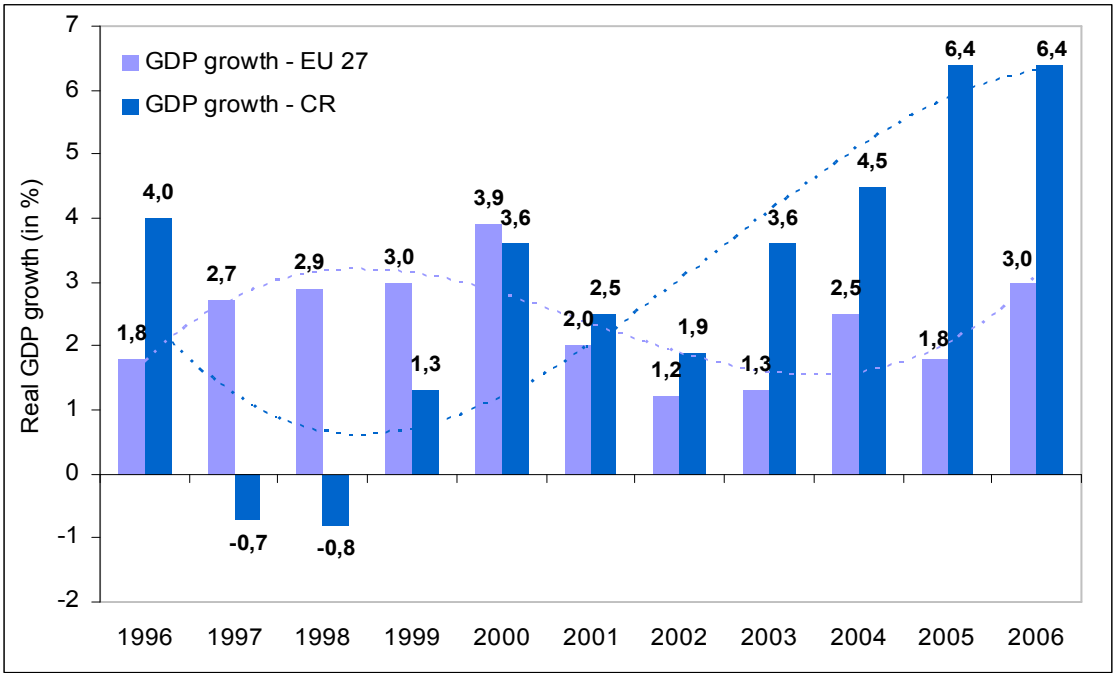
Back: Content Back: Green Paper – Macroeconomic efficiency of the Czech Republic

3.1 MACROECONOMIC FRAMEWORK

3.1.1 Macroeconomic efficiency

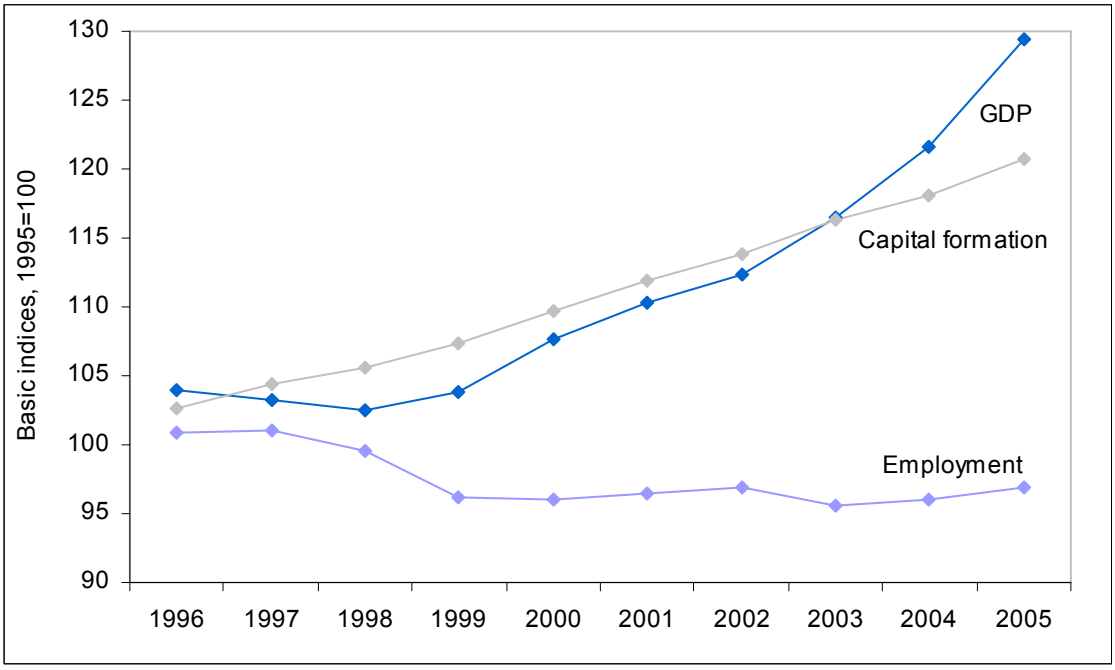
3.1.1.1 Sources of growth in the Czech economy

Growth of real GDP in the Czech Republic and EU-27



Source: Eurostat – New Cronos, our own calculations

Development of individual GDP growth factors in the Czech Republic (basic indices, 1995 = 100)



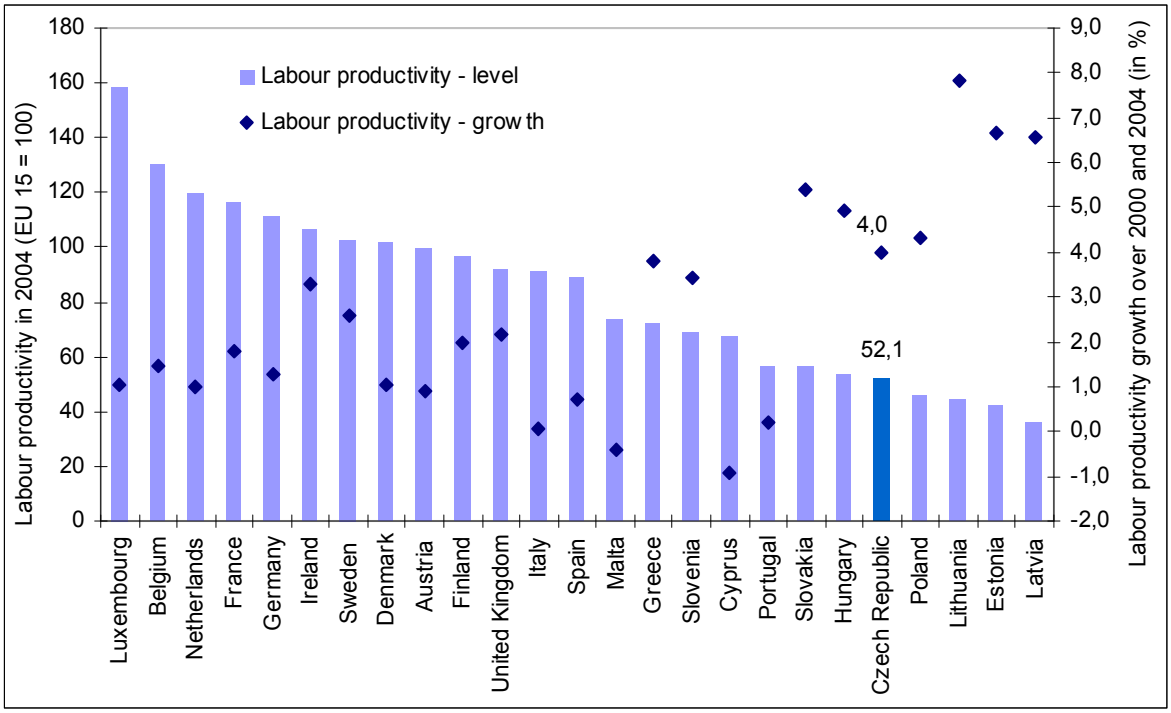
Source: CSO – National accounts, our own calculations

Analysis, comments and other information:

- The Czech economy has gained an assertive tempo in the **growth of real GDP since 1999** with the dynamics over the past few years accelerating to 6.4 % between 2005 and 2006. In comparison with the growth of the European economy, the Czech Republic is growing at an above-average rate which is positively reflected in the real convergence of the Czech economy with the EU-27 average.
- From the point of view of the **economic cycle**, the Czech economy featured a disharmonic development in comparison with the EU-27. Whereas the European economy grew between 1996 and 2000, the Czech economy found itself in a depression after the currency crisis of 1997. In contrast, during the decrease in the pace of European growth between 2000 and 2003 there was a revitalization and acceleration of economic growth in the Czech Republic. From the point of view of future development (even in connection with the adoption of a single monetary policy) this contradictory economic cycle presents a threat to the Czech economy.
- The source of the economic growth of the Czech Republic is the **increase in capital stock**, which increased by more than 20 % between 1995 and 2005. The dynamics of capital formation is stable without any large fluctuations over time.
- In contrast to the period between 1995 and 2005, there was a gradual **reduction in employment** mainly due to the restructuralization of the Czech economy. The greatest decrease in employment took place during the economic depression (1998 and 1999) which then stopped and more recently the employment has grown back to the values prior to 1995. The decrease in employment and slow stabilization of this development probably reflects the low **flexibility of the labour market** connected to low mobility of the labour force. In the future a gradual increase in employment is expected in particular in relation to the inflow of foreign investment.

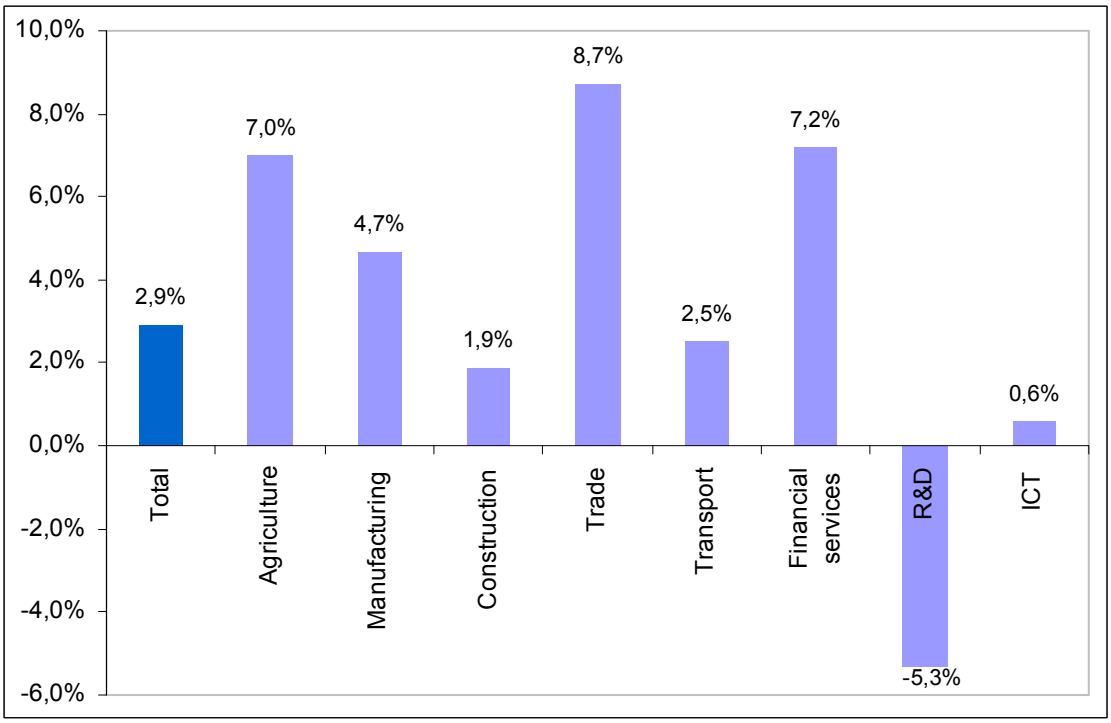
3.1.1.2 Labour productivity

Level and dynamics of labour productivity (recalculated based on purchasing power standard, PPS)



Source: Eurostat – New Cronos, our own calculations

Average annual increase in labour productivity in various sectors of the Czech economy between 1995 and 2004



Source: EU KLEMS Database, March 2007, http://www.euklems.net, our own calculations

Analysis, comments and other information:

- **Labour productivity** in the Czech Republic reached only approx. 52% of the EU-15 average (in purchasing power standard, PPS). The Czech Republic reached this level after a gradual increase from approx. 45 % of the EU-15 average in 1995.
- The labour productivity growth in the Czech Republic between 2000 and 2004, with an average annual increase of 4 %, overtook the dynamics of economically advanced EU countries. This growth was low, however, in comparison with the countries that joined the EU together with the Czech Republic.
- Between 1995 and 2004, labour productivity increased on average 2.9 % annually. From a **sectoral point of view** this growth in labour productivity was mainly due to a dynamic increase in labour productivity in trade (8.7 % annually), financial services (7.2 % annually), agriculture (7.0% annually) and manufacturing industry (4.7 % annually). In contrast, a slower increase in labour productivity was recorded in knowledge intensive services, e.g. in ICT (0.6 % annually) and in research and development (average annual decrease of 5.3 %).
- The low annual increase in labour productivity in **information and communication technologies** was mainly due to the dynamic increase in employment in this sector over the last 10 years. The high increase in value added in this sector was not reflected so much in the corresponding growth in labour productivity. In contrast, the decrease in labour productivity in **research and development** was due to a decrease in value added. The value added created in research and development in 2004 was by 40 % lower in comparison with 1995.

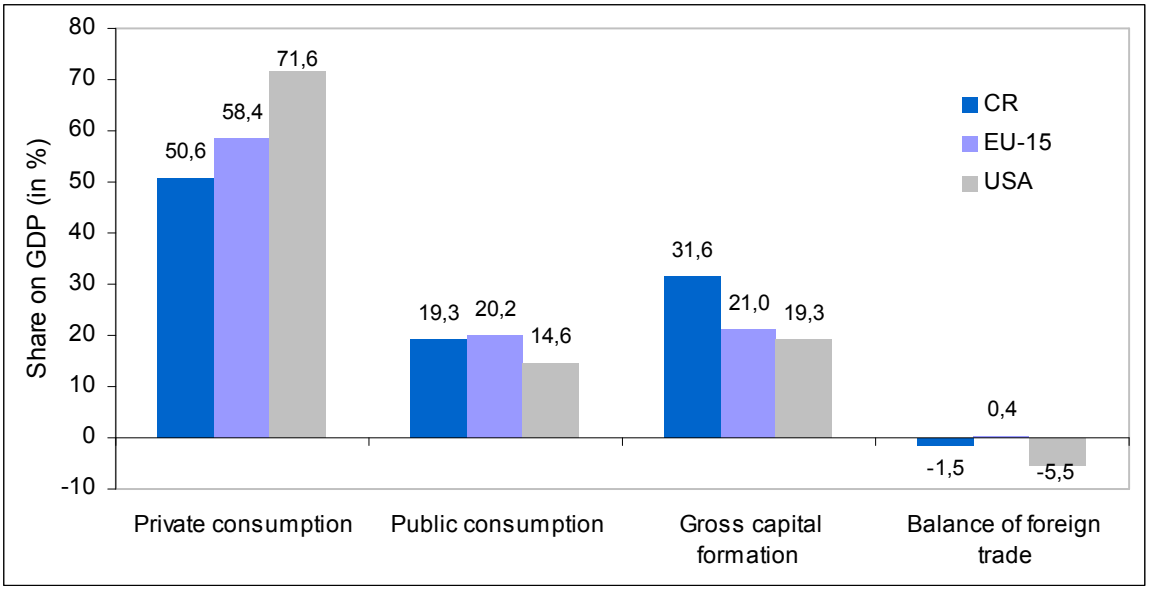
3.1.1.3 Domestic and foreign demand

Share of individual components of GDP (in %)

	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Private consumption	43.6	49.6	51.5	53.0	52.9	53.6	52.5	52.3	52.6	54.0	53.3	51.4	50.6
Public consumption	25.6	21.7	20.6	21.3	21.1	21.6	21.1	21.3	22.3	23.2	21.6	20.5	19.3
Gross capital formation	20.9	29.8	31.9	29.4	28.9	27.6	29.5	30.7	31.5	30.1	31.4	29.9	31.6
Balance of foreign trade	9.9	-1.2	-4.0	-3.6	-3.0	-2.8	-3.0	-4.3	-6.4	-7.2	-6.2	-1.7	-1.5
Export	*32.1*	*44.2*	*44.6*	*48.6*	*54.0*	*56.2*	*63.4*	*68.8*	*69.0*	*71.7*	*83.5*	*86.4*	*93.3*
Import	*22.2*	*45.3*	*48.6*	*52.3*	*57.0*	*59.1*	*66.4*	*73.1*	*75.4*	*78.9*	*89.7*	*88.1*	*94.8*

Source: AMECO

Comparison of the share of individual components of GDP (2006)



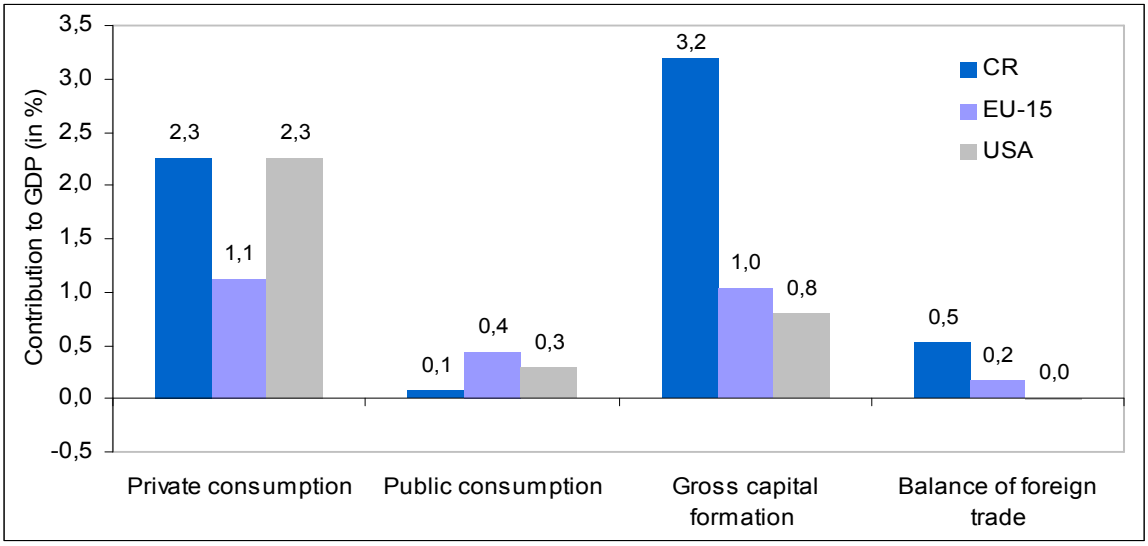
Source: AMECO

Contributions of the individual components of expenditure to the increase in GDP (in %)

	1991	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Private consumption	-10.6	3.0	4.3	1.1	-0.4	1.4	0.7	1.1	1.1	3.1	1.3	1.4	2.3
Public consumption	-2.9	-0.9	-0.2	0.6	-0.3	0.7	0.1	0.8	1.4	1.6	-0.7	0.2	0.1
Gross capital formation	-8.2	6.6	3.8	-2.8	-0.6	-1.0	2.9	2.0	1.4	-0.4	2.2	0.4	3.2
Domestic absorption	**-21.6**	**8.6**	**7.9**	**-1.1**	**-1.4**	**1.1**	**3.7**	**3.9**	**3.9**	**4.2**	**2.8**	**2.1**	**5.5**
Balance of foreign trade	10.0	-2.7	-3.9	0.4	0.6	0.2	0.0	-1.4	-2.0	-0.6	1.4	4.0	0.5

Source: AMECO

Comparison of the contributions of components of expenditure to the increase in GDP –2006



Source: AMECO

Analysis, comments and other information:

- The Czech Republic has recorded a gradual **increase in expenditures on private consumption** and at the same time a decrease in expenditures on public consumption since 1991. This development relates to the gradual limitation of the influence of the government sector on the functioning of the Czech economy. The share of total consumption in the expenditure on GDP since 1991 increased almost to 70 % in 2006 and the highest share of GDP was recorded in 2003 (more than 77 %).
- **Gross capital formation**, which includes capital investment and changes in inventories, contributed almost 32% to the expenditure on GDP. This result indicates that significant investment activity in the Czech Republic creates the potential for stable economic development.
- The Czech Republic is characterized by a negative balance of foreign trade. The development of the share of exports and imports on GDP shows that the Czech Republic recorded a significant **increase in foreign trade** related to the increase in openness of the Czech economy. Whereas in 1995 the volume of exports and imports made up approx. 45 % of GDP, exports and imports reached almost 95 % of GDP in 2006. The increase in the volume of exports indicates that Czech businesses are able to assert themselves on foreign markets and compete with foreign businesses.
- A comparison of the **structure of expenditure on GDP in the Czech Republic**, EU-15 and USA shows that in the Czech Republic there is still room for an increase in the share of private consumption, even if we cannot assume that the Czech Republic will meet the extreme levels in the share of private consumption on GDP reached by the USA.
- The relatively **high level of investment** in the Czech Republic, which is reflected in the share of the gross capital formation on GDP, significantly distinguish the Czech structure of expenditure on GDP from the EU-15 and USA where this share is approx. 20 %. In the future we can assume that an increase in the share of private consumption in the Czech Republic will lead to a decrease in the share of the gross capital formation.
- **Total domestic absorption** (private consumption, public consumption, gross fixed capital formation and changes in inventories) plays a key role in the growth of GDP on the demand side. Between 1995 and 2006, domestic absorption contributed by 3.4 % to the average annual increase in GDP. Domestic absorption had the most significant influence on the increase in GDP in 2006, which merited a y-o-y increase in GDP of 5.5%.
- **Private consumption and the gross capital formation** have the most significant influence on the increase in GDP**.** In the period between 1995 and 2006, private consumption contributed to an average annual increase in GDP of approx. 1.7% and the gross capital formation increased GDP on average by 1.5 % annually.
- **Foreign demand contributed to the growth** of GDP in particular in 2005 when the tempo of the growth of GDP increased by 4.0 % due to a significant decrease in the foreign trade deficit.
- In an international comparison with advanced EU-15 countries and the USA it is clear that there is a **significantly greater contribution of the gross capital formation** to the growth of GDP in the Czech Republic. Whereas in 2006, the gross capital formation increased to GDP by 3.2 % in the Czech Republic, in the USA this was only 0.8 %. This development represents a good assumption for the competitiveness of Czech businesses on foreign markets (increasing their capital endowment) and for the stabile and sustainable growth of the Czech economy.
- The influence of **public consumption on the** increase in GDP is lower in the Czech Republic than in EU-15 countries and the USA mainly due to persistent limitations in public consumption to the benefit of other components of domestic demand.

3.1.1.4 Structural aspects of the development of the Czech economy

Share of individual sectors of the Czech economy on value added creation (in %)

	Primary sector		Manufacturing industry		Network sectors and construction		Market services		Other services	
	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004
Austria	3.1	2.3	19.3	19.9	10.7	10.0	44.1	47.3	22.8	20.5
Belgium	1.7	1.2	20.2	17.4	7.9	7.0	47.5	50.9	22.7	23.5
Cyprus	5.6	4.5	11.3	6.2	10.5	10.6	52.2	53.8	20.4	24.9
CR	**7.2**	**4.7**	**24.3**	**25.6**	**11.8**	**10.4**	**41.2**	**41.9**	**15.5**	**17.5**
Denmark	4.3	4.9	17.1	14.5	7.1	7.4	44.5	45.5	26.9	27.7
Spain	5.8	3.8	20.1	16.3	10.2	12.6	42.9	46.6	21.0	20.8
Estonia	9.0	4.9	19.2	17.1	9.9	10.0	45.0	51.2	17.0	16.9
Finland	4.7	3.3	25.3	23.5	7.2	7.8	39.6	43.5	23.2	22.0
France	3.7	2.6	16.6	13.8	8.0	7.3	47.0	50.8	24.8	25.5
Germany	1.9	1.4	22.6	22.6	8.9	6.1	44.4	47.2	22.2	22.7
Greece	10.5	6.3	13.0	10.7	8.8	10.1	48.1	51.6	19.7	21.3
Hungary	7.3	4.1	22.3	22.5	8.5	8.1	39.6	41.3	22.3	23.9
Ireland	7.8	2.9	30.1	27.0	7.1	10.1	34.6	41.4	20.3	18.6
Italy	3.8	2.9	22.2	19.0	7.5	7.9	46.6	49.7	19.8	20.5
Lithuania	11.8	6.4	19.9	20.9	12.5	11.7	39.6	44.3	16.2	16.7
Luxemburg	1.2	0.7	13.7	9.4	7.9	7.2	60.6	64.9	16.7	17.8
Latvia	9.2	4.7	20.7	13.2	9.5	8.8	40.4	54.2	20.2	19.1
Malta	3.0	2.8	22.3	17.8	6.9	5.9	46.1	46.2	21.7	27.2
Holland	6.2	4.8	17.4	14.0	7.2	7.3	45.9	49.2	23.2	24.7
Poland	11.7	7.7	21.1	19.2	10.3	9.1	38.3	44.8	18.6	19.2
Portugal	6.3	3.6	18.6	15.7	9.3	9.0	44.1	45.7	21.7	26.0
Slovakia	7.0	5.1	26.8	23.6	10.0	11.2	42.0	44.4	14.3	15.7
Slovenia	5.2	3.3	26.4	25.7	7.9	8.7	40.8	41.9	19.7	20.5
Sweden	3.1	2.1	22.3	19.7	7.6	7.3	43.0	45.0	24.0	25.9
UK	4.4	3.0	21.3	13.7	7.5	7.8	44.7	51.9	22.1	23.6
EU-25	**3.2**	**2.3**	**19.2**	**18.3**	**9.1**	**8.3**	**44.1**	**46.2**	**24.3**	**24.8**

Source: EU KLEMS Database, March 2007, http://www.euklems.net, our own calculations

Share of the individual sectors of the Czech economy on employment (in %)

	Primary sector		Manufacturing industry		Network sectors and construction		Market services		Other services	
	1995	2004	1995	2004	1995	2004	1995	2004	1995	2004
Austria	1.3	1.2	21.2	18.2	9.9	8.3	39.3	42.7	28.3	29.6
Belgium	0.8	0.8	20.5	16.7	6.8	6.1	36.2	39.1	35.7	37.3
Cyprus	4.9	2.7	16.5	11.1	10.8	11.1	43.6	44.3	24.2	30.9
CR	**8.1**	**5.1**	**29.4**	**30.1**	**10.9**	**8.4**	**30.7**	**32.8**	**20.8**	**23.6**
Denmark	2.2	1.9	19.4	15.5	6.1	6.1	35.5	39.2	36.7	37.3
Spain	3.9	3.5	20.7	17.7	10.4	13.7	31.3	33.7	33.7	31.4
Estonia	9.4	5.2	25.8	25.0	8.0	9.4	30.9	32.0	25.9	28.4
Finland	2.3	1.9	22.3	19.8	6.6	7.0	32.5	34.8	36.3	36.4
France	1.9	1.7	17.4	14.3	6.9	6.6	38.0	41.6	35.7	35.7
Germany	2.0	1.6	23.9	21.1	9.6	6.1	35.1	40.2	29.2	30.9
Greece	5.5	3.5	19.7	15.8	10.2	11.4	29.2	31.1	35.4	38.2
Hungary	6.1	4.2	24.5	25.0	8.5	8.8	28.6	32.2	32.2	29.8
Ireland	3.1	1.9	23.7	16.6	8.1	11.2	34.5	40.1	30.6	30.1
Italy	4.1	2.8	26.2	23.3	7.0	7.2	28.0	32.2	34.6	34.5
Lithuania	10.6	4.6	23.8	20.9	10.9	11.8	25.4	31.1	29.3	31.5
Luxemburg	0.8	0.5	16.4	11.5	12.4	10.6	47.3	53.4	23.1	24.0
Latvia	9.4	5.7	23.4	17.8	7.3	10.7	29.4	37.4	30.4	28.4
Malta	2.1	1.9	24.4	17.9	9.7	8.8	36.2	40.9	27.6	30.6
Holland	1.9	1.9	16.1	12.7	6.7	5.8	44.8	47.3	30.4	32.4
Poland	6.3	3.8	28.3	24.6	9.9	7.6	26.8	34.2	28.7	29.8
Portugal	3.3	2.6	26.4	21.6	10.0	11.0	32.9	35.5	27.3	29.3
Slovakia	10.3	4.9	27.9	26.3	8.7	8.2	26.0	32.8	27.1	27.8
Slovenia	3.2	1.9	36.5	31.2	8.3	8.8	32.1	34.1	19.9	23.9
Sweden	1.6	1.5	18.9	16.9	5.8	6.0	32.9	36.0	40.9	39.6
UK	1.4	1.0	18.1	12.7	4.8	5.1	46.2	49.9	29.5	31.3
EU-25	**3.1**	**2.2**	**22.1**	**18.6**	**8.0**	**7.4**	**35.3**	**39.5**	**31.4**	**32.3**

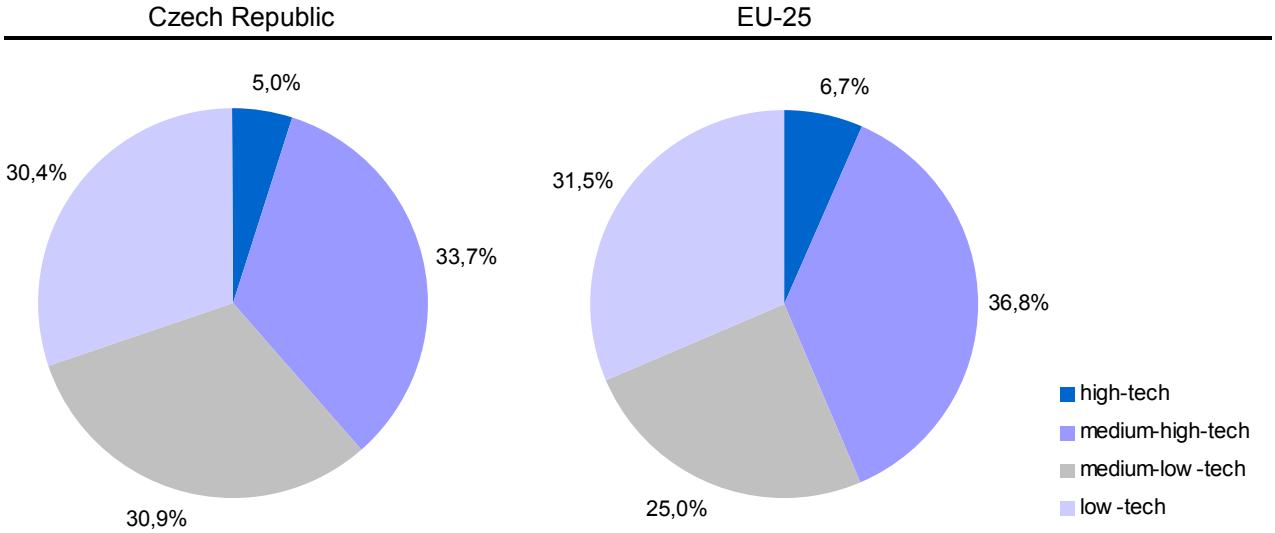
Source: EU KLEMS Database, March 2007, http://www.euklems.net, our own calculations

Analysis, comments and other information:

- In an international comparison the Czech Republic is characterized by a relatively high **share of manufacturing industry in the creation of value added and employment** in the economy (together with Slovakia this share is the highest in the EU-25 countries). In addition, the Czech Republic still has a relatively high **share of the primary sector in employment**, which is probably a result of slow structural adaptation of employment influenced by a rigid labour market.
- In contrast, the Czech Republic is characterized by a low **share of the service sector in value added creation and employment**. In comparison with the EU-25 average, the Czech Republic has a relatively low share in the segment of non-market services (learning, health care and other public services), where the share in value added in 2004 was almost 7 % lower (in employment almost 9 % lower) than in the EU-25.
- The Czech Republic is a country with a **stabile economic structure.** In principle the share of individual sectors in value added and employment between 1995 and 2004 remained constant. The most significant structural change in this period was the decrease in the share of the primary sector in the creation of value added and employment (2.5 %. to 3 %) which was accompanied by an increased share of the service sector. These structural changes are slower however than in other EU-25 countries.

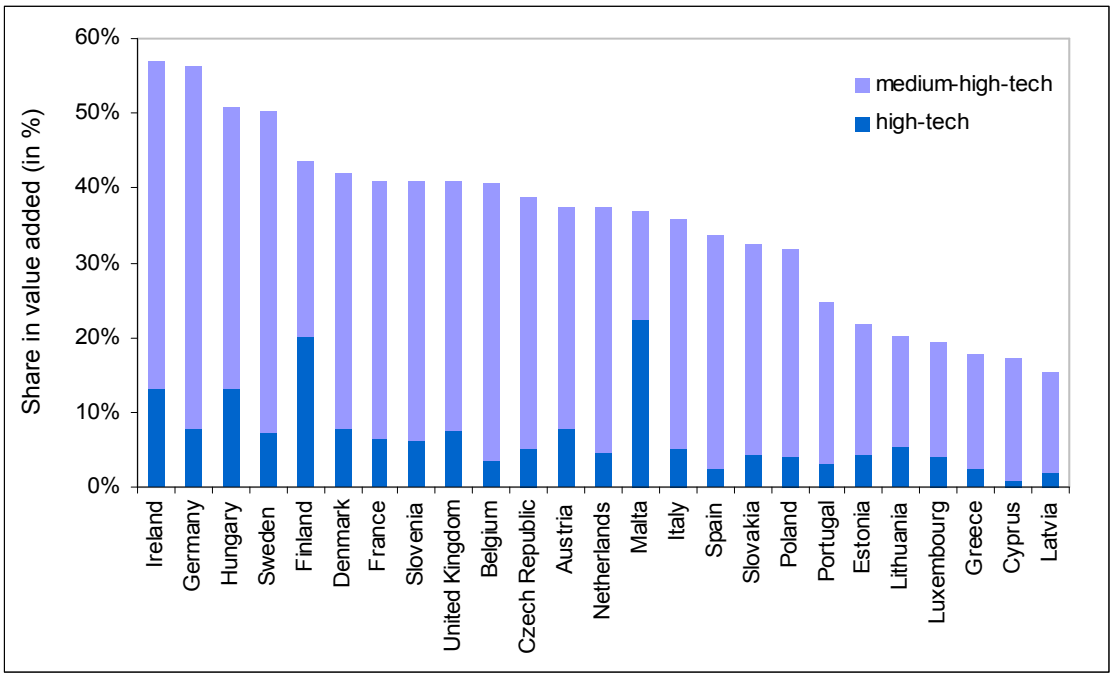
3.1.1.5 Technological and knowledge intensity in manufacturing industry

Share of sectors of manufacturing industry based on technological intensity in gross value added in 2004



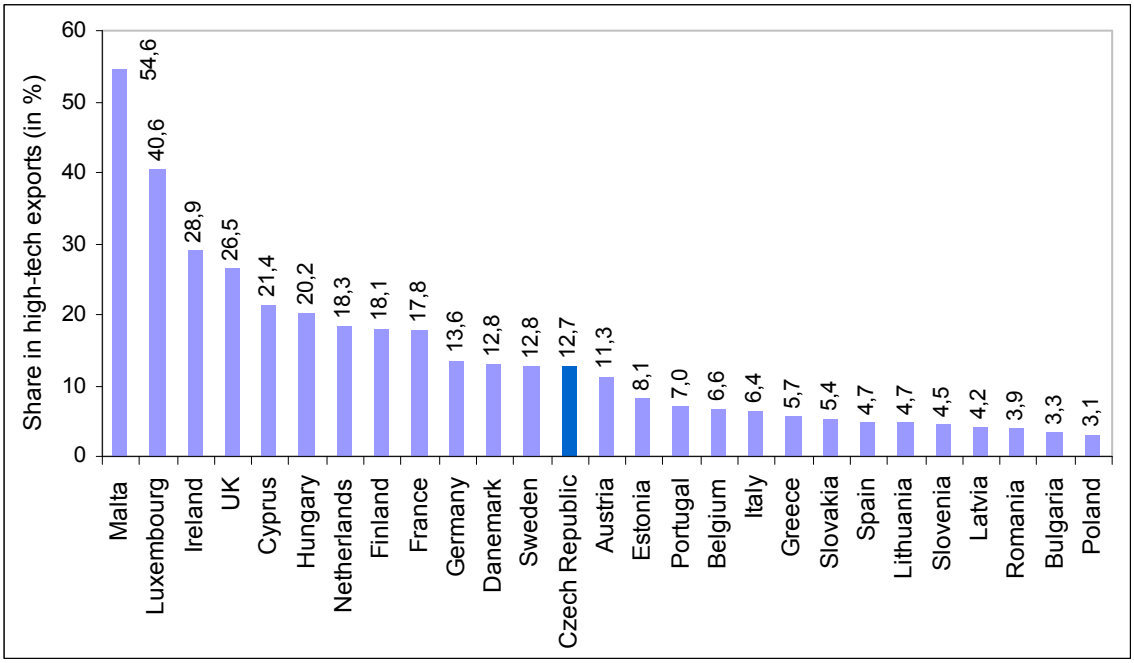
Source: EU KLEMS Database, March 2007, http://www.euklems.net, our own calculations, for the classification of sectors see Chapter Classification

Share of high-tech and medium-high-tech sectors of manufacturing industry in gross value added in 2004



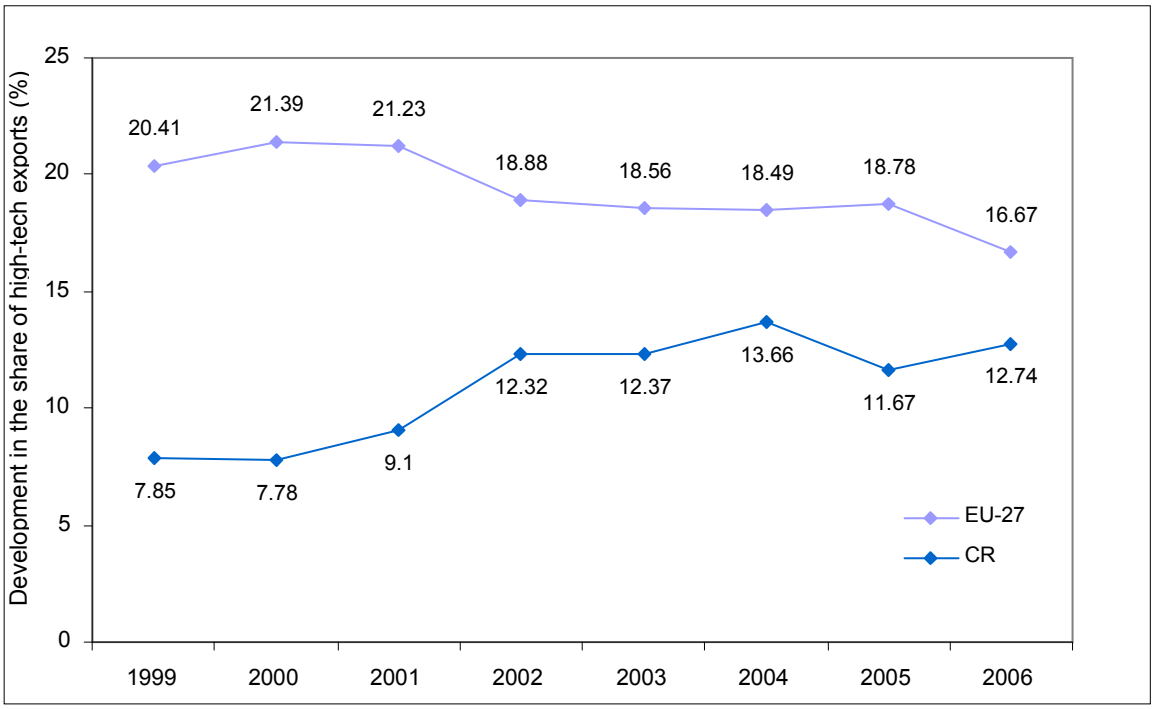
Source: EU KLEMS Database, March 2007, http://www.euklems.net, our own calculations, for the classification of sectors see Chapter Classification

Share of high-tech exports in total exports in 2006



Source: Eurostat – CIS4

Share of high- tech exports in total exports from the Czech Republic and EU-27



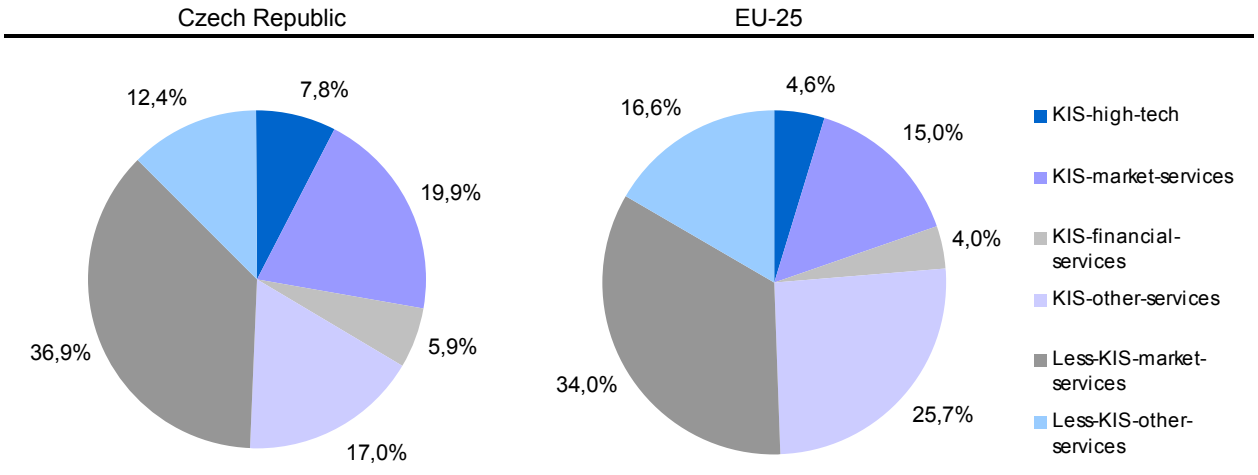
Source: Eurostat – CIS4

Analysis, comments and other information:

- **High-tech sector** of manufacturing industry is generally characterized by a relatively **high level of productivity** which creates room for higher salaries and profit. In addition, this sector has a distinct level of innovation activity as innovation represents main source of competitive advantage in this sector.
- Almost 39 % of the total value added is created in high-tech or medium-high-tech sectors of manufacturing industry in the Czech Republic. In comparison with the European average (43.5 %) the Czech Republic still has a higher **share of less technologically intensive sectors**.
- From the new EU member states only Hungary (51 %) and Slovenia (41 %) have a higher share of high-tech and medium high-tech sectors in value added generated in manufacturing industry.
- In comparison with European innovation leaders the Czech Republic significantly lags behind in the share of high-tech sector in economic performance and employment. For instance in Finland high-tech sector makes up more than 20 % of the total value added of manufacturing industry, whereas in the Czech Republic high-tech sector contributes only 5% to the creation of value added in manufacturing industry.
- There was an **increase in the share of high-tech and medium-high-tech sectors in value added in manufacturing industry** in the Czech Republic between 1995 and 2004, (in high-tech sector from 3.1 % to 5.0 % and in medium-high-tech sector from 27.9 % to 33.7 %). This increase resulted in a decrease in the share of low-tech sector (from 36.8 % to 30.4 %). There was a positive transfer of production from less technologically intensive sectors to high-tech or medium high-tech sectors in the Czech Republic.
- The level and dynamics of the share of high-tech production in total exports measure the **technological competitiveness of domestic businesses**, e.g. the ability to commercialize the results of R&D and innovation through sales on foreign markets. Whereas the Czech Republic with a share of 12.7 % is a country with an average **share of high-tech production in total exports**, this share is similar to several technologically and innovation advanced countries (e.g. Sweden, Germany and Denmark). Among the Central European countries Hungary has the highest share of high-tech production in exports (more than 20 %).
- The development of the share of high-tech exports in total exports from the Czech Republic increased from 7.8 % to 12.7 % in 1999. The highest increase was recorded in 2001, when there was an increase in high-tech export capacity in connection with the prior inflow of foreign direct investment. The **increase in the share of high-tech production in the total volume of Czech exports** indicates that Czech businesses can assert themselves on foreign markets of technologically intensive production with relatively high costs.
- In comparison with EU-27 there has been a convergence in the relative level of Czech high-tech exports with the European level. Whereas in 1999 the difference between EU-27 and the Czech Republic in this indicator was approx. 12.5 %, by 2006 this difference had reduced to approx. 4 %.

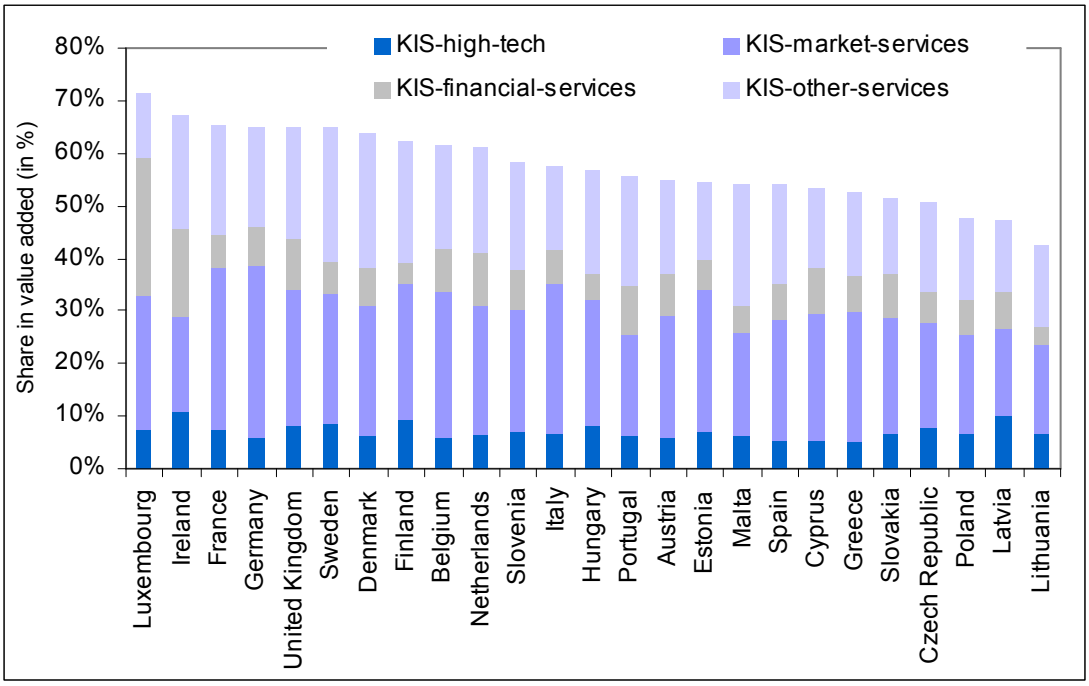
3.1.1.6 Technological and knowledge intensity in the service sector

Share services based on technological intensity in gross value added in 2004



Source: EU KLEMS Database, March 2007, http://www.euklems.net, our own calculations, for classification of sectors see Chapter Classification

Share of knowledge intensive services (KIS) in gross value added in the service sector in 2004



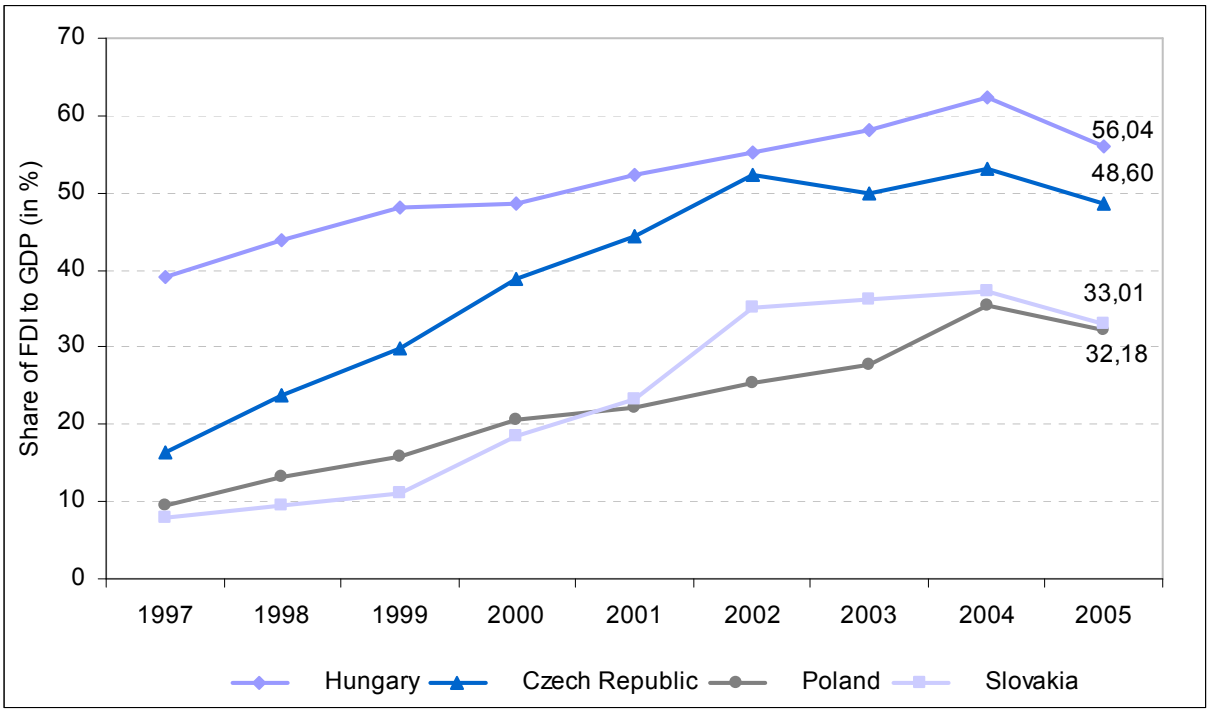
Source: EU KLEMS Database, March 2007, http://www.euklems.net, our own calculations, for classification of sectors see Chapter Classification

Analysis, comments and other information:

- With the increasing significance of services in the structure of advanced economies (the Czech Republic is a country with one of the lowest shares of the service sector in the creation of value added and employment) it is necessary to monitor both manufacturing industry and the development of knowledge intensive services and their contribution to the creation of value added and employment. In comparison with the European average the Czech Republic is characterized by a relatively low **share of knowledge intensive services (KIS) in value added** created in the service sector. Whereas in the EU-25 KIS generates 63.5 % of value added in services, in the Czech Republic KIS contributes only 50.7 %. The Czech Republic is therefore a country with one of the lowest share of KIS in the creation of value added in the service sector.
- **Market oriented services** are dominant in the Czech Republic (almost 57 %) with **less knowledge intensive services** prevailing (65 % of market services). Market oriented services are also prominent in the service sector of the EU-25, although knowledge intensive services prevail (55% of market services).
- The Czech Republic is characterized by a higher share of **technologically intensive KIS (high-tech KIS)** in the creation of value added than the European average. Telecommunication services, which are perceived by foreign and domestic investors as services with increasing market potential, significantly contribute to this.
- The Czech Republic did not record any significant change between 1995 and 2004 in the structure of knowledge intensive services (the share of KIS in 1995 was 49.4 %, 50.7 % in 2004). From individual segments of KIS in this period there was a particular increase in the share of high-tech KIS to the detriment of the share of market oriented KIS. This development corresponds with the intensive increase in investment and value added (total of 75 %) in **telecommunication services.**

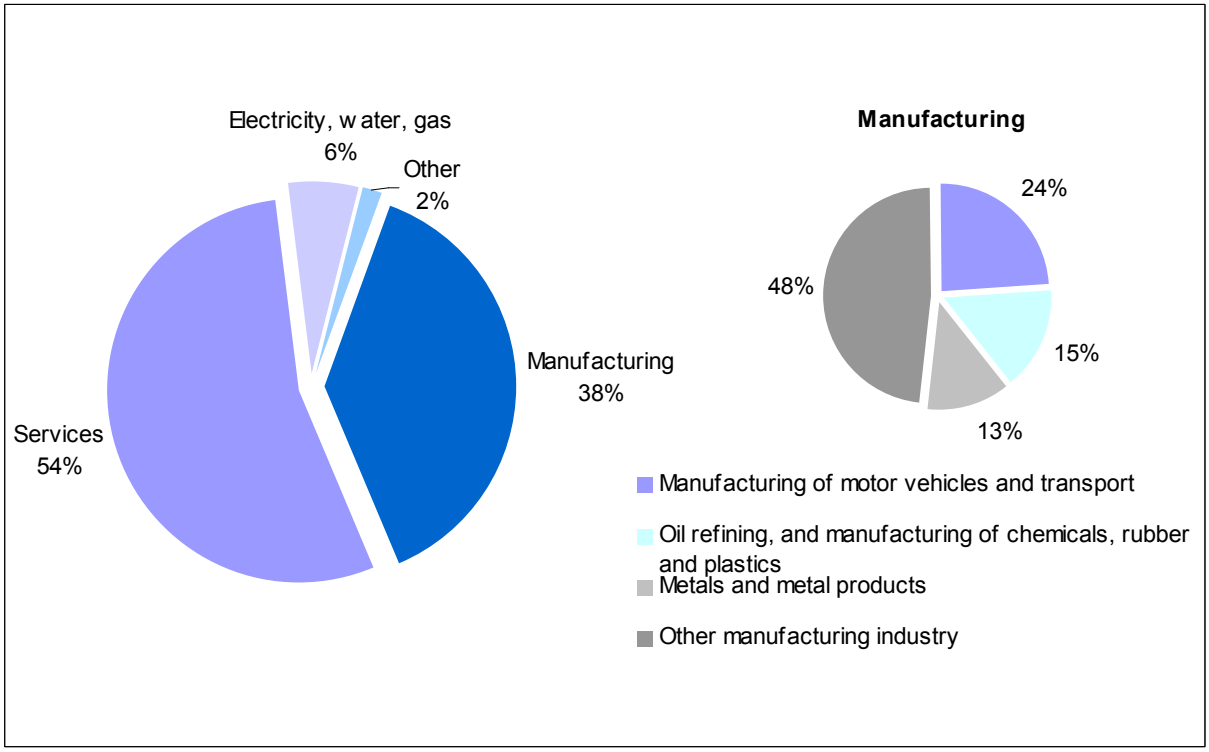
3.1.1.7 Inflow of foreign direct investment

Share of foreign direct investment stocks to GDP



Source: UNCTAD

Structure of the foreign direct investment stocks as of the end of 2005



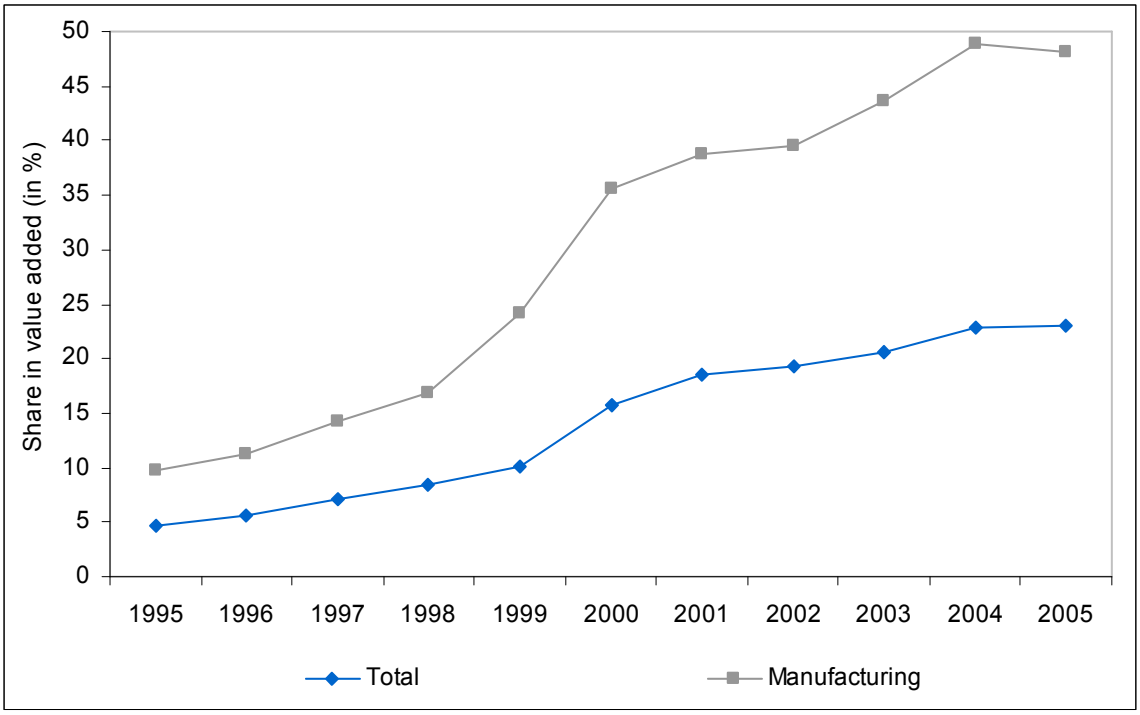
Source: CNB

Analysis, comments and other information:

- The Czech Republic has enjoyed a large **inflow of foreign direct investment (FDI) since 1999**. Whereas in 1998 FDI made up nearly 25 % of GDP, between 2002 and 2005 it was approx. 50 % of GDP. From the trend in the development of the share of FDI in GDP it is clear that the rapid growth of this share was held up in 2002 and the relative level of FDI stagnated between 2002 and 2005 at a level of approx. 50 % of GDP. A certain role is played by the dynamic growth of the Czech economy since 2002. A similar development (at different levels) can be seen in other Central European economies. The highest share of FDI to GDP is in Hungary (56 %) and the lowest in Poland (32 %).
- From the point of view of the **structure of the inflow of FDI**, there was a gradual change from investment connected to the privatization (in particular in financial and telecommunications sectors) to investment in the form of acquisition of private Czech businesses or new (greenfield) investment (particularly in the automobile industry) between 1999 and 2005.
- The motives of foreign investors and the sectoral structure of FDI are important factors from the point of view of the **potential risks of an outflow of investment** from the Czech Republic. A higher risk exists if investors were motivated by the relatively low labour costs (particularly in manufacturing industry) in the Czech Republic. In contrast investment motivated by gaining a higher market share (for example financial, telecommunications or business services and energy) does not present as much of a risk from the point of view of a possible outflow to other countries.
- From the point of view of the **sectoral structure,** FDI in services makes up the most significant share (54%), in particular investment into the financial sector and telecommunications. FDI in manufacturing industry reached almost 570 billion CZK by the end of 2005, which represents 38 % of the total FDI. In manufacturing industry FDI focused on the automobile industry (more than 24 % of all FDI in manufacturing industry).

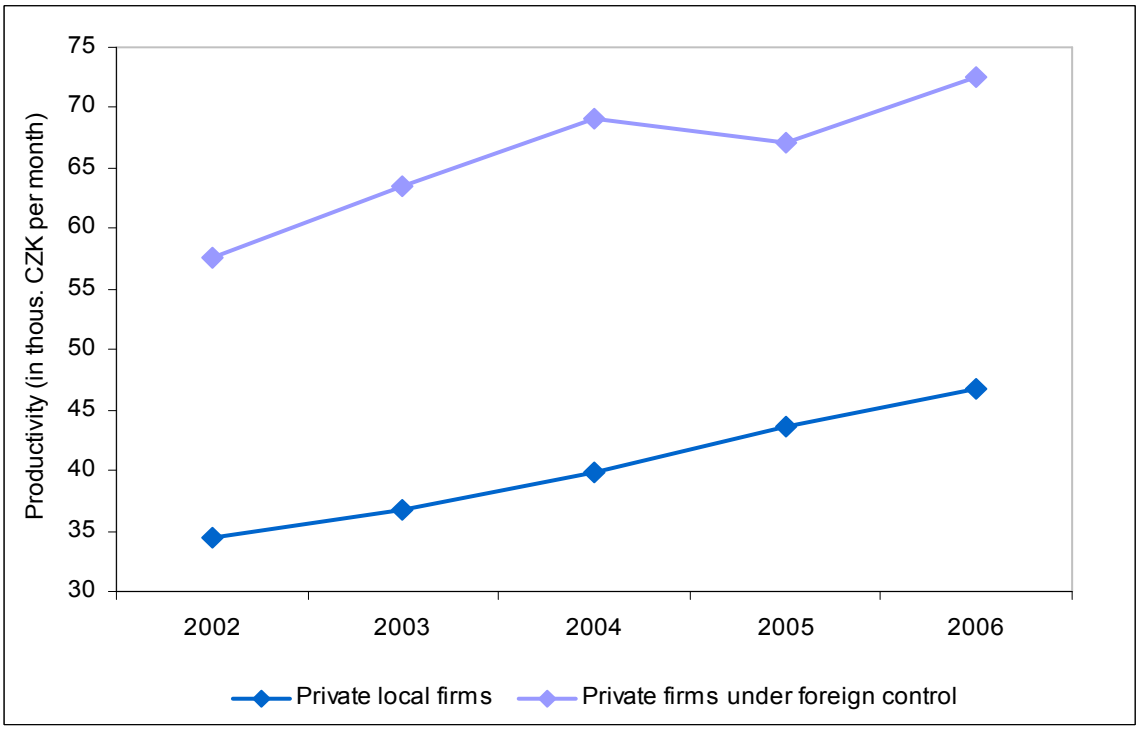
3.1.1.8 Impacts of the inflow of foreign direct investment

Share of firms under foreign control in creation of gross value added



Source: CSO

Value added per worker (labour productivity) in private local firms and private firms under foreign control



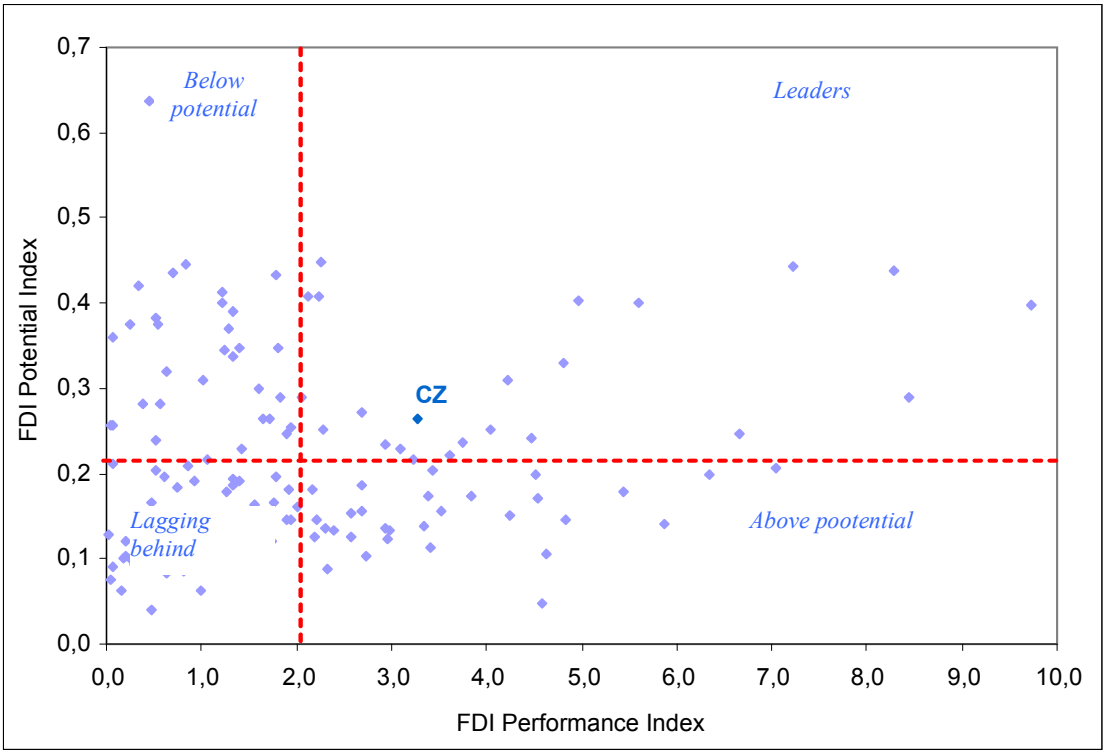
Source: CSO

Analysis, comments and other information:

- The dynamics of the inflow of FDI after 1999 is reflected in the growth **of the share of firms under foreign control in the creation of gross value added.** Whereas in 1998 firms under foreign control contributed 8 % to the creation of gross value added, by 2005 this share had risen to 23 %. A more significant dynamics can be seen in the manufacturing industry, where firms under foreign control contributed almost 50 % to the gross value added (as opposed to 17 % in 1998).
- Firms under foreign control display a much **higher level of labour productivity.** The value added per capita in these firms was 72.5 thousands CZK/month in 2006, whereas in local firms this share was only 46.8 thousand CZK/month. This difference in productivity can be attributed to the orientation of foreign investment towards sectors with higher value added and economies of scale, which follows from the larger size of firms under foreign control.
- The development of labour productivity indicates that **local firms** are gradually (but slowly) **catching up to the level of labour productivity** of firms under foreign control. Whereas firms under foreign control displayed an average increase in labour productivity of 5.9 % between 2002 and 2006, local firms grew by 8.0 % in the same period. Higher growth in the labour productivity of local firms can be attributed to a certain extent to the **positive spill over effects of** FDI, thanks to which there has been an increase in the production effectiveness of local firms.
- A certain risk connected with the higher capacity and level of labour productivity of firms under foreign control is the **creation of a dual economy** and **crowding out of local firms**. These two mutually linked effects can be seen in several sectors of the Czech economy, particularly where firms under foreign control are capable of exploiting significant economies of scale (e.g. business services – in particular retail).

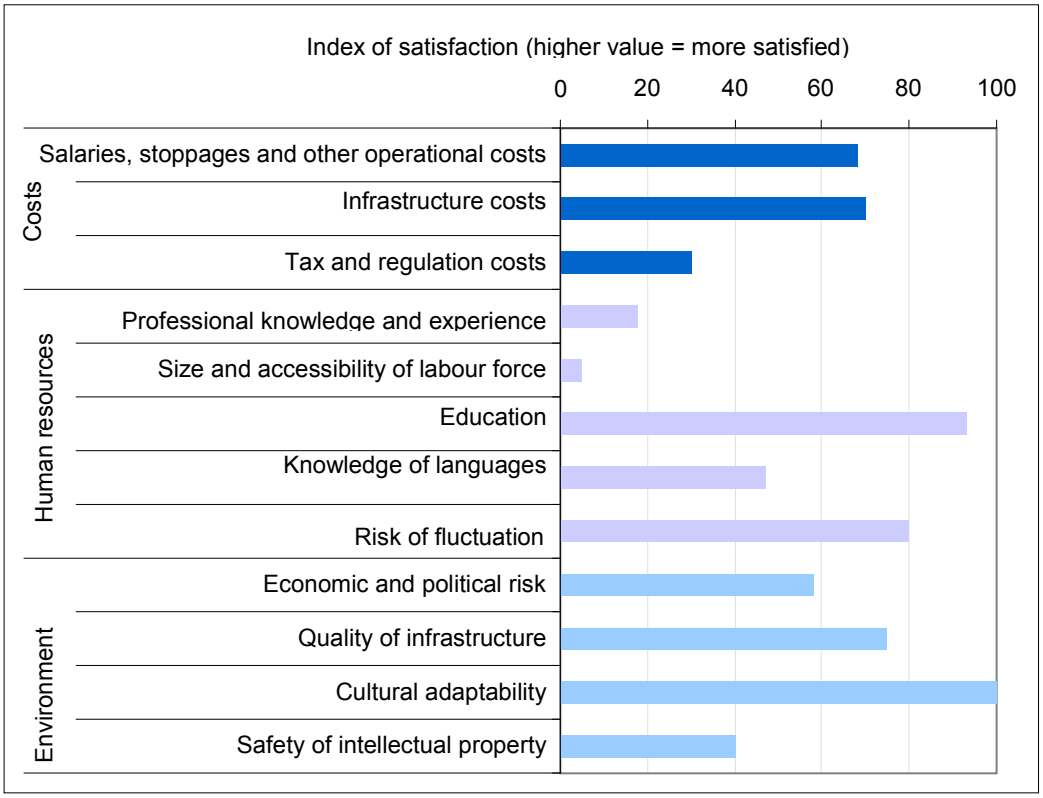
3.1.1.9 Determiners for the inflow of foreign direct investment to the Czech Republic

Attractiveness and potential of a country for the inflow of foreign direct investment



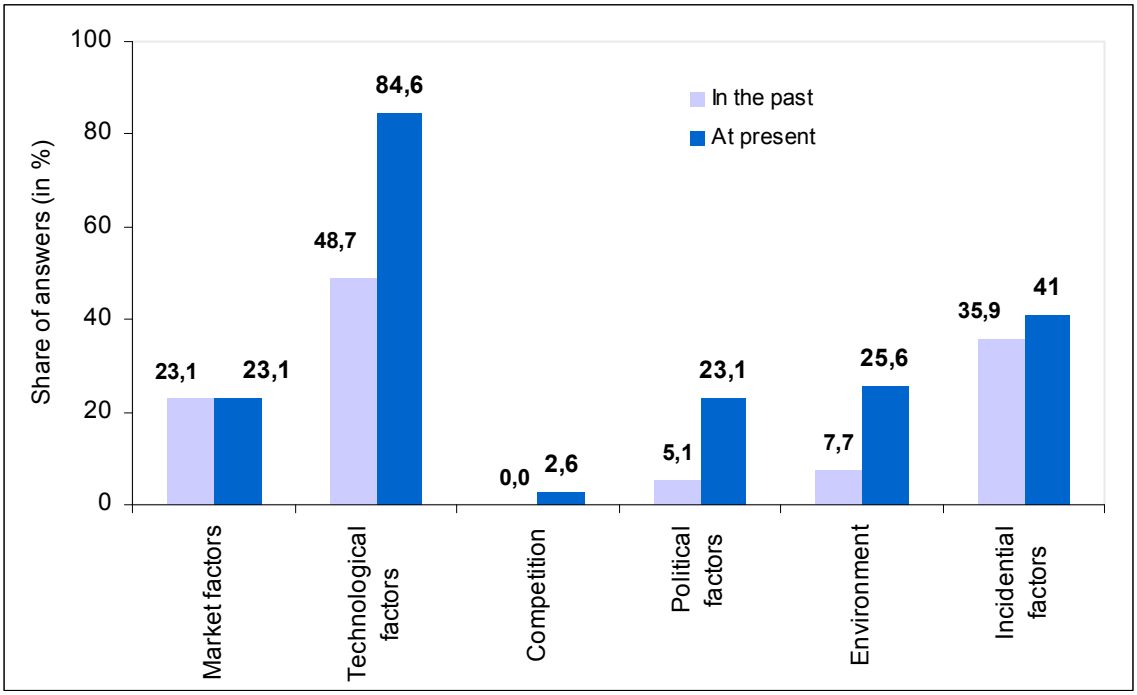
Source: UNCTAD

Perception of individual factors for the localization of investment in the Czech Republic by foreign investors



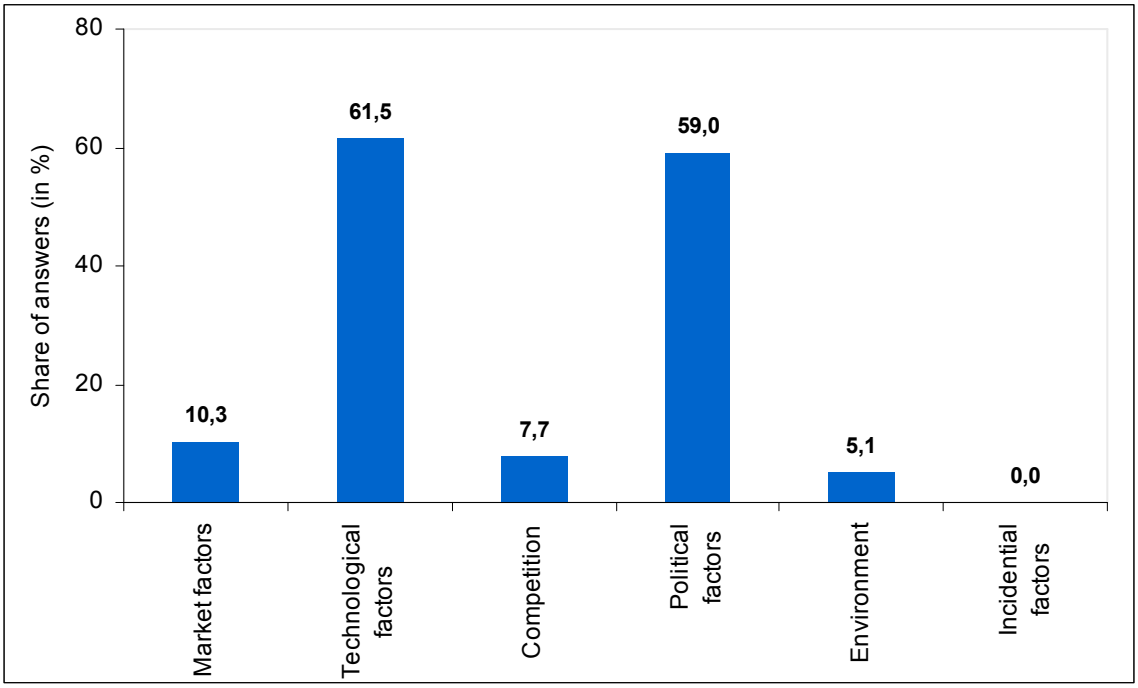
Source: A.T.Kearnay, taken from Competitiveness of the Czech Republic Yearbooks 2006 – 2007

Localization motives for R&D activity at present and in the past



Source: TC AS CR

Main weaknesses for the development of R&D activity



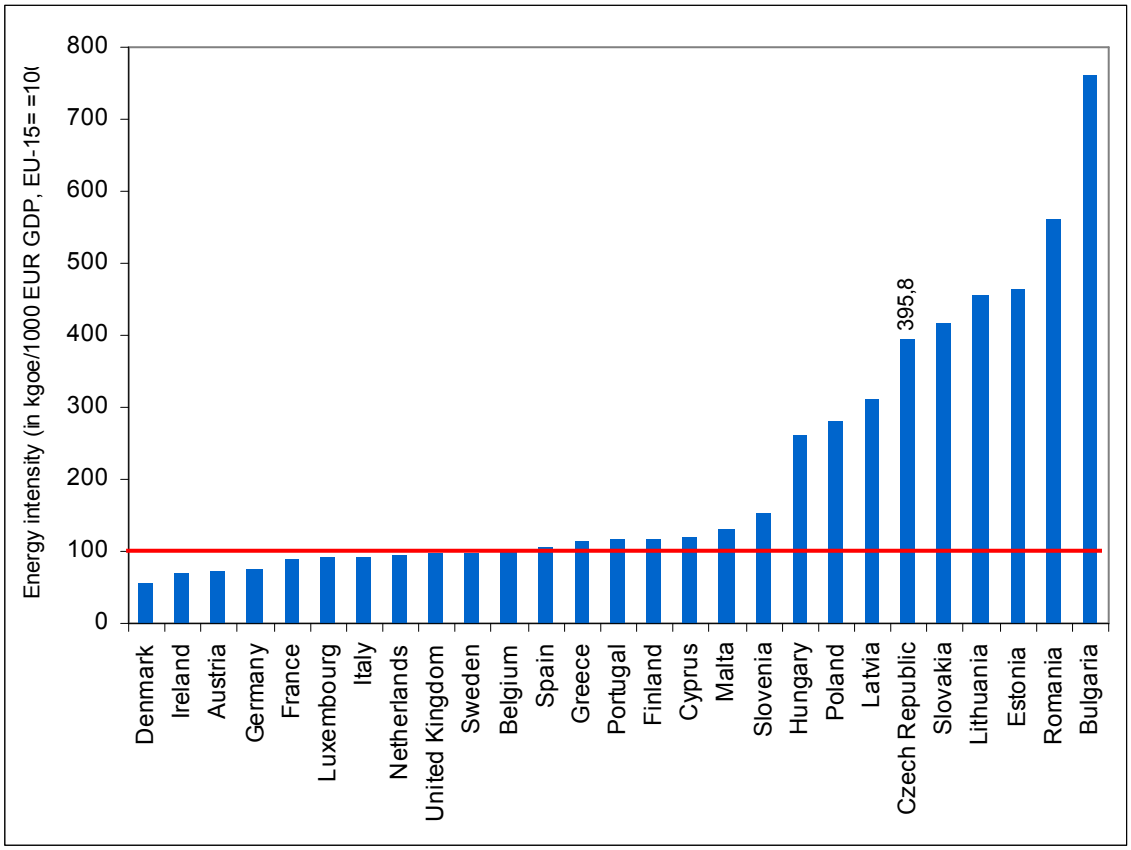
Source: TC AS CR

Analysis, comments and other information:

- The Czech Republic has long maintained a prominent position in the evaluation of countries from the point of view of their **attractiveness for inflow foreign direct investment.** The result is a relatively high inflow of FDI in relation to the size and economic advancement of the country. In the evaluation of the level of FDI and potential for their further inflow published in the World Investment Report 2007 (UNCTAD) the Czech Republic is ranked among the so-called **front-runners**, i.e. countries which have above-average both level and potential for an inflow of FDI. This group also contains other Central European countries. In an international comparison, the Czech Republic is ranked 32nd in the FDI Performance Index (8th place from the EU-27 countries), and according to the FDI Potential Index the Czech Republic is in 39th place (19th place from the EU-27 countries).
- Factors that significantly influence the **decision to invest in the Czech Republic** include good level of education of the labour force and a low risk of fluctuation. In addition, the relatively low labour costs and good infrastructure have been positively evaluated. Cultural proximity plays a significant role in decision making on the localization of investment in the Czech Republic, which makes the Czech Republic and the whole of the Central European region more attractive than low cost East Asian countries.
- From the point of view of the current global development in the flow of FDI, the price competitiveness of China and India represents a certain risk for the Czech Republic. In addition, it is possible to see that these economies create conditions not only for localization of work intensive investment but also significantly invest into infrastructure and an environment for the localization of more technologically intensive production. From this point of view a key factor for the Czech Republic for maintaining competitiveness in the field of attractiveness for FDI is **emphasis on knowledge intensive sectors of the economy** and creation of conditions for localization of R&D activity and high-tech production.
- From study performed in the framework of the LocoMotive project in selected regions of the EU it follows that the establishment and development of the R&D activity of multi-national companies are positively influenced by technology related factors. This deals in particular with a **highly qualified labour force,** the presence of other businesses that are active in the given region or the quality of local R&D. Environmental influences (e.g. good quality of life) and various political factors (e.g. support of R&D, protection of intellectual property) are also positively evaluated.
- The main weaknesses of the EU for the localization and development of research activity of multi-national enterprises are related to technological factors. In the set of responses from all EU countries, the insufficient quality of the education system, poor preparation of graduates in employment and problems in the cooperation between businesses and universities were most often mentioned. Political factors were also often mentioned (in particular high taxation and changes in EU legislation).
- In the Czech Republic the main reasons for localization and development of R&D activities of multi-national enterprises are the **cheap and at the same time qualified labour force**, good level of local R&D and universities, tradition and experience in R&D, good R&D infrastructure, geographic location close to Germany (or EU-15 countries), cultural proximity, and good technical infrastructure and transport accessibility. Another significant factor was also EU membership of the Czech Republic.
- Despite the fact that one of the main reasons for building R&D capacity in the Czech Republic was the cheap and qualified labour force, respondents often mentioned the **lack of human resources, in particular technically educated personnel** as a weakness**.** The lack of cooperation between public research and businesses was also mentioned. Managers of the questioned businesses also consider government support for R&D as being insufficient and also the lack of comprehensive R&D policy and policy towards human resources development. The insufficient size of the market in the Czech Republic is also evaluated as being a negative factor.

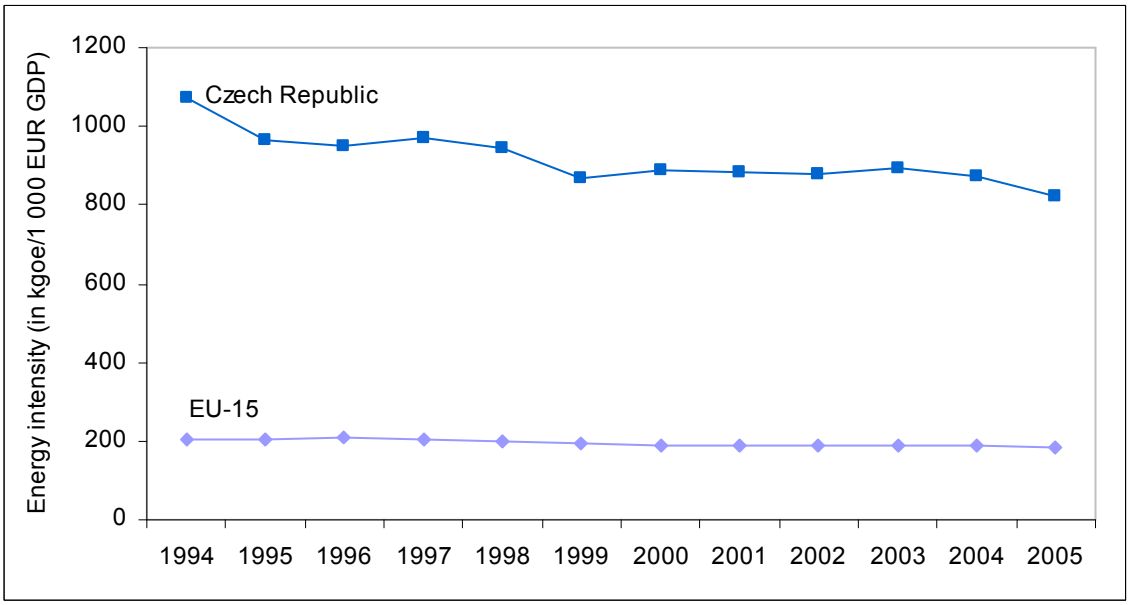
3.1.1.10 Energy intensity of production

Energy intensity of production (in kg of equivalent oil per 1 000 EUR of gross domestic product in fixed prices from 1995, kgoe/1 000 € GDP; EU-15=100)



Source: Eurostat, our own calculations

Development of energy intensity of production (in kg of equivalent oil per 1 000 EUR of gross domestic product in fixed prices from 1995, kgoe/1 000 € GDP)



Source: Eurostat

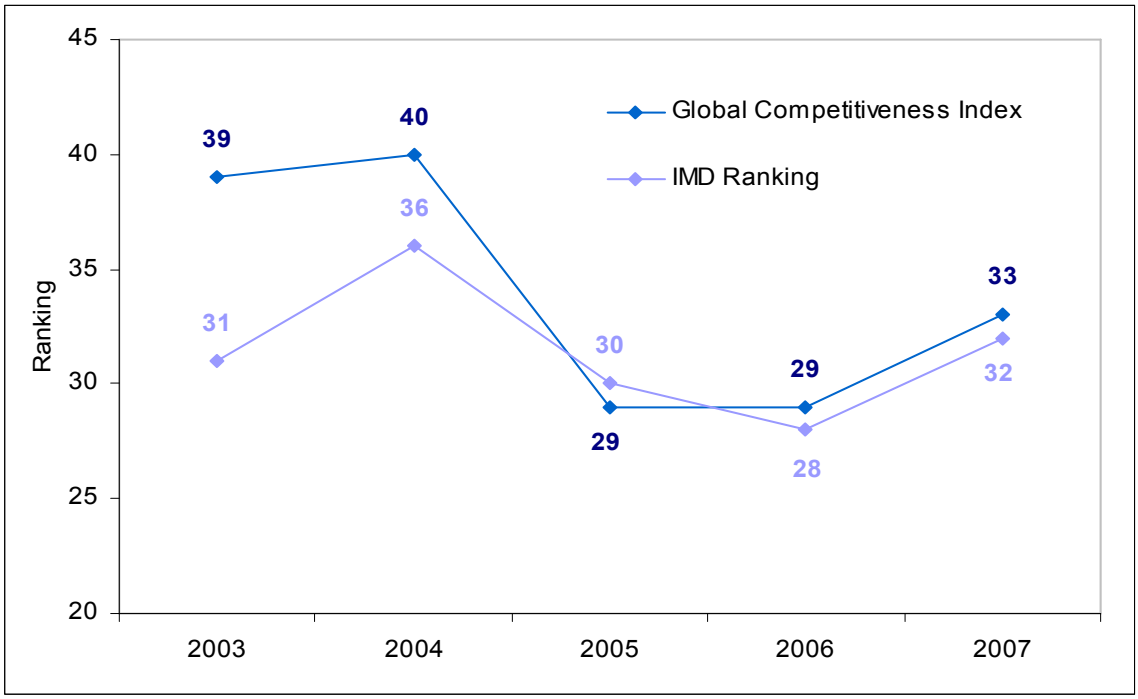
Analysis, comments and other information:

- **Consumption of energy in industry in the Czech Republic** (measured in GWh) increased by almost a third between 1994 and 2005, which corresponds to an average year-on-year increase of 2.6 %. The highest year-on-year increase in the consumption energy in industry was in 2004 (about 8.8 %).
- In comparison with other EU-27 countries, the Czech Republic together with other post-communist countries has a significantly higher **energy intensity of production**. The share of the consumption of energy per unit of value added shows that in the Czech Republic for the production of one unit of GDP almost three times more energy is consumed than the average consumption of EU-15 countries. These results reflect the fact that value added of the Czech economy is created in material and energy intensive sectors, where the increase in value added is connected to the increase in energy and material consumption.
- Despite the fact that the energy intensity of the Czech economy is gradually decreasing, the difference between the energy intensity of production in the Czech Republic and in advanced countries of the EU remains abysmal. **Intensification of the growth of value added** in the Czech Republic is very slow and its increase is based on the expansion of production.

3.1.2 Competitiveness

3.1.2.1 Competitiveness of the Czech Republic in an international comparison

Rank in competitiveness of the Czech Republic in international comparison



Source: WEF – Global Competitiveness Report 2007 – 2008, IMD – World Competitiveness Yearbook 2007

Rank of the Czech Republic in basic groups of factors of competitiveness

	Institutions	Infrastructure	Macro economy	Health and primary education	Higher education and training	Efficiency of markets	Technological readiness	Business sophistication	Innovation
2006	60	33	42	58	27	41	26	29	28
2007	69	41	43	29	28	41*	35	30	27

*Note: Group VI "efficiency of markets" is divided into four groups in the new 2007 – 2008 comparison; the rank for 2007 included here is the arithmetic average of the rank of these four groups.

Source: WEF – Global Competitiveness Reports 2006 – 2007, 2007 – 2008

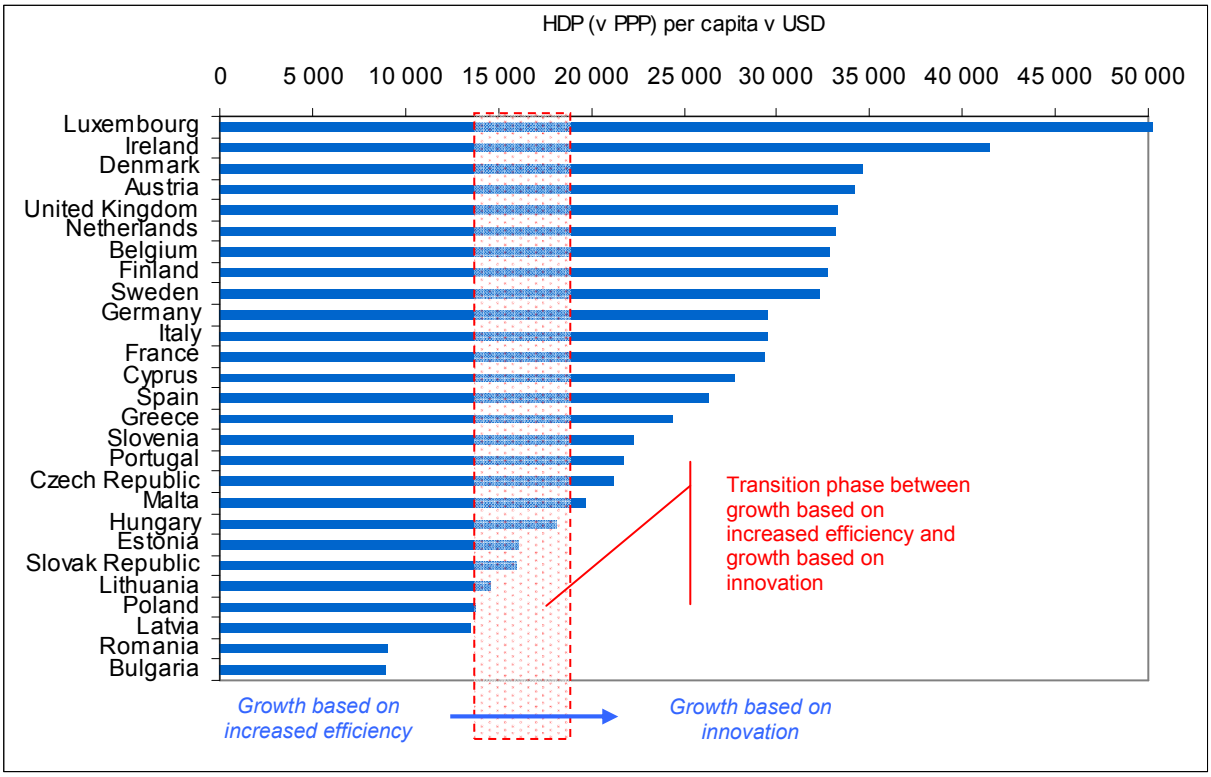
Analysis, comments and other information:

- The position of the Czech Republic in the scale of competitiveness of countries improved in the period between 2003 and 2006. The Czech Republic was ranked 29th from 125 countries in the **GCI index in 2005**. The Czech Republic held the best position in the **IMD index** in 2006 (28th place). However, the rank of the Czech Republic in an international comparison worsened in 2007 (32nd place in the IMD index and at 33rd place in the GCI index).
- From the point of view of individual groups of **factors of competitiveness** the Czech Republic is relatively well ranked in the area of innovation (27th place) due to a certain extent to the availability of scientific personnel (5th place) and the overall capacity for innovation (25th place). In contrast, the institutional environment is in a relatively weak position (69th place).
- The Czech Republic ranked poorly in the area of the **institutional environment** (122nd place from 131 countries) due to obstructions caused by governmental regulations e.g. administrative requirements, permits, bills, etc. Significant institutional factors which reduce the level of competitiveness include wastage of public finances (110th place) and the lack of public confidence in politicians (102nd place). Deficits in the public budget (97th place) have a negative effect in macroeconomic factors. In the area of **technological readiness**, where

the Czech Republic's drop in ranking was the worst, legislation in the area of ICT (45th place) and accessibility to the most state-of-the-art technology (44th place) were evaluated negatively from the point of view of competitiveness. In the area of **innovation** the most significance barrier to competitiveness is the lack of consideration of innovative solutions when tendering public contracts (46th place) and the lack of protection of intellectual property (34th place).

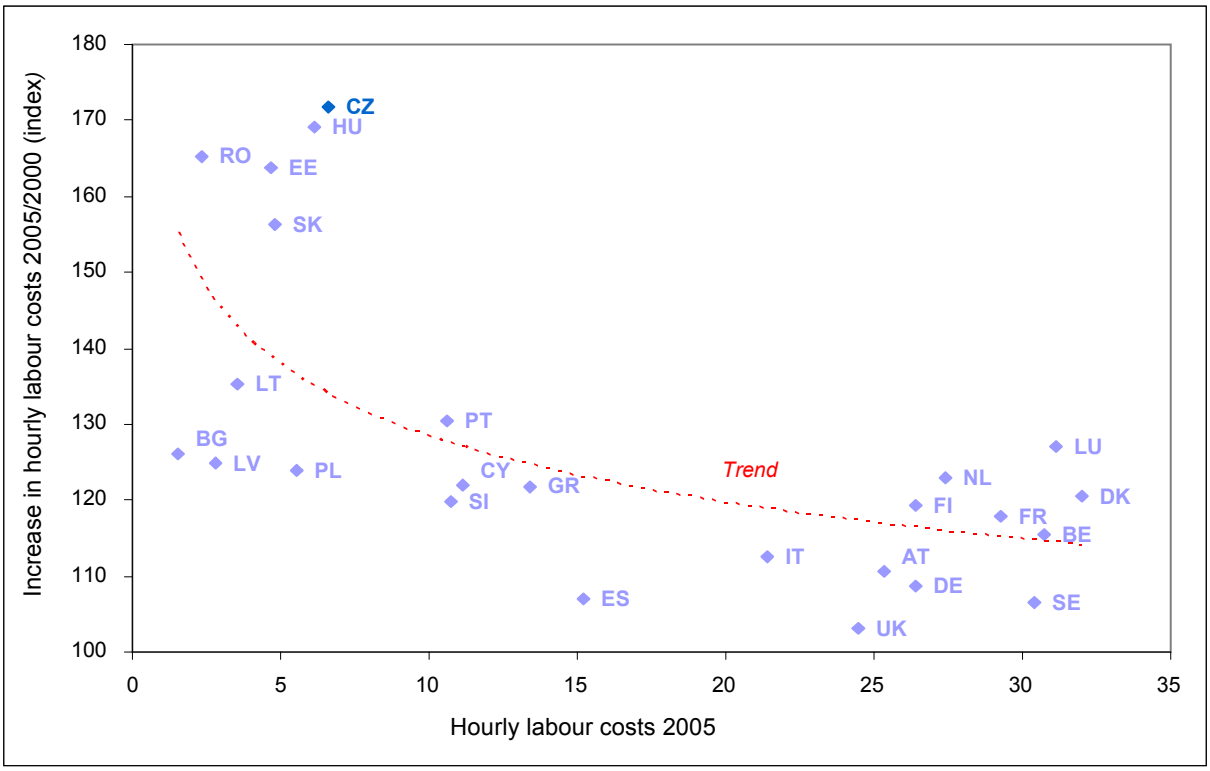
3.1.2.2 Sources of competitive advantages

Rank of the Czech Republic from the point of view of the type of competitive advantages (based on GDP per capita in PPP) in the framework of the EU-27



Source: IMF – World Economic Outlook, April 2007, WEF – Global Competitiveness Report 2006 – 2007

Hourly labour costs – 2005 level and 2005/2000 dynamics



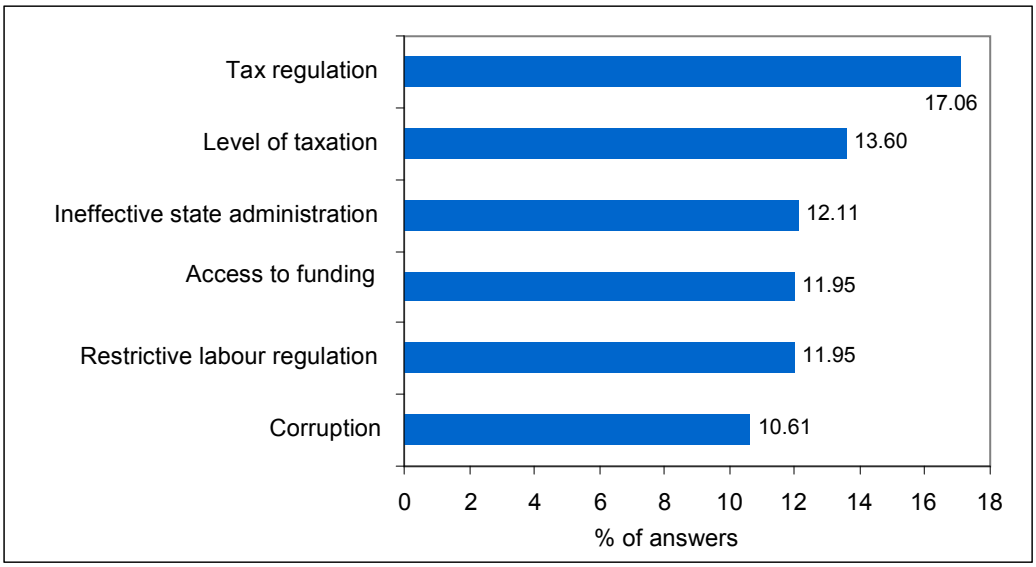
Source: Eurostat – New Cronos, our own calculations

Analysis, comments and other information:

- The economic development of a country usually leads to a gradual reduction in the significance of **competitive advantages based on low labour costs** and an increase in significance of other factors of competitiveness. In a global perspective, the main factors in EU-27 countries are competitive advantages based on increased performance (in less advanced EU-27 countries) and **competitive advantages based on the implementation of innovation**. The Czech Republic is currently in a phase of transition between these two stages in the development of a competitive economy. The implementation of innovation in the fields of production, technology and business strategy is therefore becoming a key factor in the Czech Republic for maintaining competitiveness on the global market.
- The fact that other factors of competitiveness than those based on cost will increase in significance in the Czech Republic is also demonstrated by the **development of hourly labour costs**. In an EU-27 comparison it is clear that the Czech Republic is characterized by relatively low hourly labour costs. Whereas in 2005 these costs in EU-27 countries were on average around 20 EUR, in the Czech Republic they were only approx. 6.5 EUR. The development of hourly labour costs since 2000 indicates that the hourly labour costs in the Czech Republic will gradually converge to the level of advanced EU-27 countries. In the Czech Republic hourly labour costs increased by more than 70 % between 2000 and 2005, which is the fastest rise in any of the EU-27. The average increase in hourly labour costs in this period was only approx. 9%.

3.1.2.3 Business environment

The most problematic factors for business development



Source: WEF – Global Competitiveness Report 2006 – 2007

Rank of the Czech Republic in comparison with individual aspects of the business environment

	Starting a business	Dealing with licenses	Employing workers	Registering property	Getting credit	Protecting investors	Paying taxes	Trading across borders	Enforcing contracts	Closing a business
Rank in 2007	91	83	55	54	26	83	113	30	97	108
Rank in 2006	79	109	68	57	21	81	111	27	97	115
Change in rank	-12	26	13	3	-5	-2	-2	-3	0	7

Source: Doing Business 2007

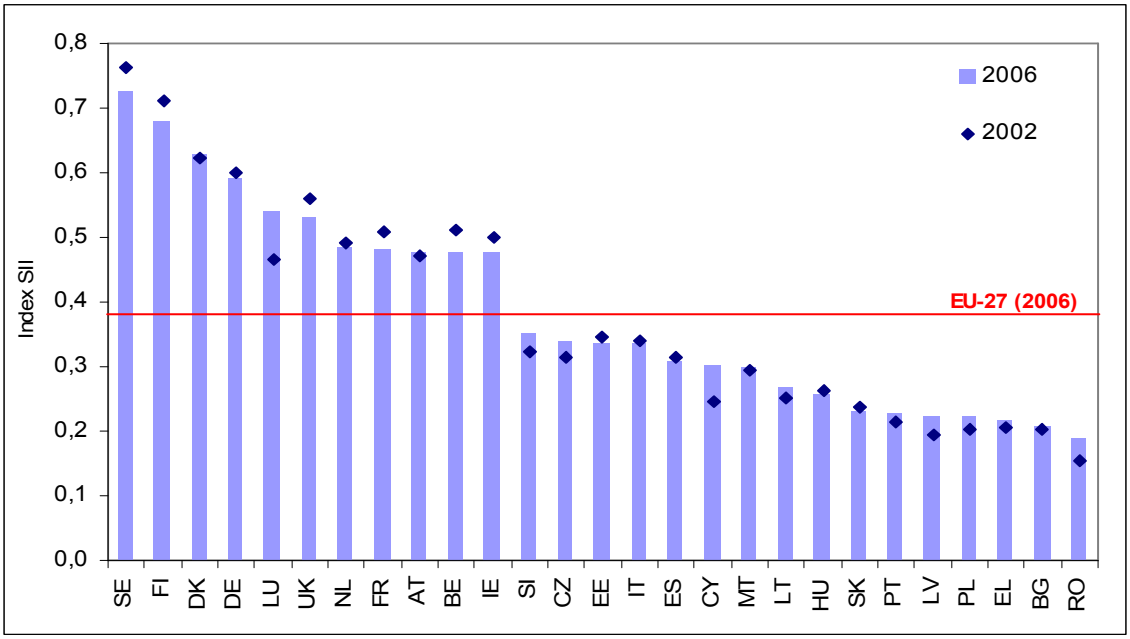
Analysis, comments and other information:

- The most significant insufficiencies in the Czech business environment, which according to the respondents of a WEF study make business in the Czech Republic more difficult, are the **tax system and level of taxation** and the **ineffective state administration**. Considering the fact that the **poor access to funding** also represents a barrier for the development of enterprise in the Czech Republic, there is room for tax measures which would simplify the whole system, reduce the tax burden of businesses, thereby indirectly improving the financial position of Czech businesses.
- A more detailed analysis of the business environment published by the World Bank in its project DoingBusiness also illustrated that the Czech taxation system (tax payments) represents a significant problem in an international comparison. The **administrative complexity of tax collection**, which is reflected in a marked burden on entrepreneurs' time, was also evaluated as being obstructive.
- A prevailing problem in the Czech business environment is the **procedural complexity of closing a business** and the high cost of this process. Whereas in OECD countries closing a business takes on average 1.3 years and the return rate from closing an insolvent business is on average 74.1 %, in the Czech Republic this process can take up to 6.5 years with a return rate of 21.3 %.
- From the point of view of the development of a business environment the greatest increase was displayed in an international comparison in the area of dealing with licenses (e.g. length and cost of the process of opening a wholesale business). In contrast a negative trend was recorded in the area of obtaining bank loans.

3.1.3 Innovation performance of the Czech Republic

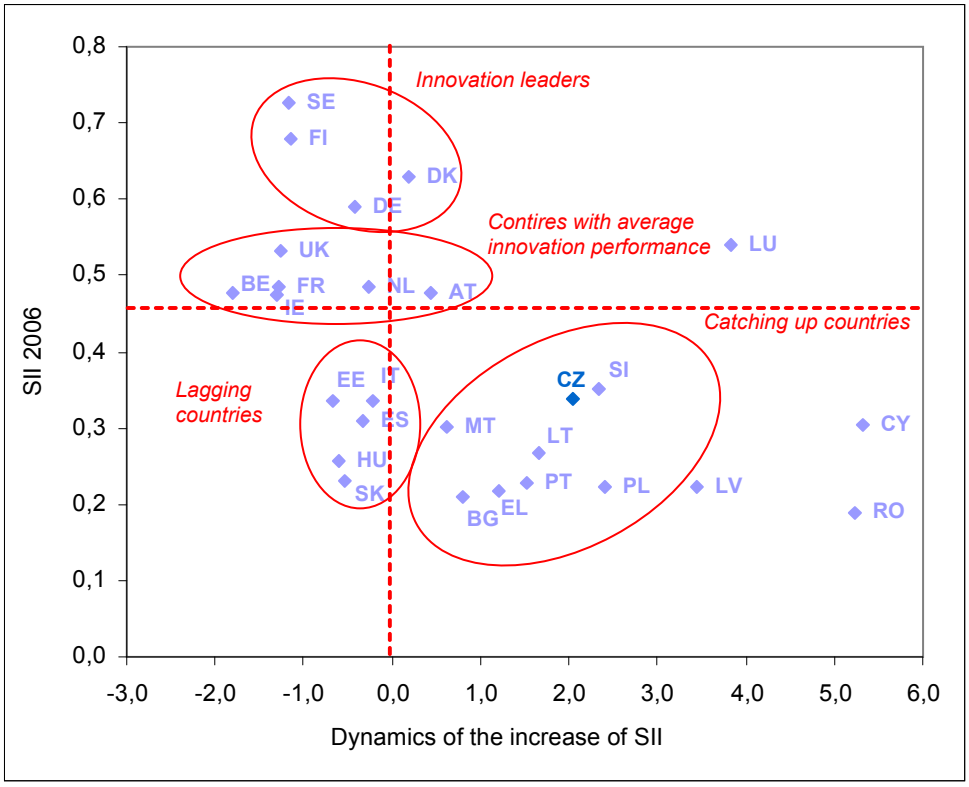
3.1.3.1 Innovation performance of the Czech Republic in an international comparison

Innovation performance of the Czech Republic in an international comparison based on Summary Innovation Index (SII)



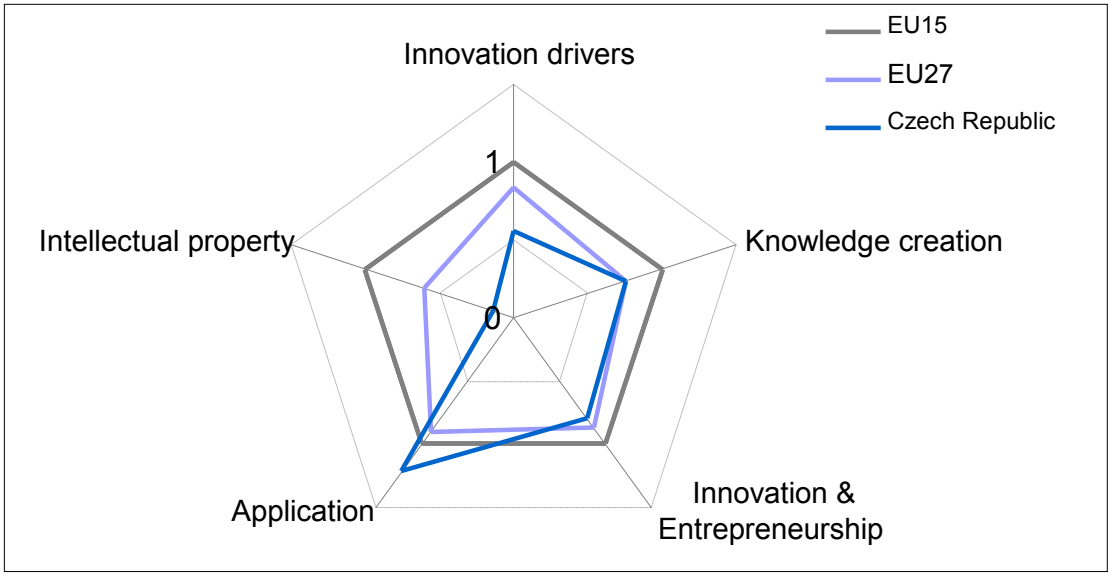
Source: Eurostat – European Innovation Scoreboard 2006.

Level and dynamics of growth of Summary Innovation Index (SII)



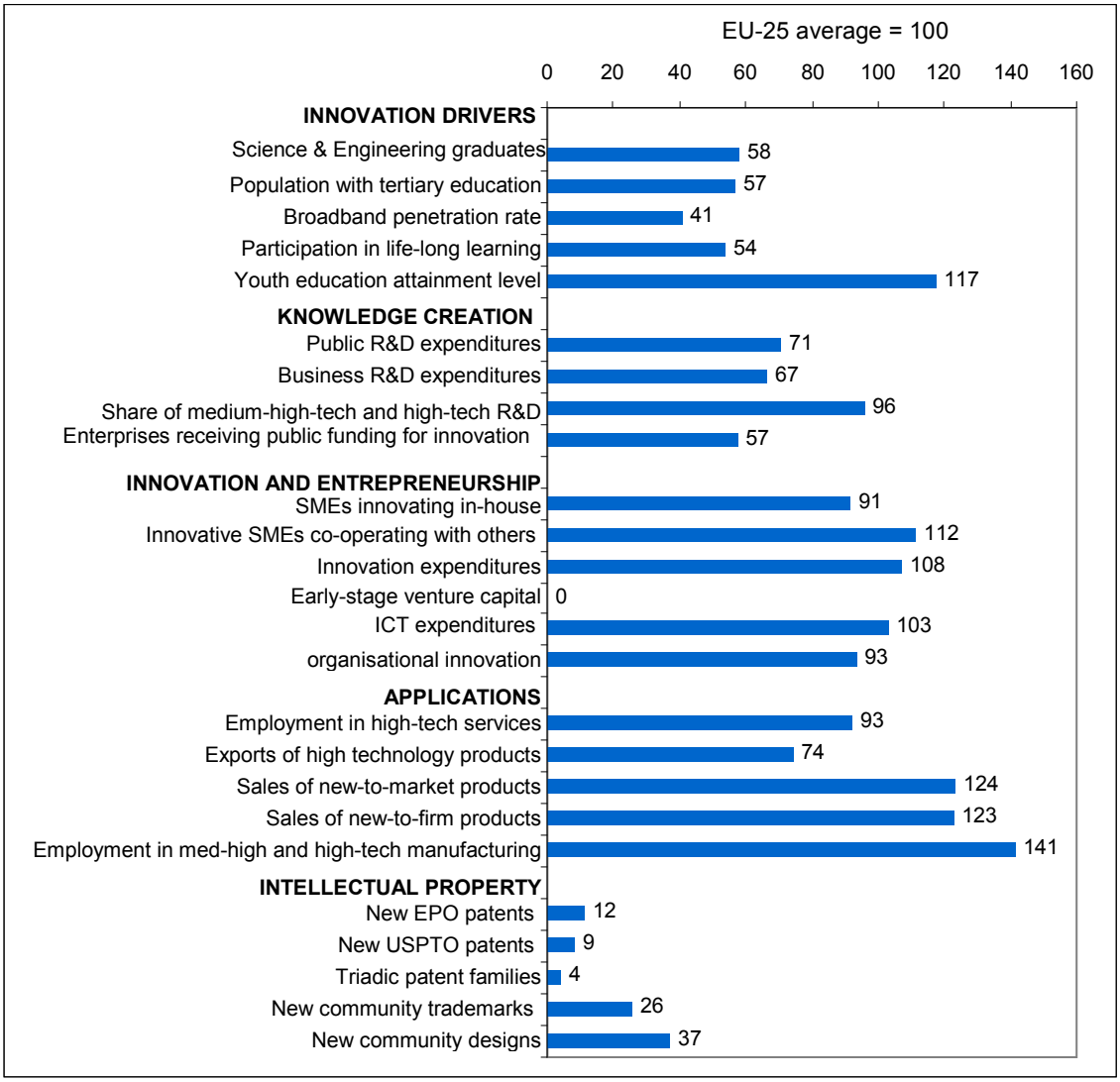
Source: Eurostat – European Innovation Scoreboard 2006.

Innovation performance and innovation dimensions



Source: Eurostat – European Innovation Scoreboard 2006

Relative levels of indicators of innovation performance



Source: Eurostat – European Innovation Scoreboard 2006 – Strengths and Weaknesses Report

Analysis, comments and other information:

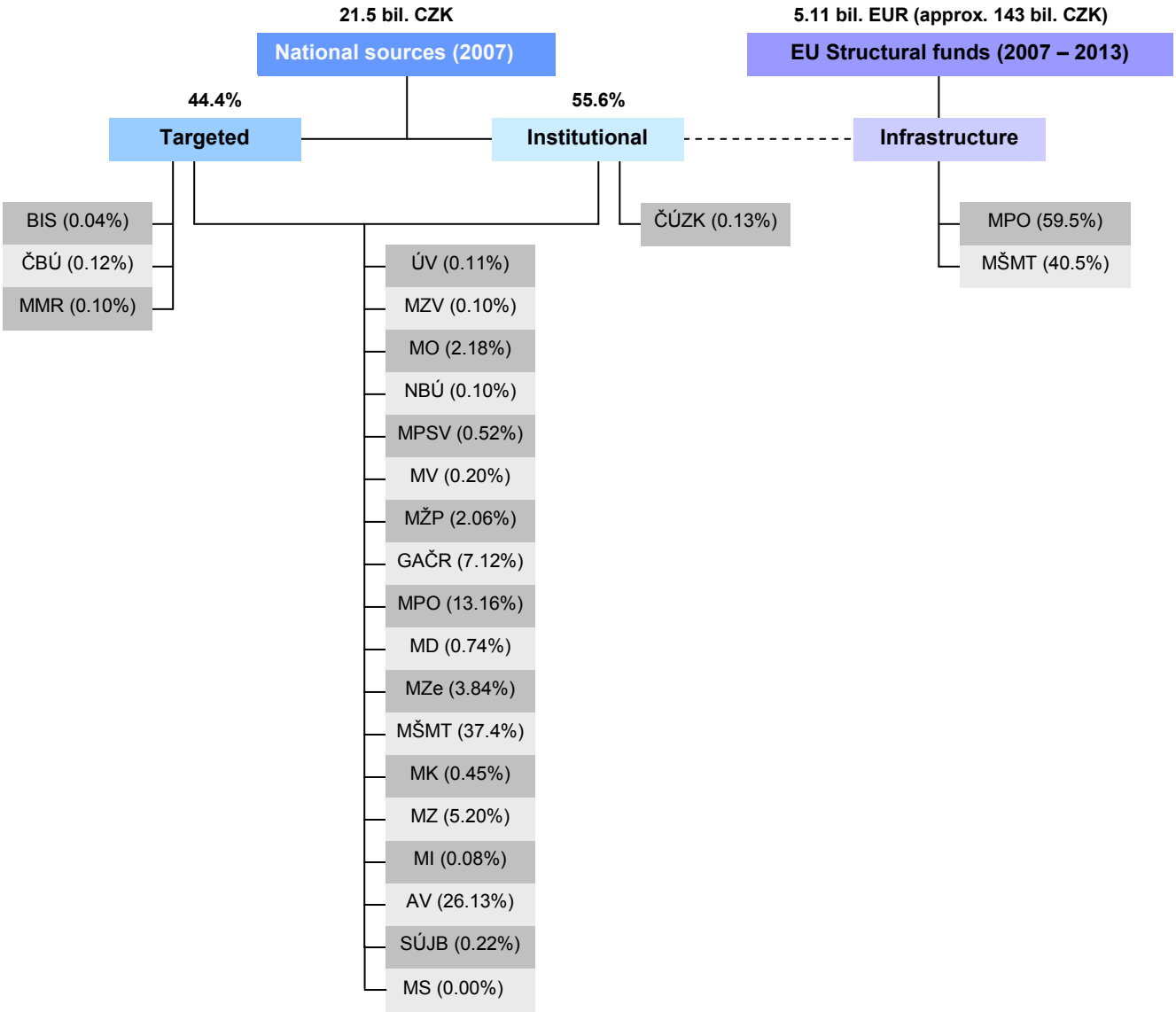
- Despite the fact that in 2006 the Czech Republic was ranked in 13th place from 27 EU countries in a comparison of innovation performance based on the **summary innovation index** (SII), the level of innovation performance in the Czech Republic is still below average on an European scale. Whereas the average SII value in the EU-27 in 2006 was 0.38, the SII for the Czech Republic was only 0.34. Since 2002 however there has been a positive development of innovation performance in the Czech Republic, with the SII increasing by 0.03 points, which represents a relatively rapid increase of more than 2 % annually. From the point of view of **the dynamics of the increase in innovation performance,** the Czech Republic was ranked in 7th place in the EU-27.
- A more comprehensive picture of the innovation environment is provided by a comparison of the level and dynamics of the summary innovation index. Since 2004, the Czech Republic has gradually shifted from the group of countries that lag behind the European average level and dynamics of development of innovation performance into the group of countries whose level of innovation performance lags behind the European average but its dynamics is gradually catching up to innovation advanced European countries.
- In other areas of innovation performance the Czech Republic has the best results in the area of **application of innovation**, which includes indicators of the sale of innovative products, exports in high-tech sector and employment in technologically and knowledge intensive sectors of manufacturing industry and services. The Czech Republic is ranked above the EU-15 average in these areas particularly due to the high share of employment in mid-tech intensive sector.
- The most significant insufficiencies can be seen in the area of **intellectual property**, where the Czech Republic reaches only 14 % of the EU-15 average. This is caused by the very low level of utilization of protection of intellectual property rights (in particular patents) by Czech subjects on an international level.
- There is significant room for improving the position of the Czech Republic in an international comparison in the area of **innovation drivers**, where the Czech Republic lags behind particularly due to the low share of the population with a tertiary education, the low share of new graduates of science and engineering subjects and insufficient broadband Internet coverage.

3.2 ENVIRONMENT FOR R&D AND INNOVATION

3.2.1 Institutional and legislative environment

3.2.1.1 System of public support for R&D and innovation

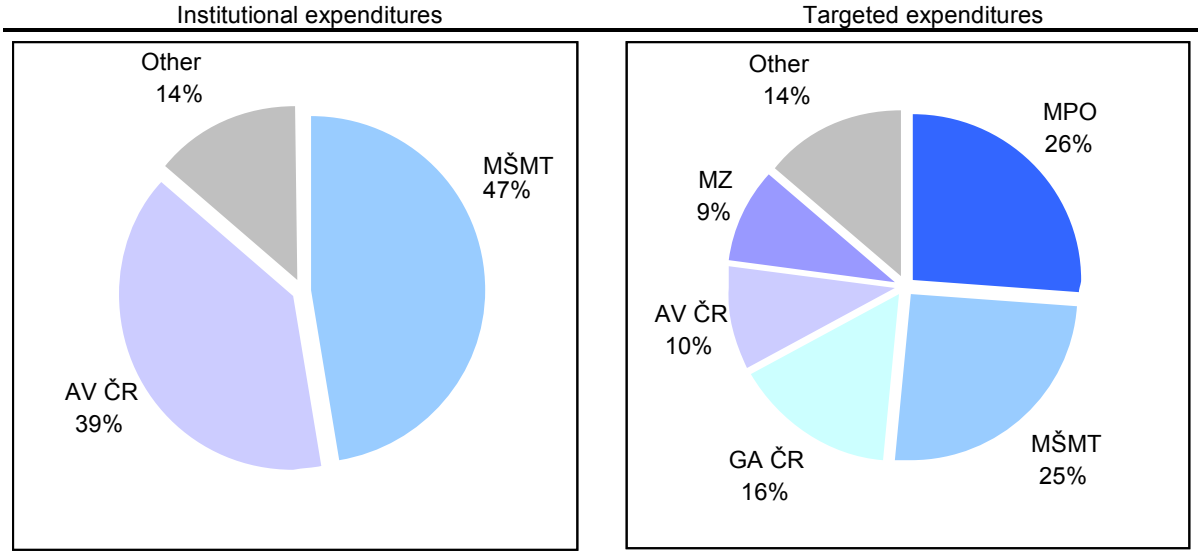
The system of public support for R&D and innovation in the Czech Republic



Legend:

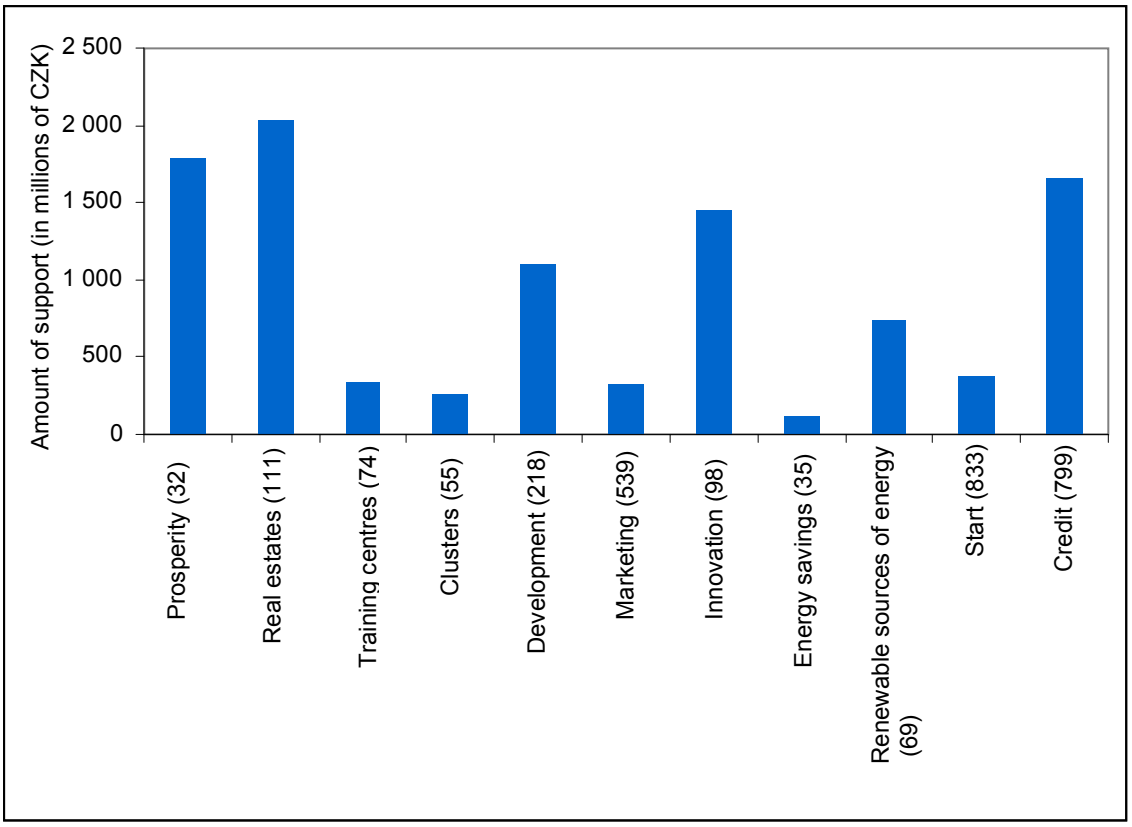
AS	Academy of Science of the Czech Republic	MPSV	Ministry of Labour and Social Affairs
BIS	Security Information Service	MS	Ministry of Justice
ČBÚ	Czech Mining Office	MŠMT	Ministry of Education, Youth and Sports
ČÚZK	Czech Office of Surveying Mapping and Cadastre	MV	Ministry of Interior
GAČR	Czech Science Foundation	MZ	Ministry of Health
MD	Ministry of Transport	MZe	Ministry of Agriculture
MI	Ministry of information	MZV	Ministry of Foreign Affairs
MK	Ministry of Culture	MŽP	Ministry of the Environment
MMR	Ministry of Regional Development	NBÚ	National Security Authority
MO	Ministry of Defence	SÚJB	State Office of Nuclear Safety
MPO	Ministry Industry and Trade	ÚV	Government of the Czech Republic

Share of individual subjects on the distribution of institutional and specific expenditure on R&D in 2007



Notice: For legend see the figure above; Source: RVV – Expenditures of the state budget on R&D between 2006 and 2007

Distribution of funding for the support of innovation in the framework of the Operational Programme Industry and Enterprise 2004 – 2006



Note: numbers in brackets indicate the number of supported projects.

Source: MIT – Operational programme Information systems (ISOP)

Analysis, comments and other information:

- The main sources of public support for research, development and innovation in the Czech Republic are funding from the state budget and since 2004 from the Structural funds of the EU. In addition to these, support is provided through programmes and initiatives of the European Commission (FP7, CIP and others).
- 21.5 billion CZK of the state budget was earmarked for R&D and innovation in 2007, from which more than 55 % was made up of institutional expenditures on R&D and more than 44 % of targeted expenditures on R&D. Expenditures on co-financing programmes of the EU Structural funds (in the framework of OPR&DI and OPEI) was also included in the **institutional expenditure of the budget for 2007,** however it was not paid out for these tasks in 2007 due to the delay in announcing and approving these programmes.
- Funding from the state budget for R&D is distributed through **22 budget chapters**, resulting in an excessive fragmentation of public support for R&D making support of complex research projects of an interdisciplinary character more difficult. Fragmentation of the system for public support of R&D is also reflected in the excessive administrative burden of the implementation process. For these reasons it would be advisable to concentrate public funding on R&D into a smaller number of budget chapters.
- The most significant mediators of **public support for R&D** provided from the state budget are MEYS (more than 37 % of R&D funding), the Academy of Science of the Czech Republic (more than 26 %), MIT (more than 13 %), the Czech Science Foundation (more than 7 %), the Ministry of Health (more than 5 %), the Ministry of Defence and the Ministry of Environment (both more than 2 %).
- The most important providers of **institutional support** are MEYS (47 %) and the Academy of Science of the Czech Republic (39 %). **Targeted support** is mostly mediated through the MIT (26 %), MEYS (25 %), the Czech Science Foundation (16 %), the Academy of Science of the Czech Republic (10 %) and the Ministry of Health (9 %).
- In the area of support of innovation and entrepreneurship, 2 863 businesses were supported from the **Operational programme Industry and enterprise (OPIE)** between 2004 and 2006 with a total volume of support exceeding 10 billion CZK. From the point of view of the volume of support the most significant programmes were programme supporting innovation infrastructure (Prosperity) and enterprise infrastructure (Reality). From the programmes of direct support of business activity the most important were the loan programme Credit and the grant programmes Innovation and Development. Despite the fact that it is not yet possible to evaluate the actual impacts of the support provided by OPIE, its innovation orientation is clear from a comparison of allocation in the individual programs.

3.2.1.2 Outlook for financing of R&D and innovation

Increase in expenditures of individual chapters of the state budget on R&D between 2008 and 2010 (in %)

Chapters of the state budget	Increase 2008 - 2010		
	Institutional expenditures	Targeted expenditures	Total expenditures
Government of the Czech Republic	6.6	28.9	14.3
Security Information Service	-	-8.0	-8.0
Ministry of Foreign Affairs	0.0	9.6	3.1
Ministry of Defence	20.6	3.0	6.7
National Security Authority	0.0	0.0	0.0
Ministry of Labour and Social Affairs	-1.7	-17.1	-9.4
Ministry of the Interior	-31.3	-2.3	-5.1
Ministry of the Environment	-5.1	35.2	15.1
Ministry of Regional Development	-	118.8	118.8
Czech Science Foundation	12.4	14.6	14.6
Ministry of Industry and Trade	54.3	35.8	37.9
Ministry of Transport	7.8	27.6	24.1
Ministry of Agriculture	0.0	24.7	10.4
Ministry of Education, Youth and Sports	34.6	74.7	46.6
Ministry of Culture	-11.3	99.5	10.7
Ministry of Health	0.0	6.2	5.0
Ministry of Justice	-	-	-
Ministry of Information	1.7	28.4	15.7
Czech Office of Surveying Mapping and Cadastre	9.2	-	9.2
Czech Mining Office	-	-15.6	-15.6
Academy of science of the Czech Republic	-1.1	2.9	-0.4
State office of nuclear safety	0.0	-6.8	-4.1
Total increase	**17.5**	**33.9**	**24.8**

Source: Calculations based on the proposal for expenditures approved by the Governmental Decree of the Czech Republic No. 564 from the 23rd of May 2007

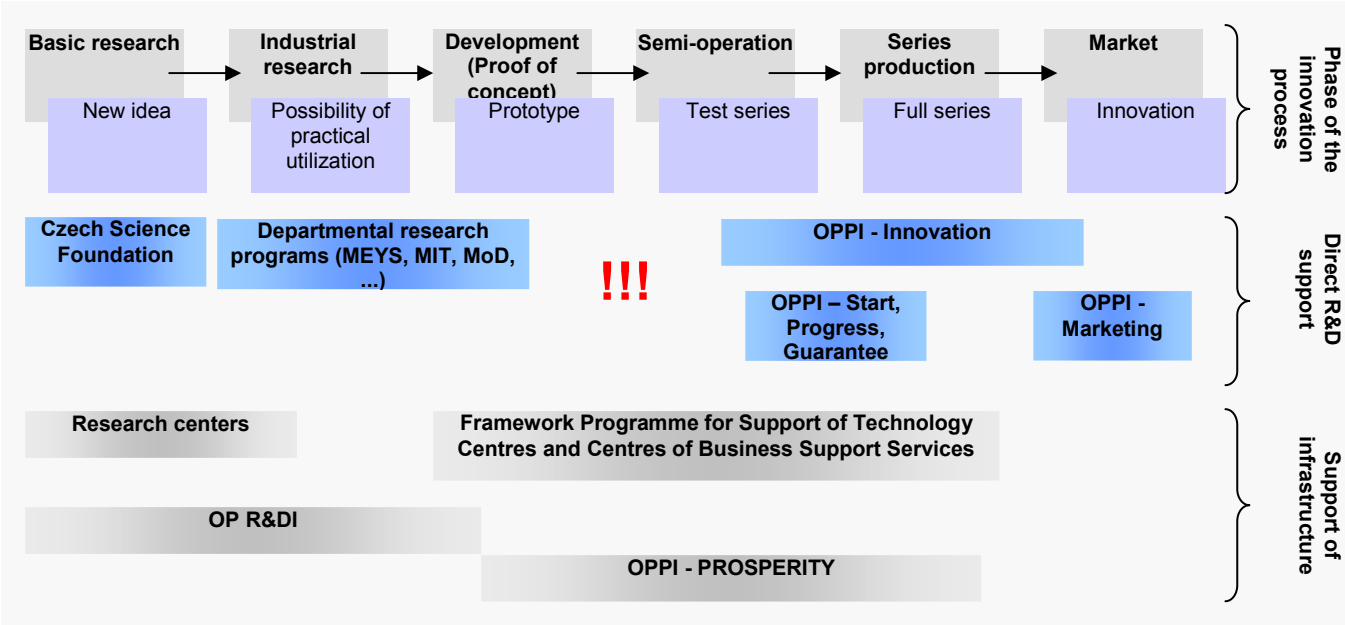
Allocation of funding from OPIE between 2007 and 2013

Priority axis	Area of support	Program	Allocation (in EUR)*	Share of allocation
1. Establishment of firms	1.1 Support of starting entrepreneurs	START	21 468 088	0.60%
	1.2 Use of new financial instruments	JEREMIE	71 560 295	2.00%
2. Development of firms	2.1 Bank instruments to support SMEs	PROGRESS	93 028 384	2.60%
		GUARANTEE	178 900 738	5.00%
	2.2 Support of new manufacturing technologies, ICT and selected strategic services	DEVELOPMENT	107 340 442	3.00%
		ICT AND STRATEGIC SERVICES	250 461 033	7.00%
		ICT IN BUSINESSES	150 276 620	4.20%
3. Energy efficiency	Energy savings and renewable energy sources	ECOENERGY	286 241 181	8.00%
4. Innovation	4.1 Increasing the innovation performance of firms	INNOVATION	500 922 066	14.00%
	4.2 Capacities for industrial research and development	POTENTIAL	299 260 578	8.36%
5. Environment for enterprise and innovation	5.1 Cooperation platforms	COOPERATION	189 634 782	5.30%
		PROSPERITY	429 361 772	12.00%
	5.2 Infrastructure for human resources' development	TRAINING CENTRES	178 900 738	5.00%
	5.3 Infrastructure for enterprise	REAL ESTATE	468 719 934	13.10%
6. Business development services	6.1 Support for consulting services	CONSULTANCY	161 010 664	4.50%
	6.2 Support for marketing services	MARKETING	85 514 553	2.39%
7. Technical			105 412 892	2.95%

assistance		
Total	**3 578 014 760**	**100%**

* Total public resources (e.g. SF EU + state budget), Source: MIT (situation as of 18/2/2008)

Simplified diagram of public support instruments covering the innovation process

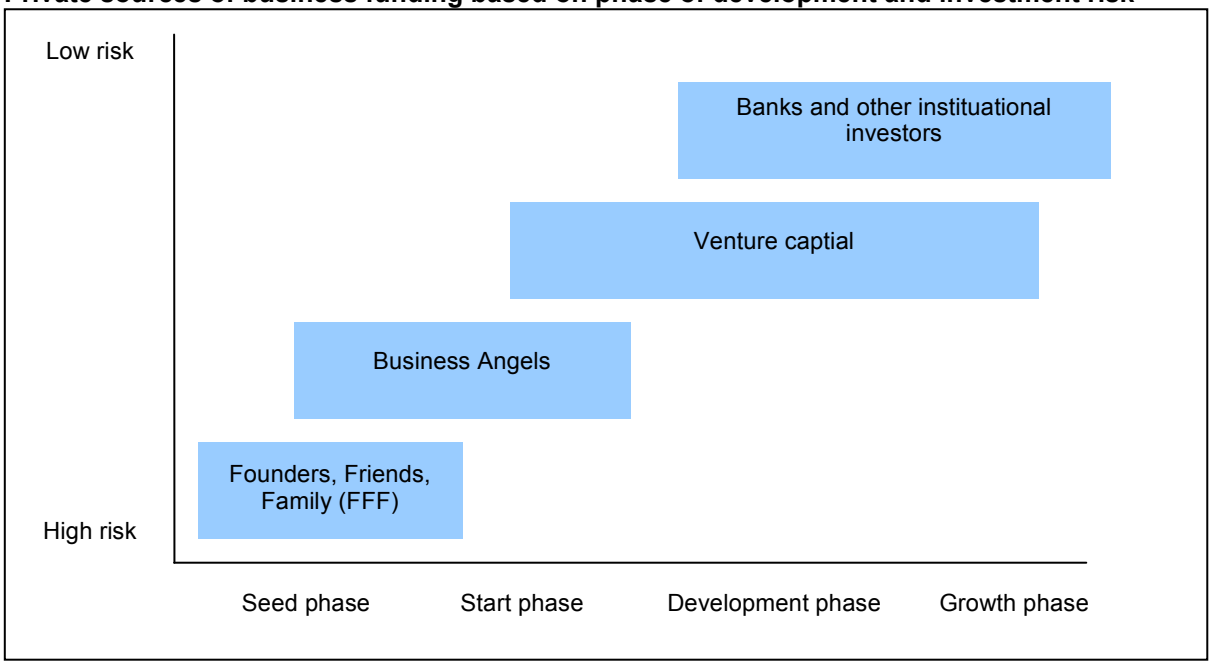


Analysis, comments and other information:

- **The outlook for the development of expenditures on R&D from the state budget for the period 2008 to 2010** indicates that institutional expenditures increase by 17.5 %, whereas targeted expenditures increase by almost 34 %. Overall the expenditure on R&D from the state budget should increase by almost a quarter, to 26.8 billion CZK.
- In addition to the sharp increase in targeted expenditures on R&D from the Ministry for regional development (from almost zero values) there is also a significant **increase in expenditures on R&D** from funding distributed by the most important providers of public support for R&D from groups of central bodies of the state administration, e.g. MEYS and MIT. Whereas the greatest increasing in targeted expenditures on R&D should be in the MEYS budget, the departments of MIT should strengthen institutional expenditures, which is represented by funding to cover the national co-financing programmes of the EU structural funds.
- The most significant subjects for the support of R&D and innovation from the Structural funds of the EU between 2007 and 2013 are the MIT with overall funding of approx. 3.5 billion € (Operational programme Enterprise and Innovation – OPEI) and MEYS, which will in this period implement programmes with a budget of approx. 4.5 billion € (Operational programme Research and Development for Innovation – OP R&DI and Operational programme Education for Competitiveness – OP EC). **Funding from Structural funds** in the area of R&D and innovation will be invested mainly into the building, expansion and modernization of research and innovation infrastructure. In addition to the development of innovation infrastructure and cooperation, OPIE (approved by the European Commission in December 2007) places emphasis on support in the areas of ICT, development of the research potential of businesses and protection of intellectual property rights.
- From the point of view of covering the individual phases of the innovation process using instruments of public support for R&D and innovation it can be stated that the individual instruments cover the innovation process with the exception of a single phase. **This is the transition from the phase of development to semi operational phase** or the phase when a trial series of innovative products is created based on the prototype. This phase, characterized by the testing of prototypes, is usually connected with large overheads and a significant risk of failure. For this reason projects in this phase of the innovation process are not attractive for external sources of private financing and the risk and costs are usually covered entirely by the innovative subject.
- In contrast, the orientation of **programmes for the support of research and innovation infrastructure** fully covers all phases of the innovation process (with the exception of the market application phase, which does not require any special infrastructure).

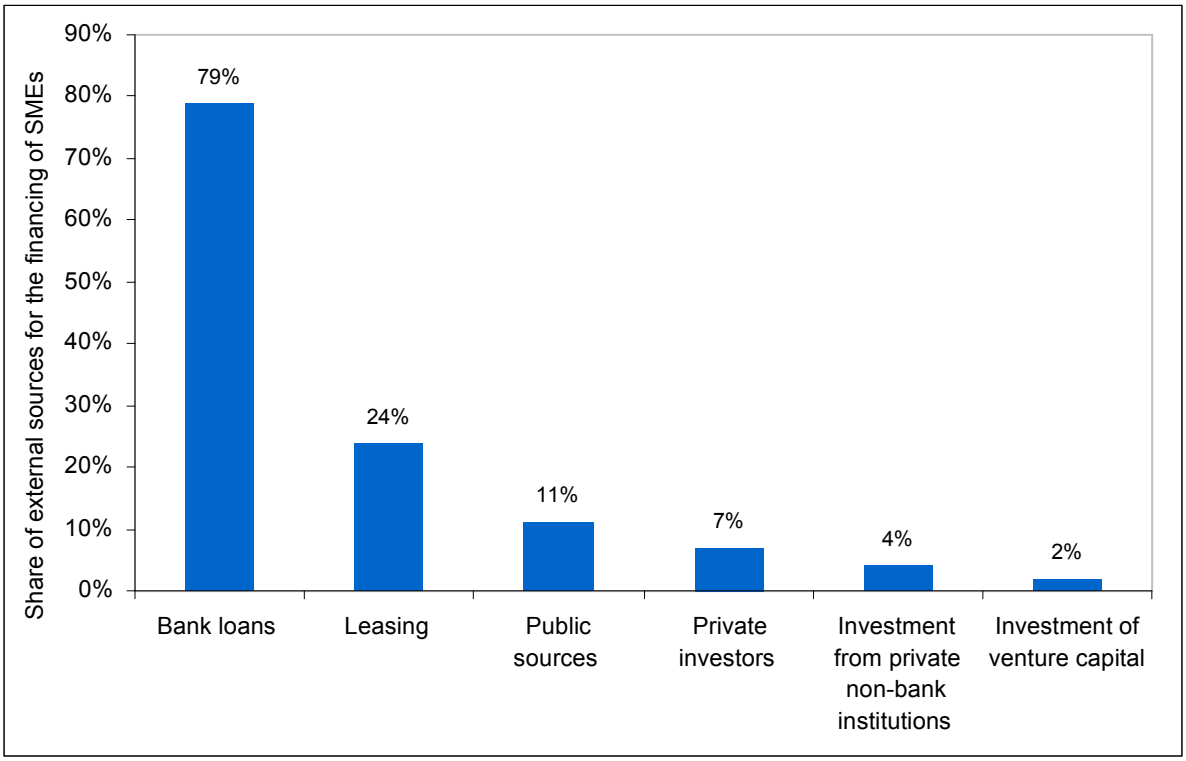
3.2.1.3 Private financing of R&D and innovation

Private sources of business funding based on phase of development and investment risk



Source: TC AS CR

External financial resources used by SMEs



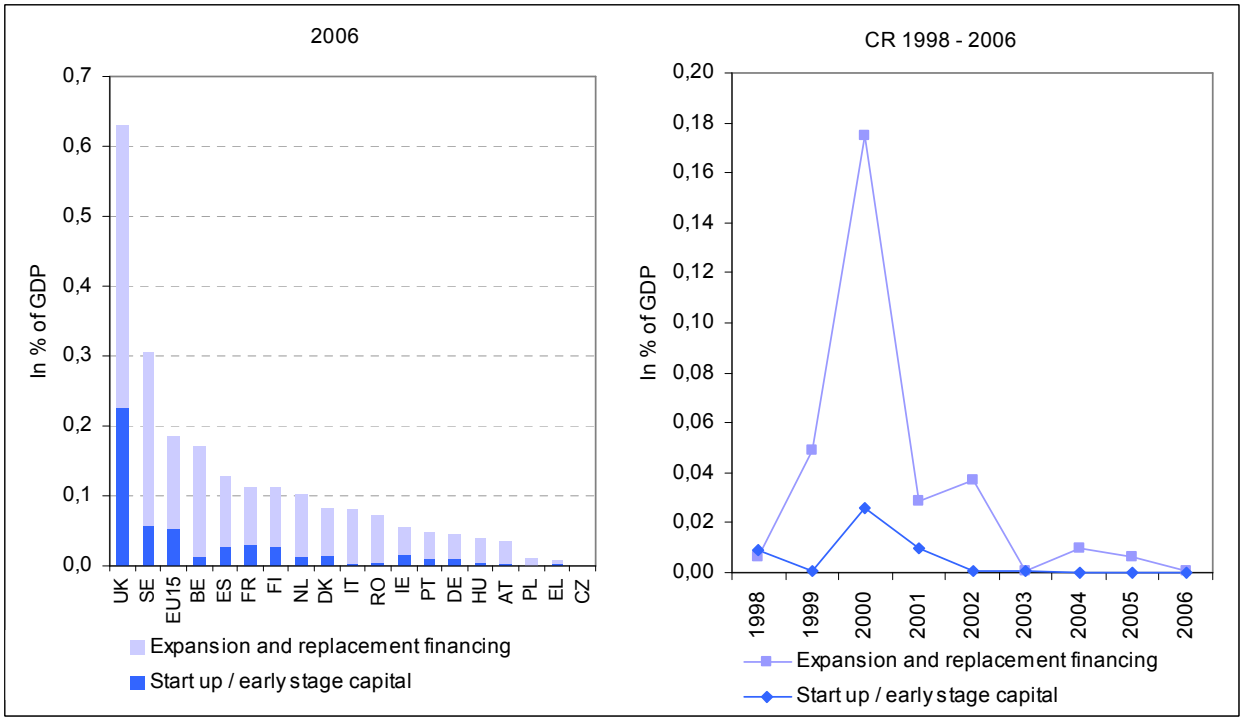
Source: EC – Flash Eurobarometer No. 174 "SME Access to Finance"

Analysis, comments and other information:

- There are various risks of failure connected to the phases of the development of a business. For this reason there are separate sources of financing for each individual phase of the development of a business. The **seed phase**, in which the business plan is formulated, is connected with high risk from the point of view of investment and therefore the entrepreneur's private resources are mainly utilized – equity capital. In the **start-up phase** the best source of financing is from business angels, which allow entrepreneurs to obtain not only capital for this very risky period of business development but also provide the necessary know-how (or contacts) in the areas of managing a business and establishing it on the market. In **later phases of the development and growth of a business,** venture capital, bank loans or other financial market tools (IPO,...) are considered as being appropriate sources of financing.
- **Bank loans** represent a convenient source of financing in the development or the growth phase of a business. In the start-up phases this funding instrument is usually not available because start-up businesses are not usually capable of providing the bank with a sufficient guarantee (due to insufficient capital strength). It is also difficult for the bank to evaluate the feasibility and risk of failure of the business plan of an innovative business. In addition a bank loan is not a convenient source of financing for a business in the start-up phase as the loan repayments have a negatively effect on its cash-flow. In the start-up phases of the development of a business therefore the availability of **equity capital** (venture capital, business angels, etc.).
- Nevertheless, bank loans are the main **source of financing of small and medium-sized enterprises (SME)** in Europe. This tool of external financing is utilized by 79 % of all SMEs. The second most significant source of external financing is leasing, which is utilized by almost one quarter of all European SME. In contrast venture capital is used by only 2 % of SMEs in Europe.

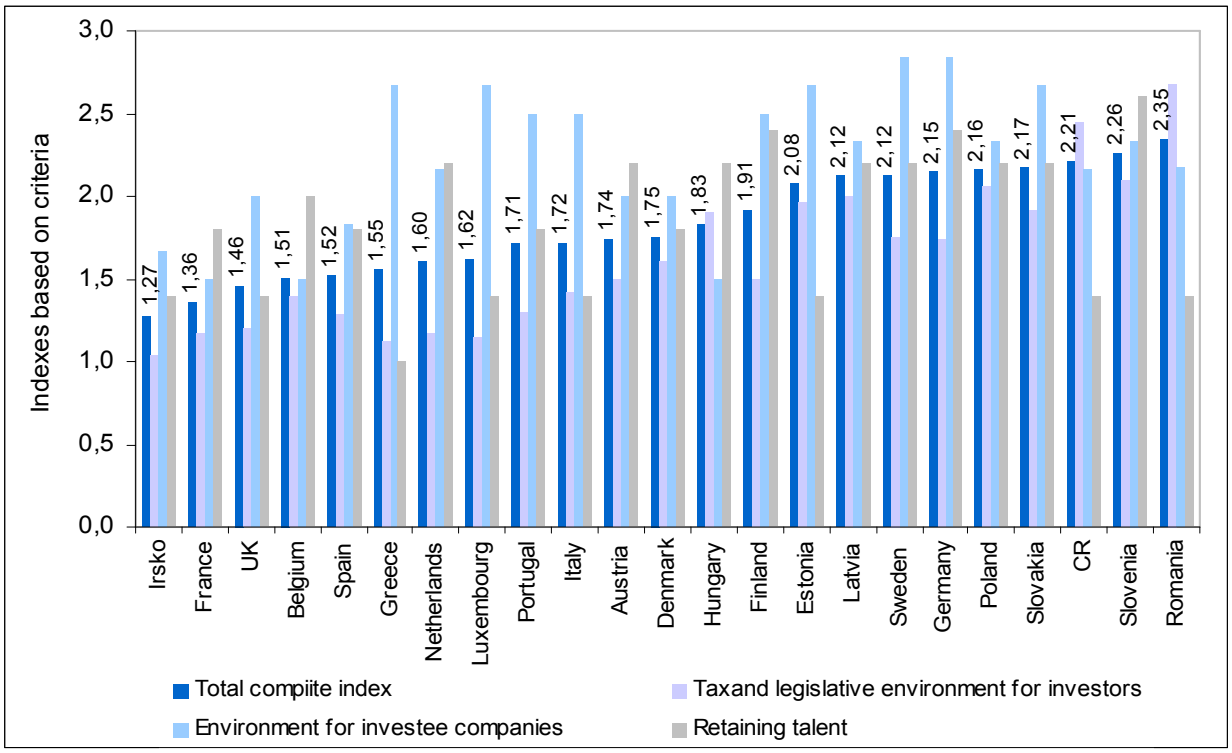
3.2.1.4 Venture capital

International comparison of venture capital investment in 2006 and development of venture capital investment in the Czech Republic 1998 - 2006



Source: Eurostat

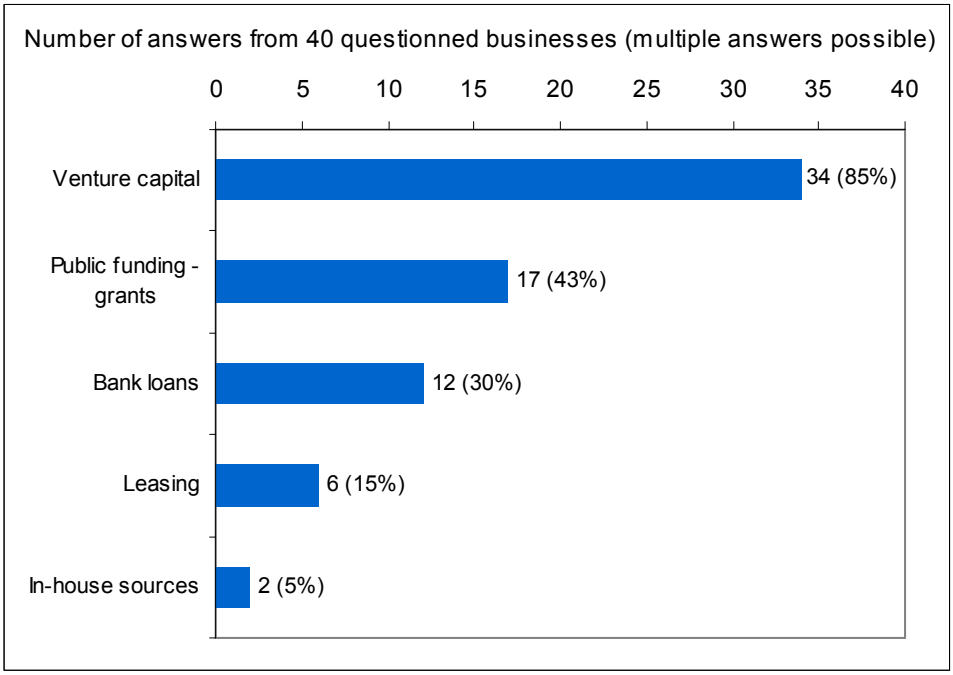
Comparison of environments for venture capital investment*



*Note: a lower index value means a better environment for venture capital investment.

Source: EVCA – Benchmarking European Tax and Legal Environments (December 2006)

Results of the survey on financial resources which innovative businesses do not utilize or do not want to utilize in business



Source: Barriers to the growth of competitiveness the Czech Republic, Technology Centre AS CR, study

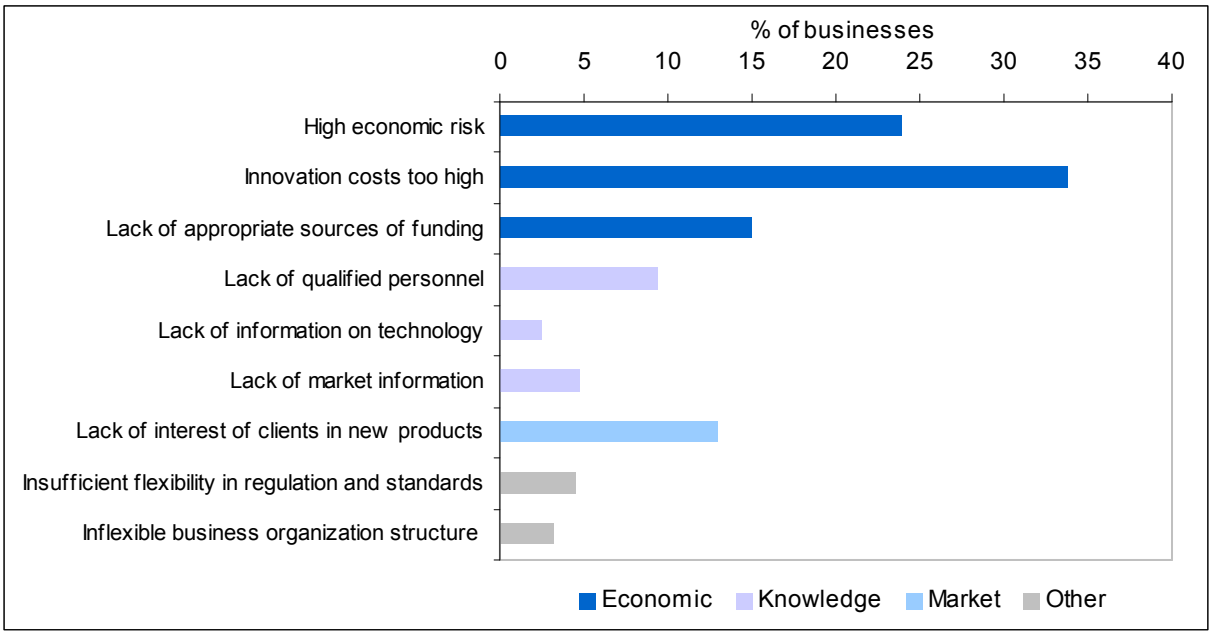
Analysis, comments and other information:

- The Czech Republic is one of the European countries at the bottom of the scale in indicators of **venture capital investment**. Only 0.001 % GDP was invested as venture capital in the Czech Republic in 2006, which ranks the Czech Republic in last place among the European countries for which this indicator was available. For a comparison in the United Kingdom 0.63 GDP was invested in the form of venture capital in the same year and the EU15 average is 0.186 % GDP.
- From the point of view of the potential of venture capital for covering the financial requirements in the development phase of a business the situation in the Czech Republic is very poor because **investment of early stage venture capital** has been almost negligible since 2004 and the Czech Republic is deservedly ranked last among the countries in the comparison. The highest share of early stage capital (in relation to GDP) is invested again in the United Kingdom (0.224 % GDP).
- **Development in the field of venture capital** in the Czech Republic does not paint an optimistic picture either. After 2000, the most significant year from the point of view of investment of early stage and expansion venture capital, the volume of venture capital investment decreased to 0.001 % GDP.
- In an international comparison the Czech Republic is a country with one of the worst **tax and legislative environments for investment of venture capital** (with only Slovenia and Romania behind them). The situation in the Czech Republic has worsened since 2004 (from the values of composite indicators 2.12 in 2004 to 2.21 in 2006).
- The most significant insufficiencies of the Czech environment for investment of venture capital are in the areas of tax and legislation for investors, where the weakest points are the **existence of double taxation** (on a business and fund level) and the strict **regulation of pension funds and insurance companies,** not permitting these institutions to invest the equity capital. In addition, there are no fiscal incentives for venture capital investors in the Czech Republic.
- The unfavourable environment for investment of venture capital can also be seen **from the point of view of demand for this type of** financing. From the survey among innovative businesses performed in 2004 it follows that they do not utilize venture capital and 85 % of innovative businesses do not even want to utilize it. The main barriers to the utilization of venture capital mentioned were the apprehension that the businesses will lose their independence, the slow growth of businesses and the excessively high investment threshold required by the investors. In contrast most businesses rely on their own resources or external financing in the form of leasing.

3.2.2 Infrastructure and cooperation

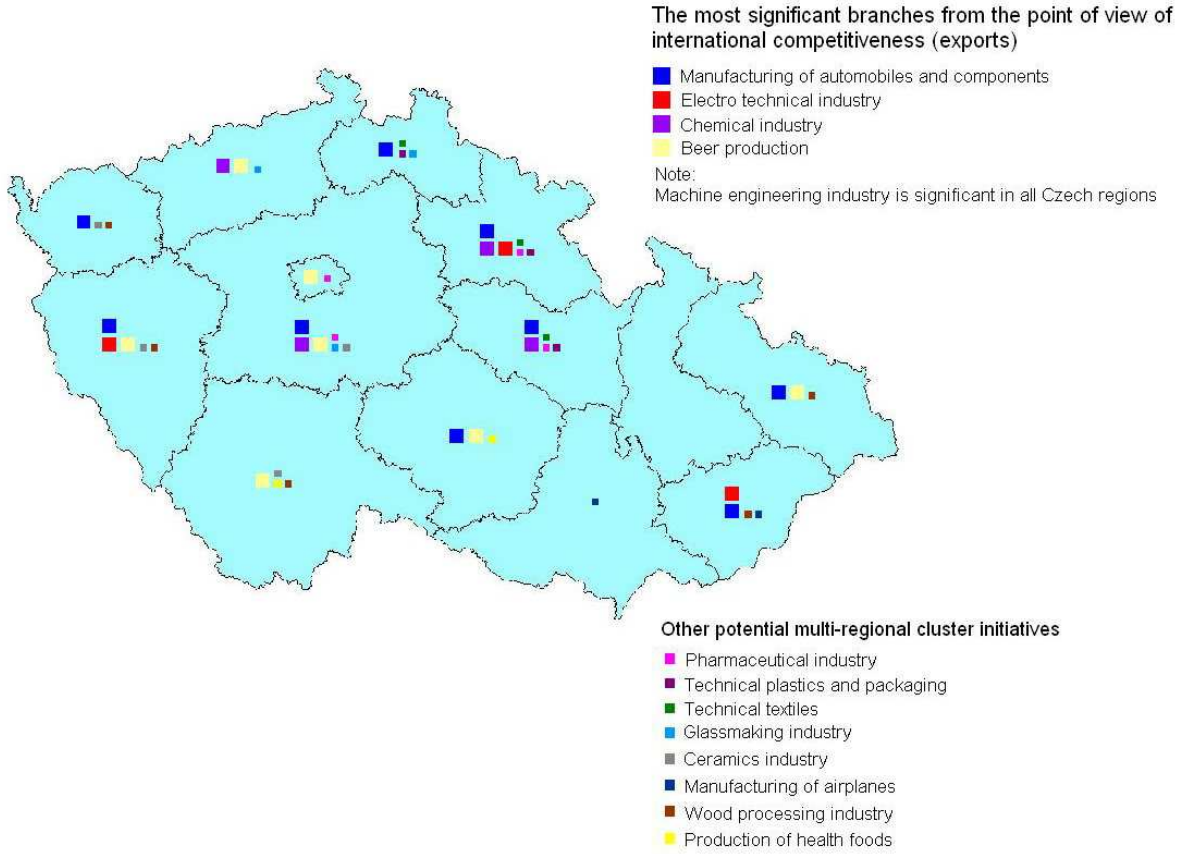
3.2.2.1 Cooperation between subjects of the innovation process

The most significant barriers for the transfer of technology (based on survey among research and development institutes



Source: Barriers to the growth of competitiveness the Czech Republic, Technology Centre AS CR, study

The most significant sectors from the point of view of competitiveness and multi-regional clusters in the Czech Republic



Source: elaborated based on BermanGroup study, Identification of potential competitive clusters

Analysis, comments and other information:

- **Cooperation between public research and universities on the one hand and the business sector on the other hand and the transfer of R&D knowledge in to practice** (commercialization of R&D results) is one of the major weaknesses of the Czech knowledge based economy. It follows from the results of survey among research institutes that a very significant obstruction is the **lack of demand of Czech businesses for the results of R&D**, which is probably caused not only by the lack of funding in smaller businesses but also by the orientation of businesses towards the utilization of the hitherto relatively cheap labour force and products with lower value added (more than half of the businesses in the survey mentioned that their advantage on foreign markets is mainly the low cost of their products). The **high costs for foreign patents** were also considered to be a significant barrier.
- A significant obstruction to the transfer of knowledge from research into practice and performance of innovation in the business sector is **the low motivation and conservative thinking of R&D personnel**, who consider research as being an 'academic game' without practical outputs. This way of thinking is significantly influenced by the system of evaluation of R&D as there is a poor correlation between the allocation of public funding for research and the research results.
- A major way of commercializing the results of R&D is the creation of spin-off businesses. Research results show that the greatest barrier to the creation of such businesses in R&D institutes is their **poor access to funding** (in particular pre-seed and seed capital). At the time of the study the creation of these businesses was also limited by complicated **legislation.** The bias of academic personnel and an institutional culture oriented towards academic research also play a significant role.
- **Cooperation between businesses** is not at a satisfactory level. The BermanGroup study focusing on clusters active in the Czech Republic indicated that the concept of clusters and their significance for regional economic development are not appreciated in the public or private sector. It also shows that clusters are yet to be a decisive priority for public policy at any level lower than national level.
- The Berman Group study also identified the following clusters with nationwide competence **which are significant from the point of view of international competitiveness**:

- Manufacturing of automobiles (NACE 34) and components is based in Středočeský region (Mladá Boleslav, Kolín) which together with Praha makes up one of the main 'motors' of the Czech economy. This cluster is part of a Central European automobile cluster with strong ties to Germany and growing connections to Slovakia and Poland.
- Machine engineering industry (NACE 29) is the most significant exporter, employer and recipient of foreign investment in the Czech Republic after manufacturing of automobiles. Taking into consideration the scale of the branch the presence of the machine engineering cluster was identified in all of the regions the Czech Republic, for the same reason there are several specialized clusters in the framework of machine engineering manufacture.
- Beer production (NACE 15) represents a traditional sector with its roots in the regions of Středočeský, Jihočeský, Plzeňský, Ústecký and the region of Praha. Major exporters are also located in the regions of Moravskoslezský and Vysočina.
- Chemical industry (NACE 24) and electrical industry (NACE 31) were also identified as being very important from the point of view of the international competitiveness of the Czech Republic however they do not have nationwide competence.
- Several clusters were identified as having multi-regional competence. These clusters include: pharmaceuticals (NACE 24.4), technical plastics and packaging (NACE 25), technical textiles (NACE 17), glass manufacture (NACE 26), ceramics (NACE 26), manufacture of airplanes (NACE 35), wood and products of wood (NACE 20) and manufacturing of health food (NACE 15). The electrical industry (NACE 31) does not form a similarly coherent multi-regional cluster but it is focused in several regions in various parts of the Czech Republic.

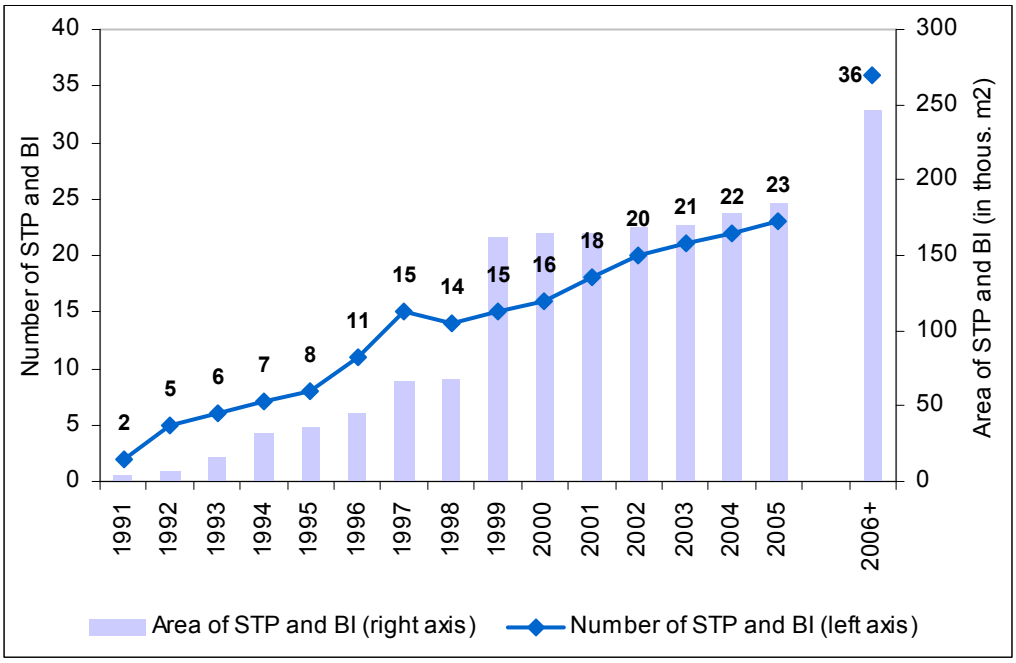
3.2.2.2 Infrastructure for R&D and innovation

Number of reporting units performing R&D, index of change 2001-2005 and share per region in the overall number of reporting units performing R&D in the Czech Republic

Region	Number of R&D reporting units					Index of change 2001-2005	Share in the Czech Republic (in %)				
	2001	2002	2003	2004	2005		2001	2002	2003	2004	2005
Praha	453	453	522	557	591	130.5	33.3	29.2	28.3	28.4	29.3
Středočeský	108	129	149	164	162	150.0	7.9	8.3	8.1	8.4	8.0
Jihočeský	55	69	81	89	92	167.3	4.0	4.4	4.4	4.5	4.6
Plzeňský	47	71	71	73	74	157.4	3.5	4.6	3.8	3.7	3.7
Karlovarský	13	14	18	20	16	123.1	1.0	0.9	1.0	1.0	0.8
Ústecký	55	67	78	70	71	129.1	4.0	4.3	4.2	3.6	3.5
Liberecký	50	57	74	74	73	146.0	3.7	3.7	4.0	3.8	3.6
Královéhradecký	61	75	96	98	97	159.0	4.5	4.8	5.2	5.0	4.8
Pardubický	56	64	86	91	88	157.1	4.1	4.1	4.7	4.6	4.4
Vysočina	38	57	56	62	69	181.6	2.8	3.7	3.0	3.2	3.4
Jihomoravský	182	218	277	292	292	160.4	13.4	14.1	15.0	14.9	14.5
Olomoucký	55	68	86	97	98	178.2	4.0	4.4	4.7	4.9	4.9
Zlínský	66	75	96	114	118	178.8	4.8	4.8	5.2	5.8	5.9
Moravskoslezský	123	134	156	160	176	143.1	9.0	8.6	8.5	8.2	8.7
CR total	1 362	1 551	1 846	1 961	2 017	148.1	100.0	100.0	100.0	100.0	100.0

Source: CSO

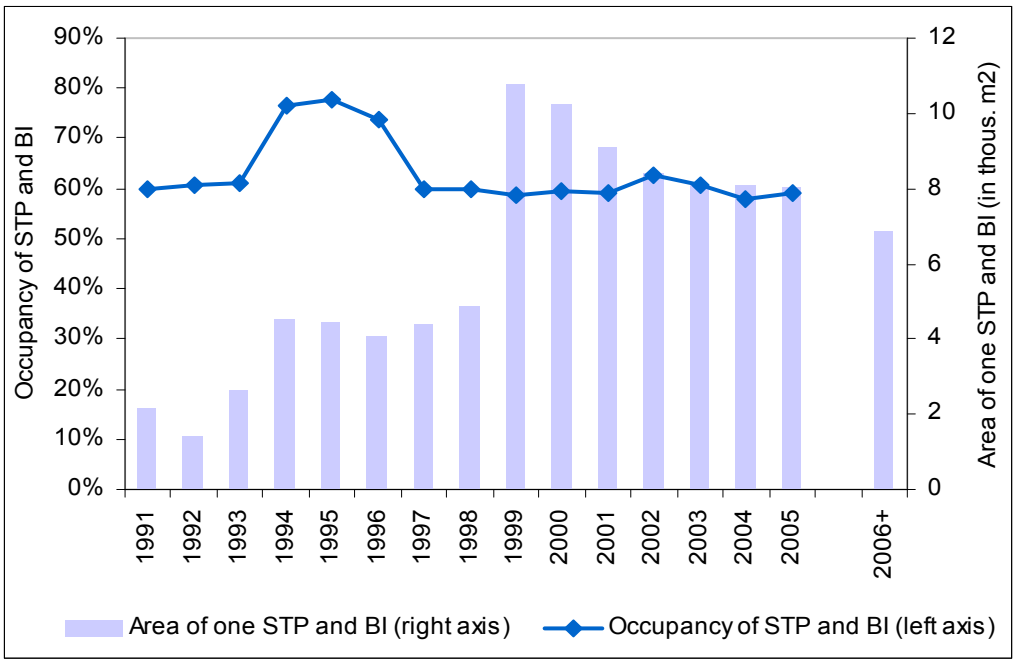
Number and total area of Science and Technology Parks (STP) and Business Incubators (BI) in the Czech Republic



Note: 2006+ estimated number and area by 2008 based on projects submitted in the support program of MIT (OPPS – Prosperity).

Source: SVTP, CzechInvest, our own estimates

Average area per Science and Technology Park (STP) and business incubator (BI) and average occupancy of STP and BI in the Czech Republic



Note: 2006+ estimation of average area of STP and PI by 2008 based on projects submitted in the support program of MIT (OPPS – Prosperity).

Source: SVTP, CzechInvest, our own estimates

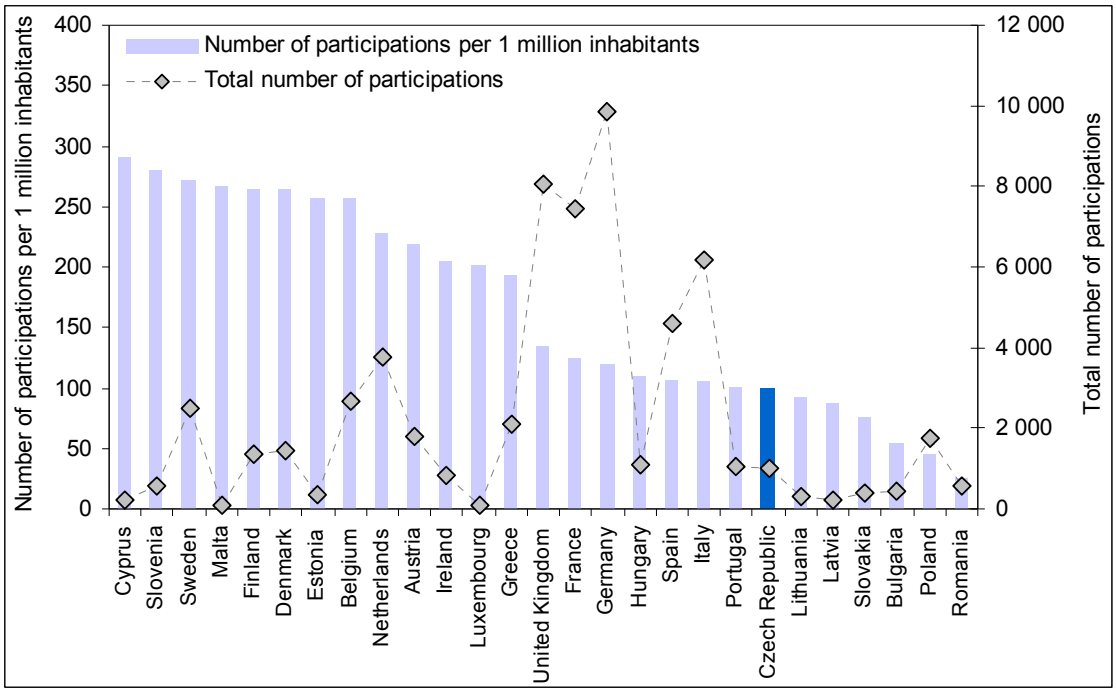
Analysis, comments and other information:

- From a total number of 2 017 R&D reporting units almost 30 % were based in the capital city in 2005. In 2001 Praha had a share of one third and together with Středočeský region it had more than 40%. The three regions with the highest number of R&D units (Praha, Jihomoravský and Moravskoslezský region) have a concentration of 52.5 % of this capacity whereas in 2001 this share was 55.7 %. We can say that there is a certain **decentralization of research capacity into other regions**.
- Important infrastructure which stimulates and simplify innovation activity of businesses are **science and technology parks, business incubators and technology transfer centres**. In the Czech Republic these innovation infrastructure subjects began to develop in 1999 (inter alia in relation to the creation of public support tools for this area). In 2005 there were 23 parks active in the Czech Republic offering a total area of more than 180 thousand m^2.
- In relation to the increased emphasis on expanding innovation infrastructure from the side of the government since 2004 we can expect an increase in the number of science and technology parks (STP) and business incubators (BI), and an increase in the area for incubation and development of innovative businesses in the Czech Republic. Based on estimates from monitoring reports of the Operational Programme Industry and Enterprise there will be around 36 active parks and incubators by 2008 and the space leased will increase to almost 250 thousand m^2.
- **Development in the average area per individual STP or BI** shows that since 2002 this indicator has stabilized at around 8 thousand m^2. This value corresponds approximately to the minimal area for financial sustainability of the functioning of these innovation infrastructure subjects (STP generally require more surface area than BI for financial sustainability).
- From the point of view of **occupancy of STP and BI** the average value has stabilized at approx. 60 %. This level of occupancy forms the assumption for sufficient self-financing and flexibility of STP and BI. With an increase in the awareness of the importance of innovation and cooperation in the business sector there will be an increase in the demand for the services that STP and BI provide. This demand will lead to an increase in the services offered by the innovation infrastructure related to their development since 2006. From the point of view of occupancy however no pressure on the capacity of the innovation infrastructure is expected.
- A major component of the services provided in the framework of innovation infrastructure (in particular business incubators) are **consulting and other services** for businesses located in STP and BI. From the investigation performed by TC AS in the framework of the project 'Barriers to the growth of competitiveness of the Czech Republic' and other studies for the state administration it follows that businesses lack a sufficient level of quality of services provided by the innovation infrastructure. The main insufficiencies include weak support for the transfer of technology (in particular between R&D workplaces and businesses), insufficient support in mediating contacts or lack of consulting in the area of intellectual property.

3.2.3 Participation of the Czech Republic in ERA and international cooperation in R&D

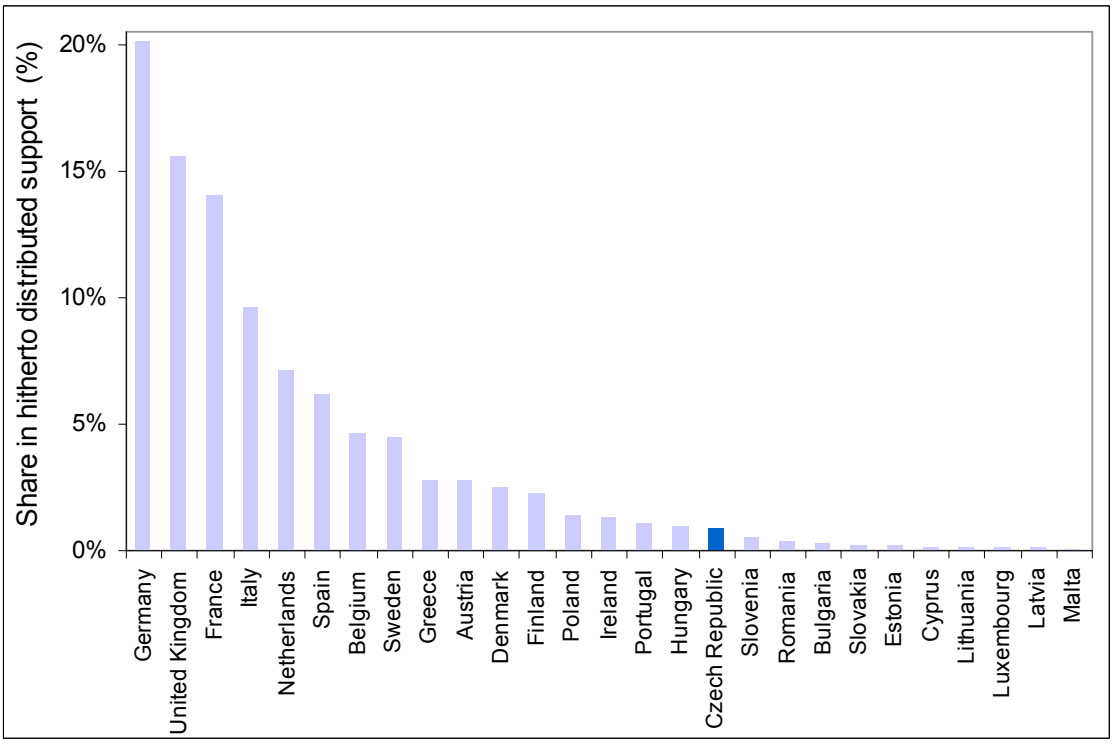
3.2.3.1 Participation in the 6th European Framework Programme for Research and Technological Development – number of participants and financial support

Participation of EU-27 in contracted projects of the 6th European Framework Programme (FP6) and number of participants per 1 mil. inhabitants (data from July 2006)



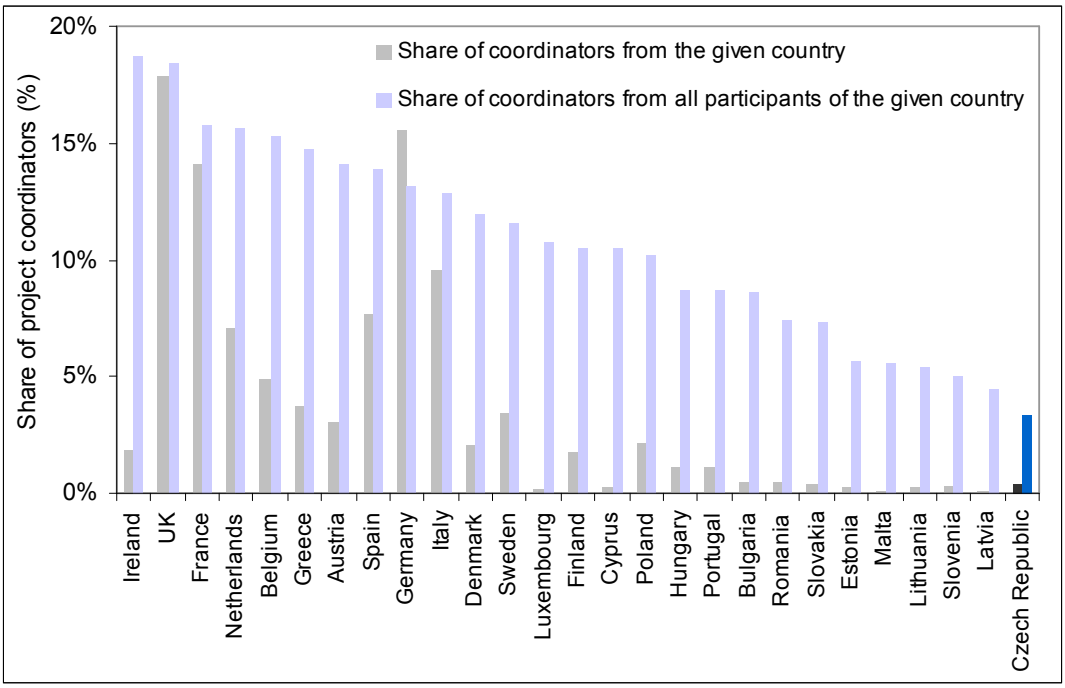
Source: Database of the E-CORDA project, data as of 30th of July 2007

Country ranking based on share of EC support distributed to-date to national teams in FP6



Source: Database of the E-CORDA project, data as of 30th of July 2007

Percentage of coordinators in FP6 projects



Source: Database of the E-CORDA project, data as of 30th of July 2007

Comparison of the average budgets of participants of Czech teams with EU-11 teams (new member states without the Czech Republic) and EU-15.

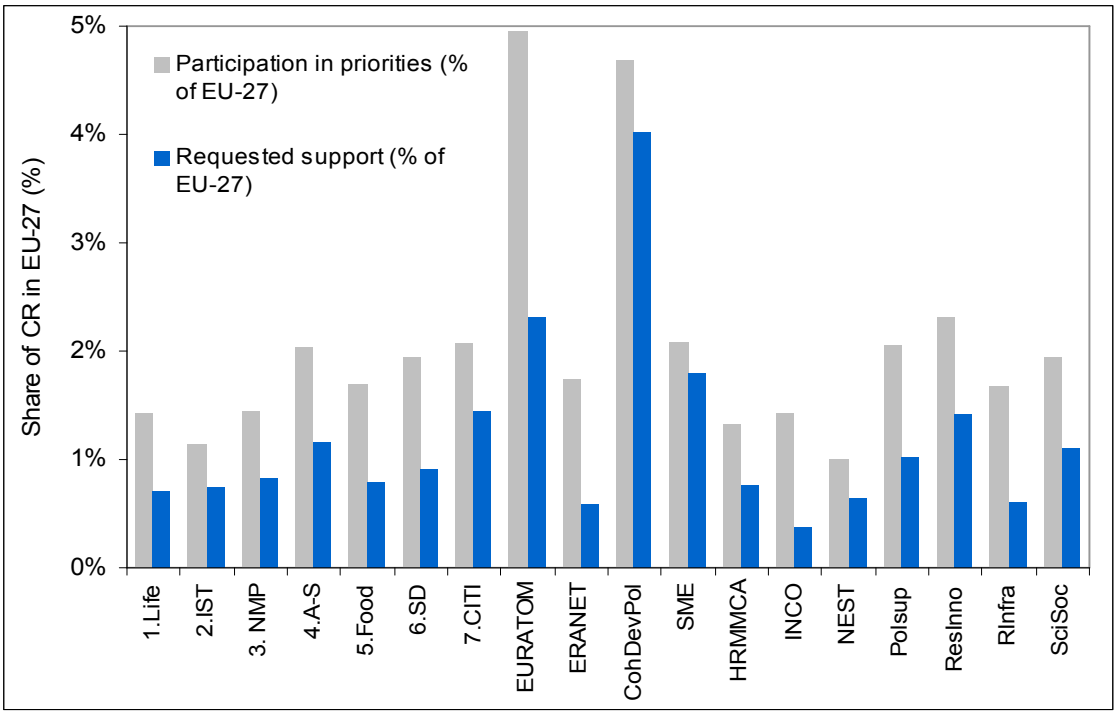
	Average budget €	Share of EC contribution from budget	EC contribution €
CZ	184 277	123 004	66,7 %
EU-11	151 045	109 504	72,5 %
EU-15	396 228	255 366	64,4 %

Analysis, comments and other information:

- By the 30th of July 2007 contractual negotiations for 8 861 FP6 projects was completed with a total of 69 162 participants (not necessarily different, several teams participate in more than one project). There are 1 015 Czech teams involved in the 830 FP6 projects, which is approx. 1.5 % of all participants. The Czech Republic has a significantly **lower number of participants per 1 million inhabitants** in FP6 projects in comparison with the EU-15 and lags behind several new member states (21st place among the EU-27 and 6th position among the new member states).
- From the total budget of the FP6 of 15 811 mil. € (contracted projects by 30th of July 2007) Czech participants obtained a total of 124.48 mil. €. The amount contracted by Czech teams represents approx. 0.78 % of the amount which the EC has released from the FP6 budget till July 2007. The average budget of Czech teams is approx. 184.3 thousand € and Czech teams have requested approx. 123.0 thousand € from the EC in the average. In comparison with similar sized countries **the support obtained is significantly lower.** For instance Hungary has obtained a much larger contribution.
- The average budget of Czech participants in FP6 projects is higher than in the EU-11 (new member states without the Czech Republic). Nevertheless, the **average budget of Czech participants is approx. half of the average budget of participants from the EU-15**. The same situation is also true for the average contributions that the participants have obtained from the European Commission.
- The Czech Republic has a very **low number of project coordinators**. Whilst there are 18.8 % of coordinators in Irish teams, only 3.4 % of coordinators are in Czech teams. The ambition of Czech teams to coordinate international consortia is the lowest from all of the EU-27. Undoubtedly this is because coordination activity requires a high level of specific expertise. Czech coordinators represent 0.4 % of EU-27coordinators, which is significantly lower than by states of a similar size – Hungarian coordinators have a three times higher representation (1.2 % from the EU-27) and countries like Austria, Sweden, Belgium and Greece have more than 3 % of coordinators from the EU-27.

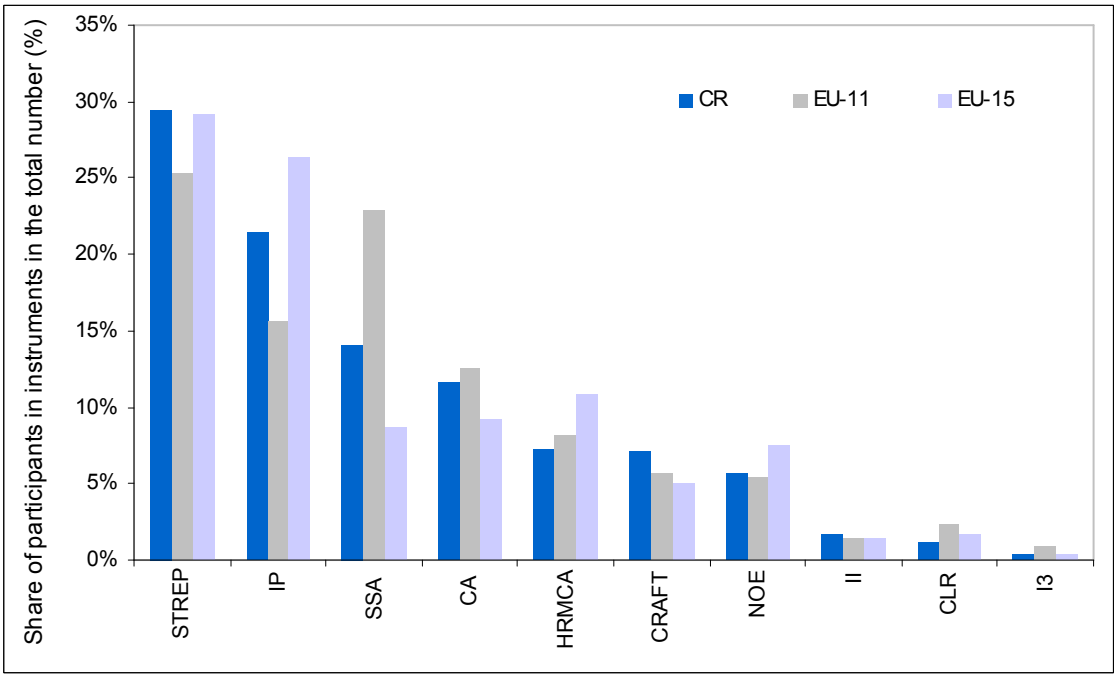
3.2.3.2 Participation in the 6th European Framework program – thematic priorities and financial instruments

Participation of the Czech Republic in individual thematic priorities and horizontal programmes of FP6



Source: Database of the E-CORDA project, data as of 30th of July 2007; for abbreviations see the List of abbreviations (Chapter 5)

Participation of the Czech Republic in individual FP6 financial instruments



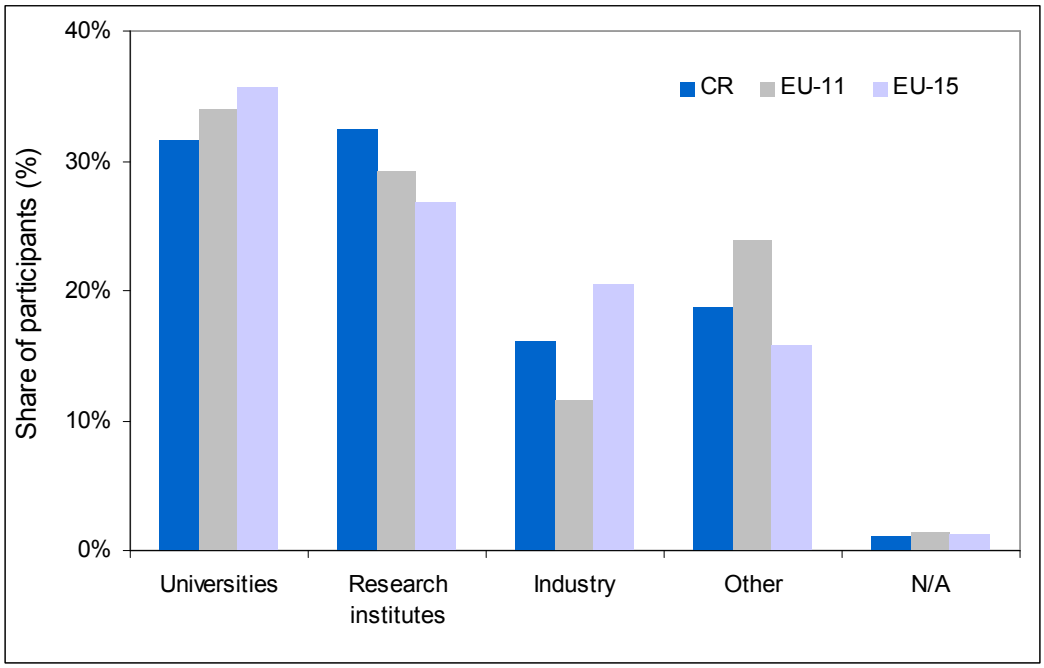
Source: Database of the E-CORDA project, data as of 30th of July 2007; for abbreviations see the List of abbreviations (Chapter 5)

Analysis, comments and other information:

- The most Czech teams participate in the 6th thematic priority SD (Sustainable Development, Global Change and Ecosystems), in which the Czech Republic has 164 participants. In second place is priority IST (Information Society Technologies) – 146 participants – and then the priorities Life Sciences, Genomics and Biotechnology for Health (LIFE) and Nanotechnologies and Nano-sciences, Knowledge-based Multifunctional Materials, New Production Processes (NMP), in which there are approx. 77 participants. In the 4th priority A-S (Aeronautics and Space) there are 58 participants, in the 5th priority Food (Food Quality and Safety) 45 participants and in the 7th priority CIT (Citizens and Governance in a Knowledge-based Society) there are 34 participants. In the EURATOM program there are 52 participants (it is necessary to take into consideration that participants in this program typically participate many times e.g. one institution participates more than 30 times).
- The percentage of Czech participants (teams) in individual thematic priorities and horizontal priorities of FP6, which can be regarded as a level of success of Czech teams in FP6, is the highest in the EURATOM program, in which Czech participation represents 4.9 % of the participation of teams from the EU-27 and Czech participants request 2.3 % of the total support distributed by EURATOM for the performance of projects. Next are the priorities Citizens and Governance in a Knowledge-based Society (7. CIT) and Aeronautics and Space (4. A-S). In both of these priorities Czech participation exceeds 2 % of the participation of the EU-27 and the requested contribution very significantly exceeds 1 % of the amount requested by EU-27 teams from the EC. The participation in the priority Sustainable Development, Global Change and Ecosystems (6. SD) is also high, with Czech participation reaching 2 % of the participation of the EU-27 and Czech teams requesting 0.9 % of the total support for all EU-27 teams (i.e. significantly more than the Czech Republic on average contributed to the FP6 budget between 2003 - 2006).
- In thematic priorities 1. LIFE, 2. IST, 3. NMP, whose total budget makes up approx. 3/4 of the total budget of all thematic priorities, the Czech Republic has a lower participation, both in the percentage of representation among teams of the EU-27, and in the percentage of requested support. The Czech Republic is least represented in the thematic priority Information Society Technologies (2. IST; 1.14 % of the participation of the EU-27). The Czech Republic requests the least support in the priority Life sciences, Genomics and Biotechnology for Health (1. LIFE), with 0.71 % of the support for all of the EU-27 teams. In the priorities Nanotechnologies and Nano-sciences, Knowledge-based Multifunctional Materials, New Production Processes (3. NMP) and Food Quality and Safety (5. Food) Czech teams request support on the level of approx. 0.8 % of the support requested in these priorities by all EU-27 teams.
- In horizontal priorities the Czech Republic is most successful in the area of coherent development policies (CohDevPol). The budget for this priority represents only a fraction of the total budget of the FP6 and only seven teams from the Czech Republic participate in it. A major success is the participation of the Czech Republic in Specific SME (small and medium-sized enterprises) Activities, where Czech participants make up 2.1 % of all participants EU-27 and support makes up 1.8 % of the total EC support for EU-27 participants in this priority. A relatively high amount of the distributed funding (1.4 %) is requested by Czech participants in the priority Research and Innovation. Czech participation should be higher in the Marie Curie Actions (support for mobility) which currently represent 1.3 % of the participation of the EU-27 and the requested support represents 0.76 % of the total support requested in this priority.
- In the main types of projects, e.g. in integrated projects (IP), networks of excellence (NoE) and specific targeted research projects (STREP) the structure of Czech participation nears that of the EU-15. The highest percentage of total support is obtained by Czech participants in integrated projects with STREP projects coming in second place. It is very encouraging that Czech teams are pro-active in projects which represent the main instruments of FP6. In third place are networks of excellence which are again large projects that should lead to the building of virtual research institutes whereby overcoming the limitation that European 'bricks and mortar' R&D institutes are faced with. Meanwhile it is clear that the SME sector in the Czech Republic reacts vigorously to FP6 calls as the Czech Republic has a higher percentage of participants in CRAFT projects (Co-operative Research Projects) than the EU-15 or EU-11.

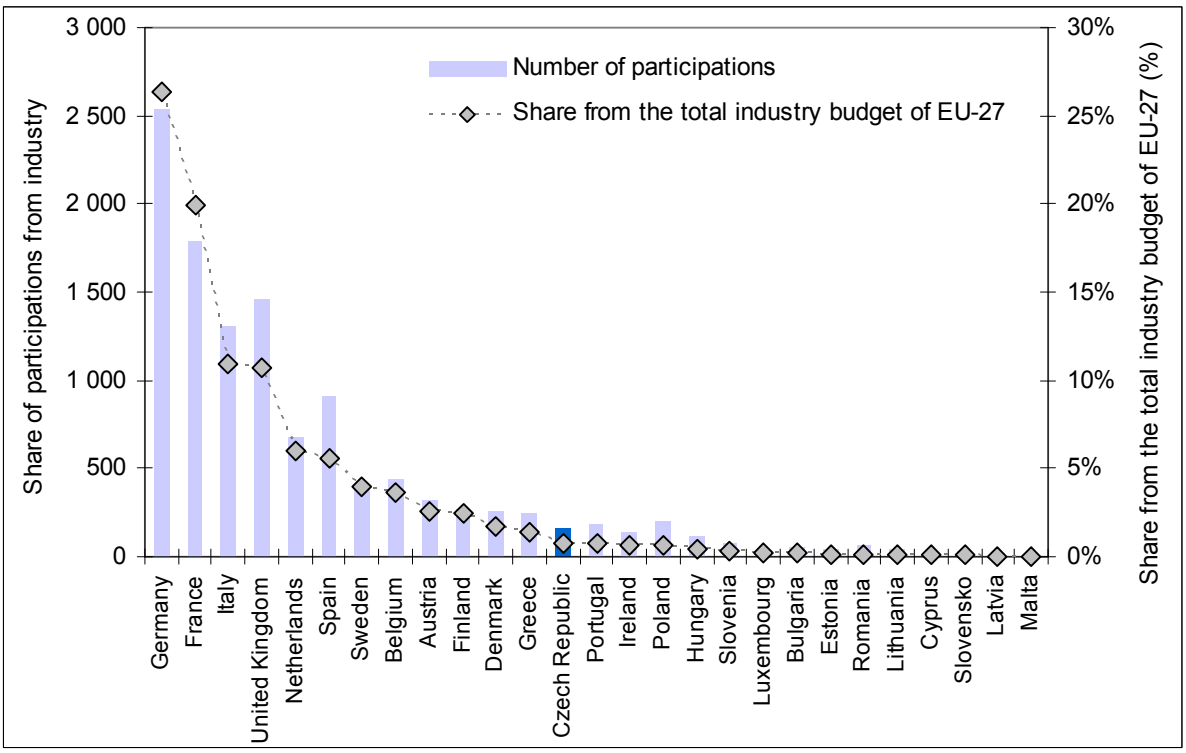
3.2.3.3 Participation in 6th EU Framework program – based on type of participant

Participants in FP6 based on type of organization – comparison between the Czech Republic, EU-15 and EU-11 (new EU Member States without the Czech Republic)



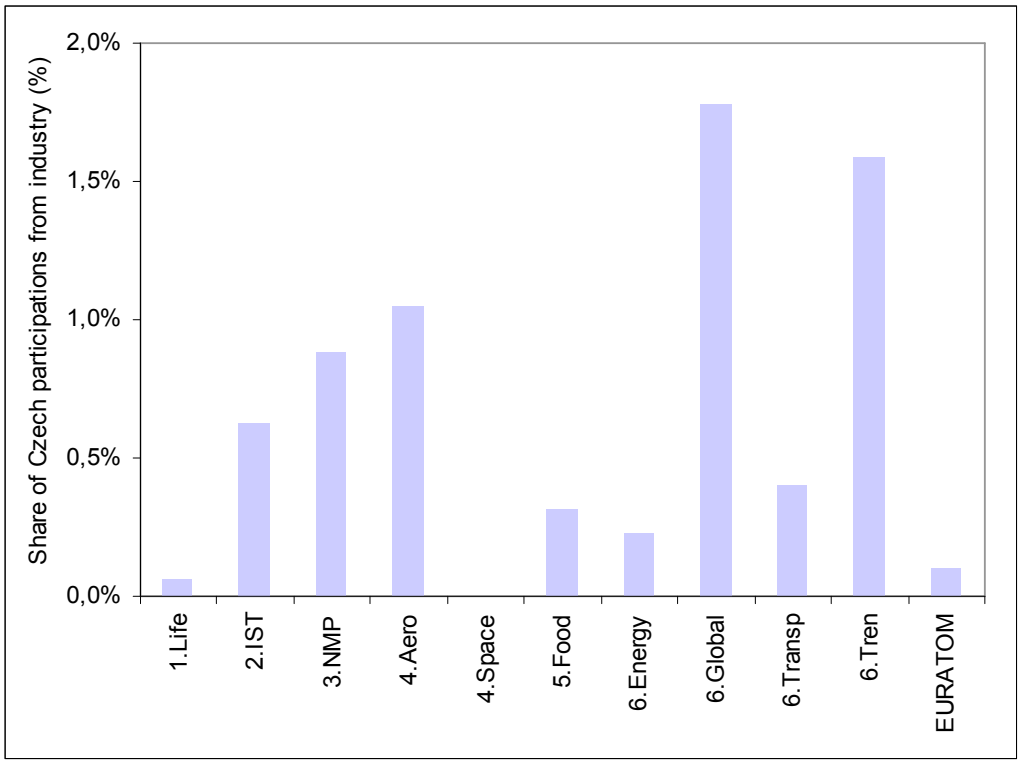
Source: Database of the E-CORDA project, data up to 30th of July 2007

Comparison of the number of participations from industrial enterprises in FP6 in individual countries and their share on the total budget of industrial enterprises from EU-27



Source: Database of the E-CORDA project, data up to 30th of July 2007

Share of allocated finances of industrial enterprises in the Czech Republic on the summary support of industrial teams in EU-27 in individual priorities of FP6



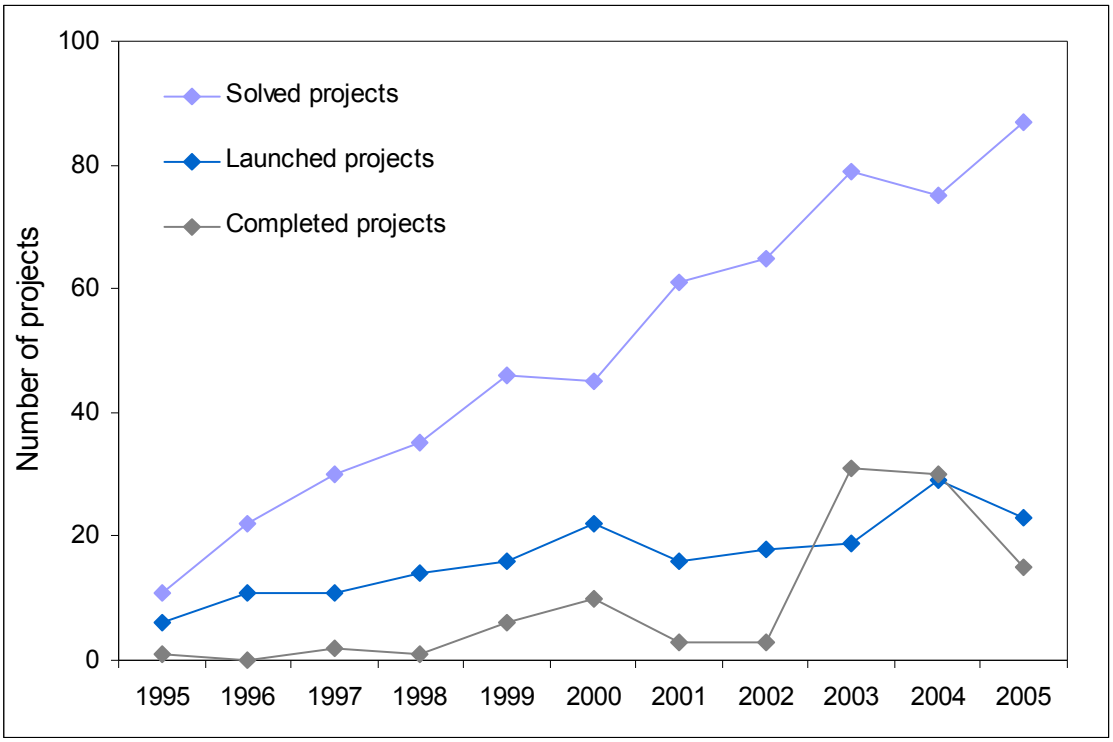
Source: Database of the E-CORDA project, data up to 30th of July 2007. Abbreviations are included in the conclusion to this publication.

Analysis, comments and other information:

- The Czech Republic has a lower percentage of participants from universities than the EU-15 or EU-11 (new member states without the Czech Republic). In comparison with the EU-15 and EU-11 the Czech Republic has the highest percentage of participants from research institutes, which is a result of the relatively large participation of institutes from the Academy of Sciences of the Czech Republic.
- The distribution of contributions requested by the individual types of FP6 participants is similar to the distribution of participants. Czech universities, the same as research institutes, request 35 % of the total support that the EC provides Czech teams. Whereas Czech industry requests 17 % of the total support for the Czech Republic, industrial countries of the EU-15 request 19 % of the total support of all EU-15 teams. In contrast industrial participants from EU-11 request only 9.4 % of the total support for EU-11 teams, which is half of the level of the EU-15. Participation of Czech industry indicates that the structure of Czech participation is to a greater extent approaching the structure of participation in the EU-15.
- In total 162 industrial partners from the Czech Republic have participated on FP6 projects so far. The total budget for industrial teams from the EU-27 is 5.3 billion €. The total budget of Czech industrial teams is 41.8 mil. €, i.e. approx. 0.79 % of the total budget of industrial partners from the EU-27. This value ranks the Czech Republic in 13th place among the EU-27 which is significantly higher than all the new member states and also three countries from the EU-15 (Portugal, Ireland and Luxemburg). Whereas the average Czech participant from industry invests an approx. 40 % higher amount than the average budget of all other Czech participants, in the EU-15 this figure is 18 % and in new member states (without the Czech Republic) this figure is only 12 %.
- Individual sectors of Czech industry participate in FP6 in different ways. Czech industry does not participate in space research and only loosely participates in research into life sciences, food research and in research in the area of energy. The participation of industry in the EURATOM programme is also low even though the Czech Republic is otherwise very successful in this programme.
- The participation of Czech industry in the area of global climate changes, aeronautics and transport has been very successful. Almost 60 % of the support for industrial teams from the new member states in aeronautical research was obtained by teams from the Czech Republic. Meanwhile in the area of global climate change Czech industry obtained 50 % of the total support for the new member states.

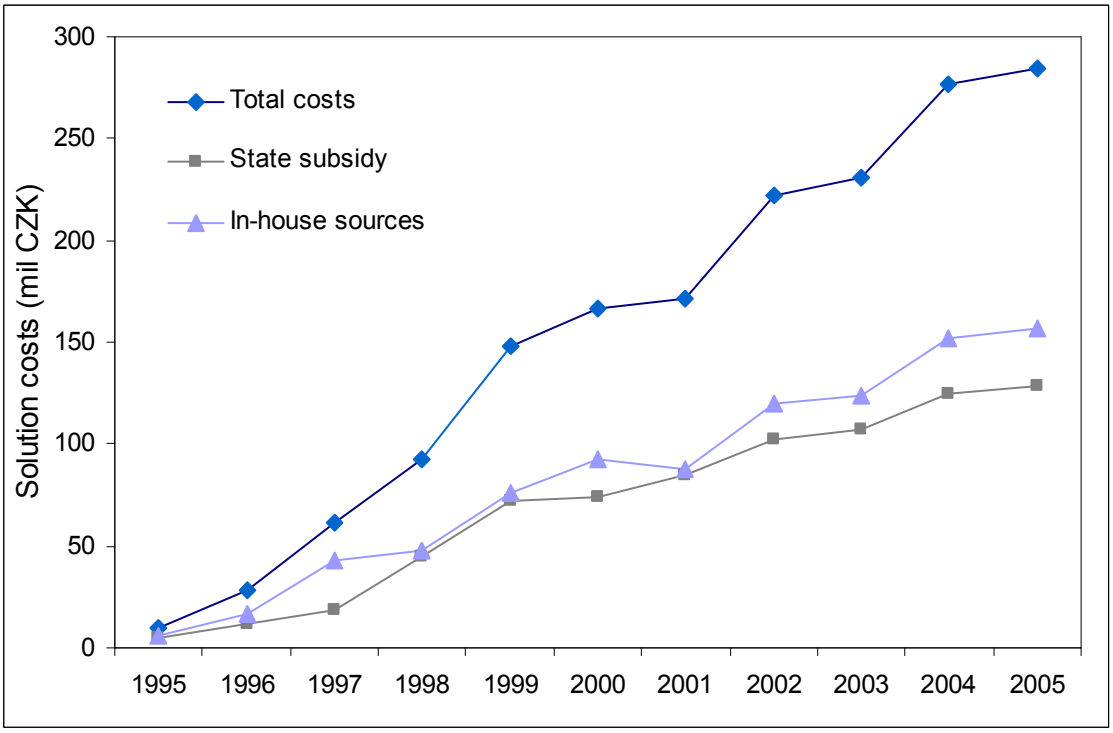
3.2.3.4 Participation in the Eureka program

Number of launched, solved and completed EUREKA projects with Czech participants between 1995 and 2005



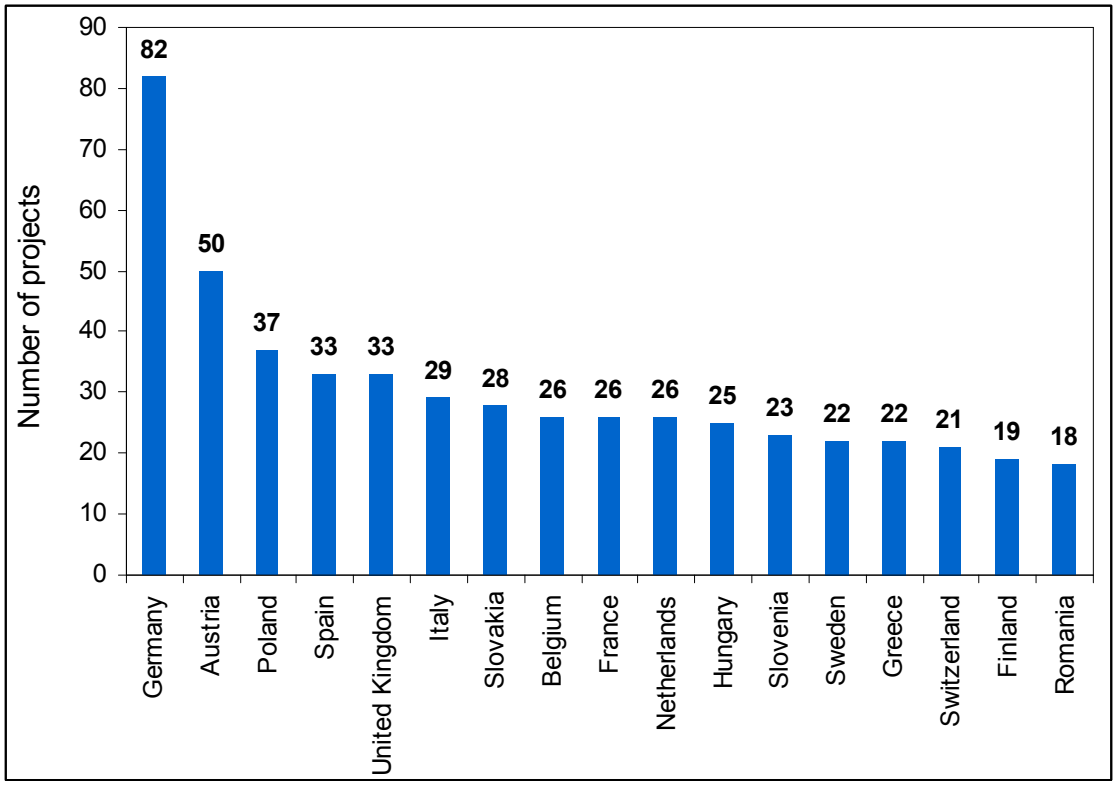
Data source: EUREKA secretariat; database the Czech Republic

Cost of EUREKA projects in the Czech Republic between 1995 and 2005



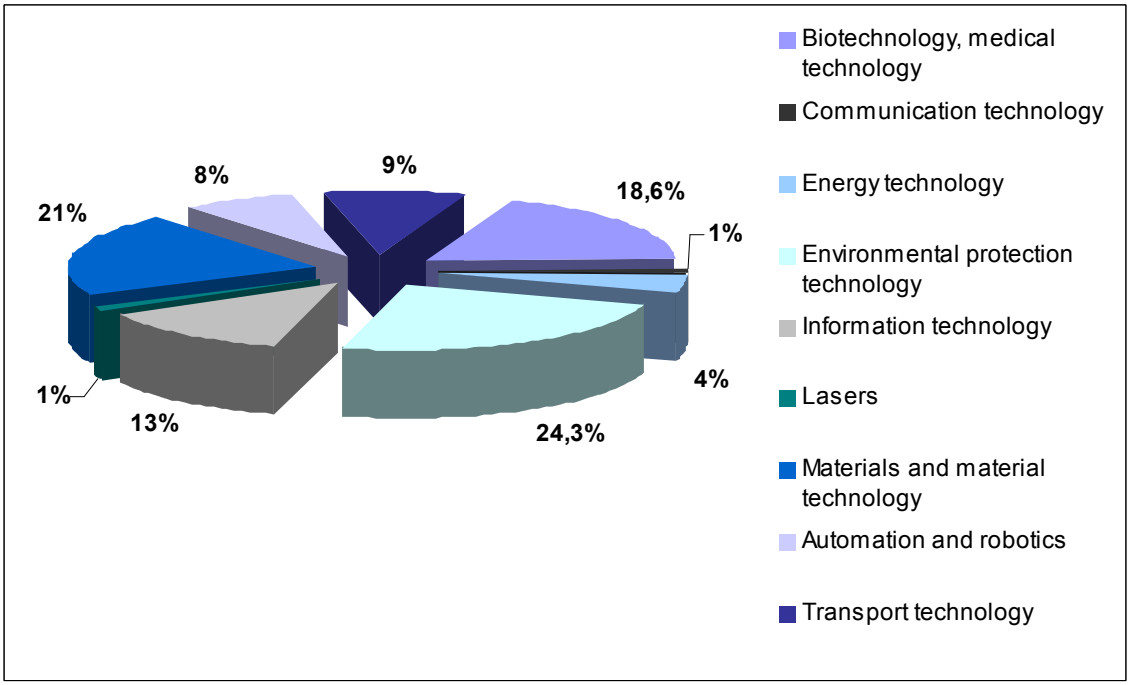
Data source: EUREKA secretariat; database the Czech Republic

Number of participants from other member states of the Eureka program in projects performed in the Czech Republic between 1995 and 2005



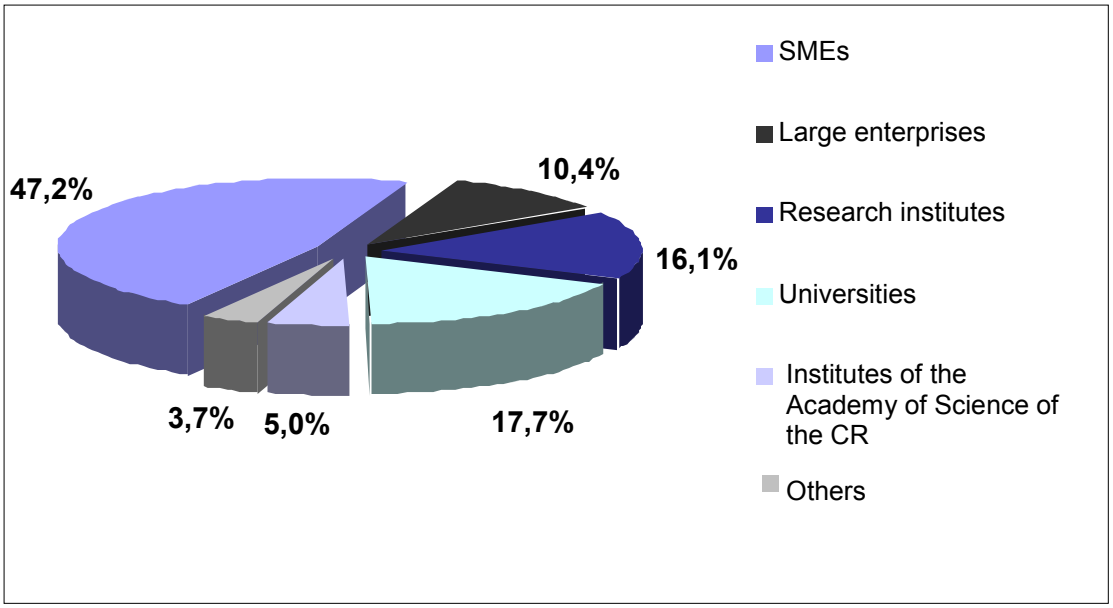
Data source: EUREKA secretariat; database the Czech Republic

EUREKA projects with Czech participants based on technological field between 1995 and 2005



Data source: EUREKA secretariat; database the Czech Republic

Participants in EUREKA projects in the Czech Republic based on type of organization between 1995 and 2005



Data source: EUREKA secretariat; database the Czech Republic

Analysis, comments and other information:

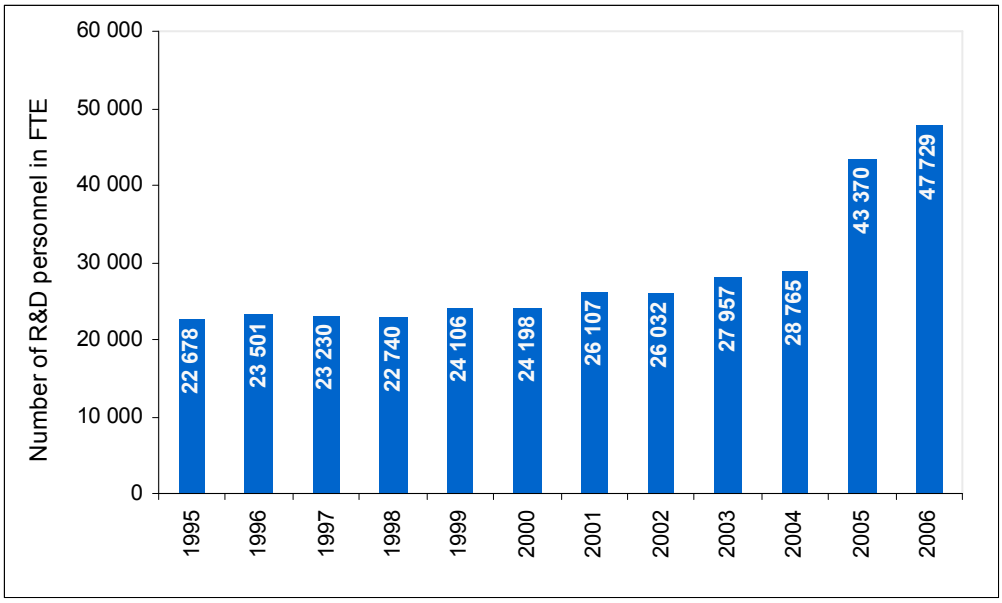
- **Projects with Czech participants** accounted for almost 11 % of the total number of **EUREKA** projects launched between 1995 and 2005 and the Czech Republic was the project leader of approx. 7 % of the total number of launched EUREKA projects. The most projects with Czech participants were accepted over the past three years, when the share of launched projects with Czech participants ranged around 14 – 15 % of the total number of all newly launched projects. During this time, 40 % of projects with Czech participants were launched in which a Czech subject is the main project leader.
- The number of projects launched and performed with Czech participants has increased over the past few years. The annual cost of project performance has almost doubled in comparison with 1999. During a ten year period (1995 – 2005) the total cost for performing EUREKA projects in the Czech Republic was 1.692 billion CZK, from which 46 % was financed from the state budget. The average cost of a project reached 8 462 thousand CZK, the average state support for a project was 3 855 thousand CZK and the average project time was approx. 3 years.
- Czech participation in EUREKA projects over the past ten years focused on environmental and material fields (almost 45 % of all projects with Czech participants). A significant share of projects was also in the area of biotechnology - medicine. In comparison with the total participation in the Eureka program, projects in the areas of informatics and robotics were significantly less represented in the Czech Republic.
- A major share in the structure of Czech projects is made up of SMEs, between 1995 and 2005 these SMEs had a 47% share (the total share of the industrial sector e.g. including large enterprises in projects with Czech participants was approx. 58 %). The second most represented sector was universities.
- Czech project managers most often cooperated with German (82 projects) and Austrian organizations (50 projects). Over the past few years there has been a significant increase in cooperation with Polish organizations. More than a quarter of the cooperating organizations came from neighbouring countries.

3.3 INPUTS FOR RESEARCH, DEVELOPMENT AND INNOVATION

3.3.1 Human resources for R&D and innovation

3.3.1.1 Total number of R&D personnel

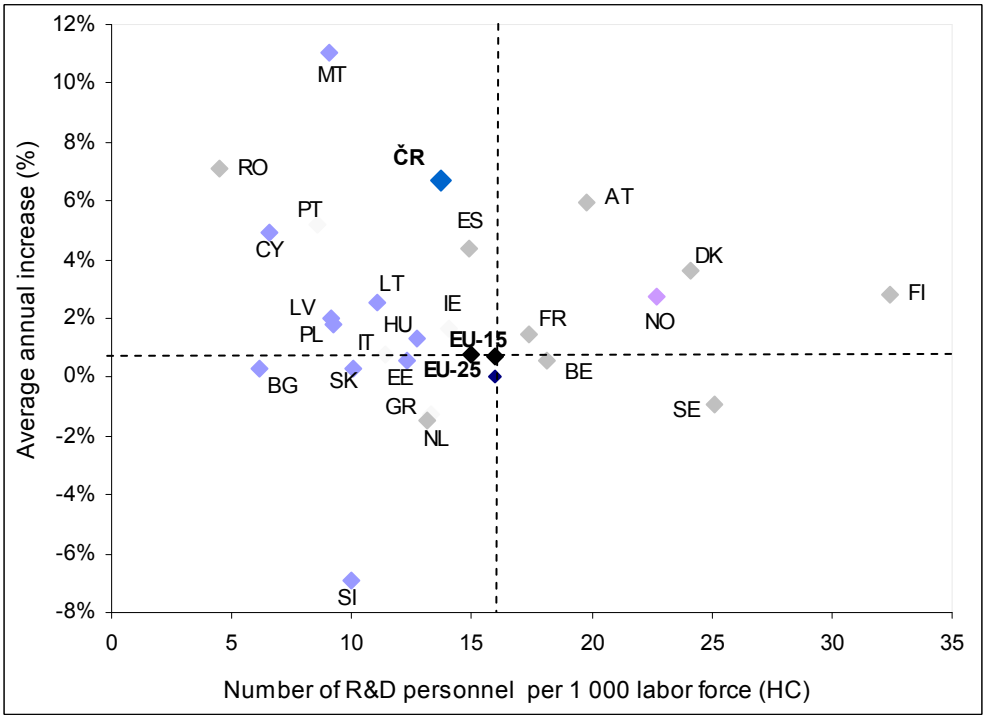
Total number of R&D personnel in the Czech Republic between 1995 and 2006 - in Full Time Equivalent (FTE)*



* Note: in 2005 there was a change in the way CZSO calculates FTE (for more details see Methodological notes)

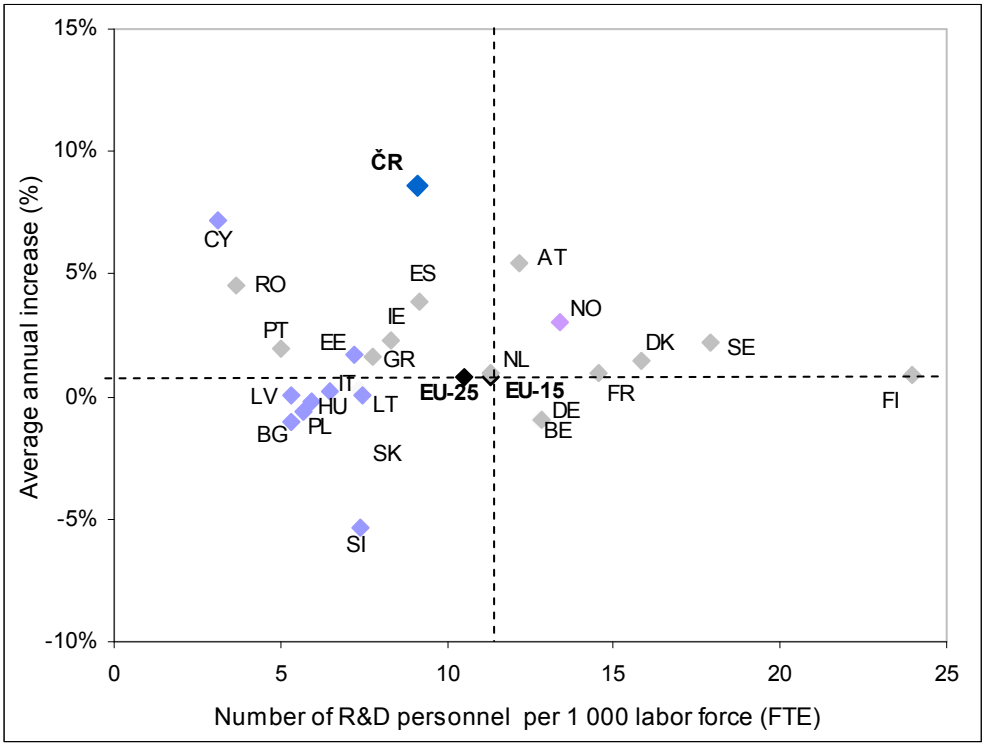
Source: CZSO

Total number of R&D personnel in 2005 per 1 000 labour force and its average annual increase between 2001 and 2005 – in Head Counts (HC)



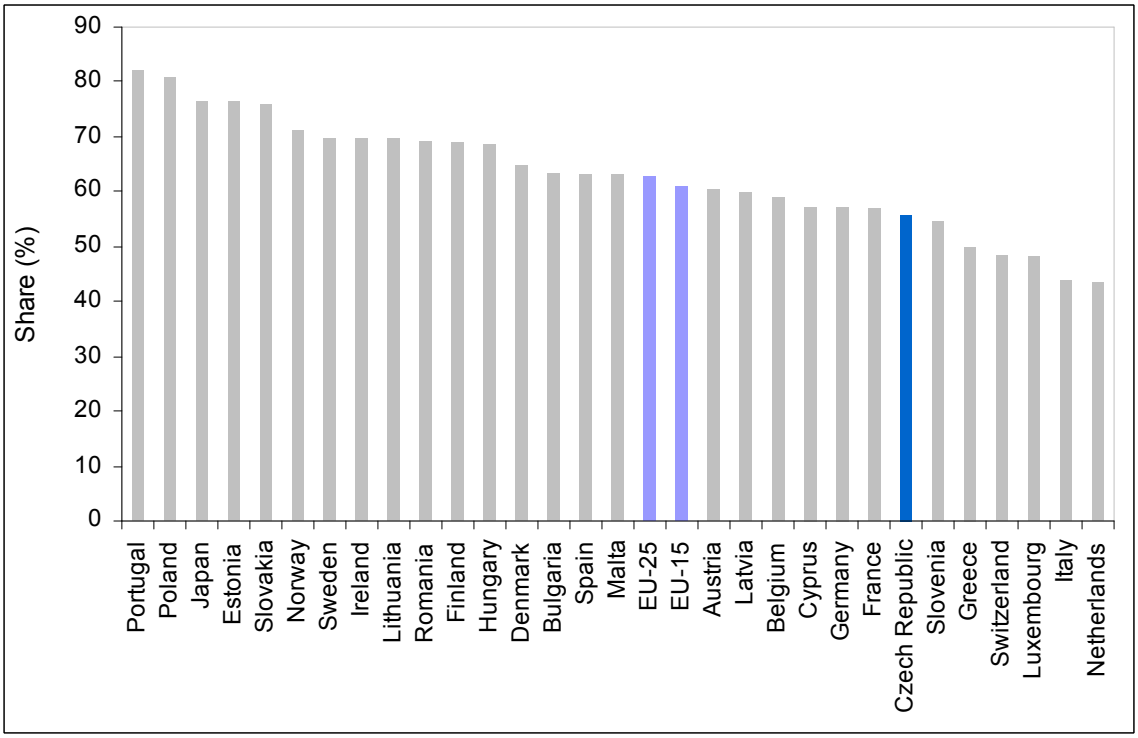
Source: Eurostat

Total number of R&D personnel in 2005 per 1 000 labour force and its average annual increase between 2001 and 2005 - FTE



Source: Eurostat

Percentage share of researchers on R&D personnel in 2005 - FTE



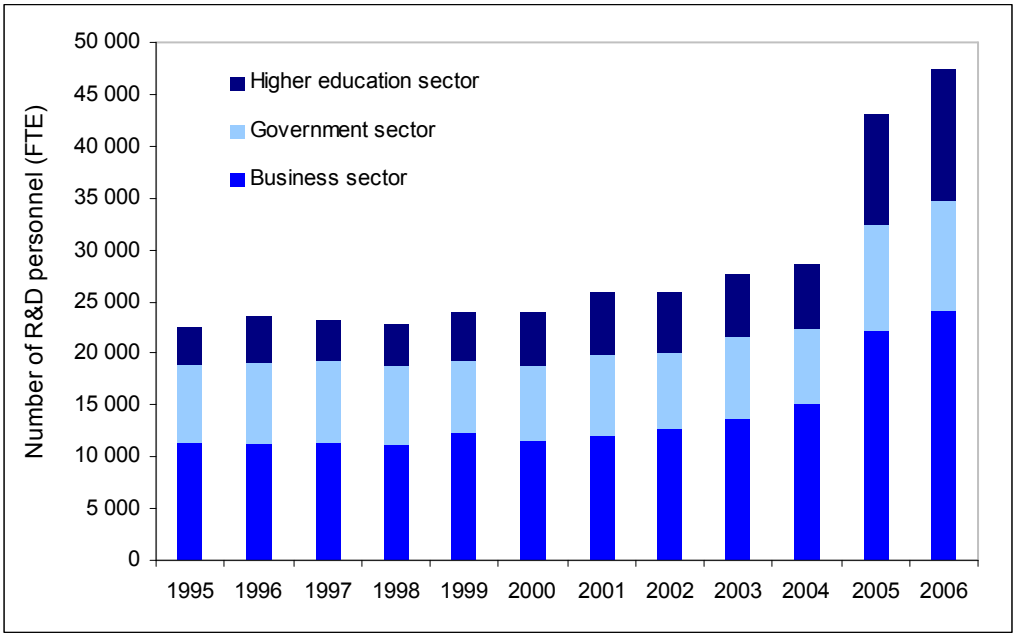
Source: Eurostat

Analysis, comments and other information:

- **The number of R&D personnel** in the Czech Republic has constantly increased since 1995. In 2006 a total of 69 162 natural persons worked in science and research (Headcount, HC), or 47 729 recalculated into full-time equivalent (FTE), from which one third were women. The number of R&D personnel increased between 2005 and 2006 by approx. 5.8 % natural persons (HC), or 10 % recalculated as FTE. In 2006 there were 14.3 R&D personnel (HC) or 9.9 recalculated personnel (FTE) working in R&D per 1 000 inhabitants of the Czech Republic.
- Despite the fact that the **average annual increase in recalculated R&D personnel** (FTE) per 1 000 labour force between 2006 and 2005 was almost 10 %, the Czech Republic is still under the average for the EU-25 and in particular EU-15. In 2006 there were 10 persons per 1 000 labour force working in R&D in the Czech Republic, which in comparison with the latest available information on the average for the EU-15 (2004) is approx. 87 %. There is a more significant lag behind more innovatively advanced countries of the EU-15 in 2006 the Czech Republic reached the level of approx. 40 % of the R&D personnel working in Finland and 55 % of the R&D personnel in Sweden. It is important to note however that the number of R&D personnel per 1 000 labour force in the Czech Republic is the highest of all new EU member states.
- An international comparison between the numbers of R&D personnel recalculated into full time equivalent (FTE) and non-recalculated personnel in R&D (HC) shows that R&D personnel in the Czech Republic more than in other EU countries **do not use their whole labour capacity for R&D activity**. This can be due to several factors, one of which may be the financial and social status of R&D personnel in the Czech Republic in comparison with the attractiveness of other job opportunities of the highly qualified labour force.
- In comparison with other European countries there is also a relatively low share of researchers in the total number of R&D personnel in the Czech Republic. In 2005, researchers made up approx. 55 % of R&D personnel, whereas the average for the EU-25 and EU-15 was almost 63 % and 61 %, respectively. This comparison shows that in the Czech Republic there is a relatively high number of professional and technicians in research who perform support services in R&D. In an international comparison it also follows that the highest share is reached by Portugal and Poland (more than 80 %) but more than 70 % is reached in Japan, Estonia, Slovakia, Norway and Sweden.
- In 2006 **R&D personnel with a university education** made up almost 45 % of the total number of R&D personnel (in FTE). The share of personnel with a PhD qualification was approx. 22%**,** the share of R&D personnel with a **higher professional** education was 2%. In 2006, 69 % of R&D personnel in FTE had at least a tertiary education.

3.3.1.2 Employment in R&D – per sector and scientific field

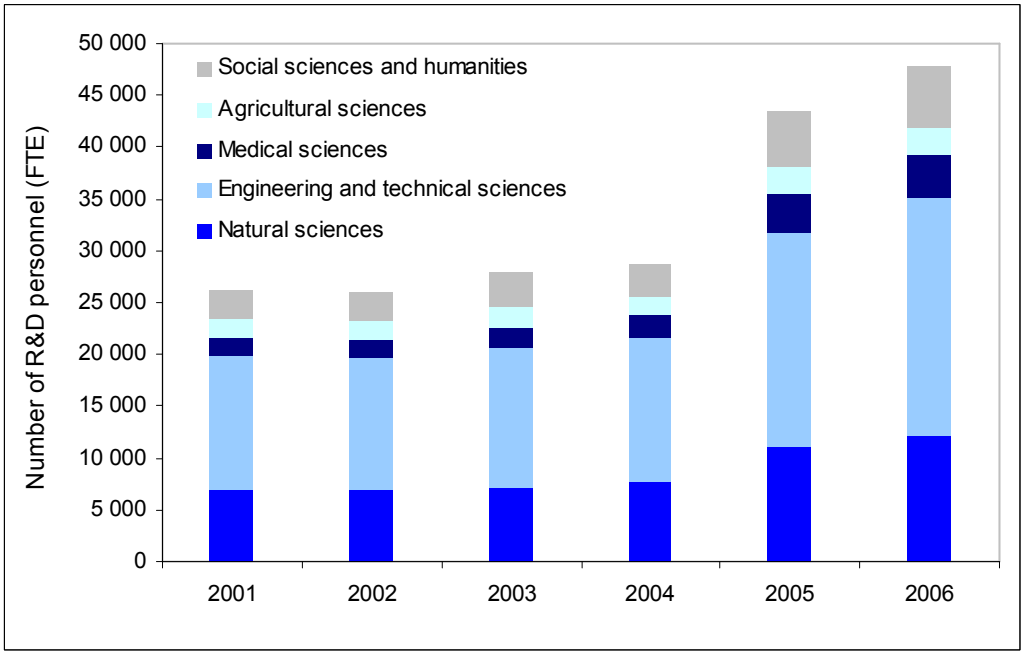
Total number of R&D personnel in the Czech Republic between 1995 and 2006 in FTE by sectors of performance



Note: the number of R&D personnel in the private non-profit sector is very low and therefore is not illustrated in the graph.

Source: CZSO

Number of R&D personnel in the Czech Republic between 2001 and 2006 in FTE by fields of science



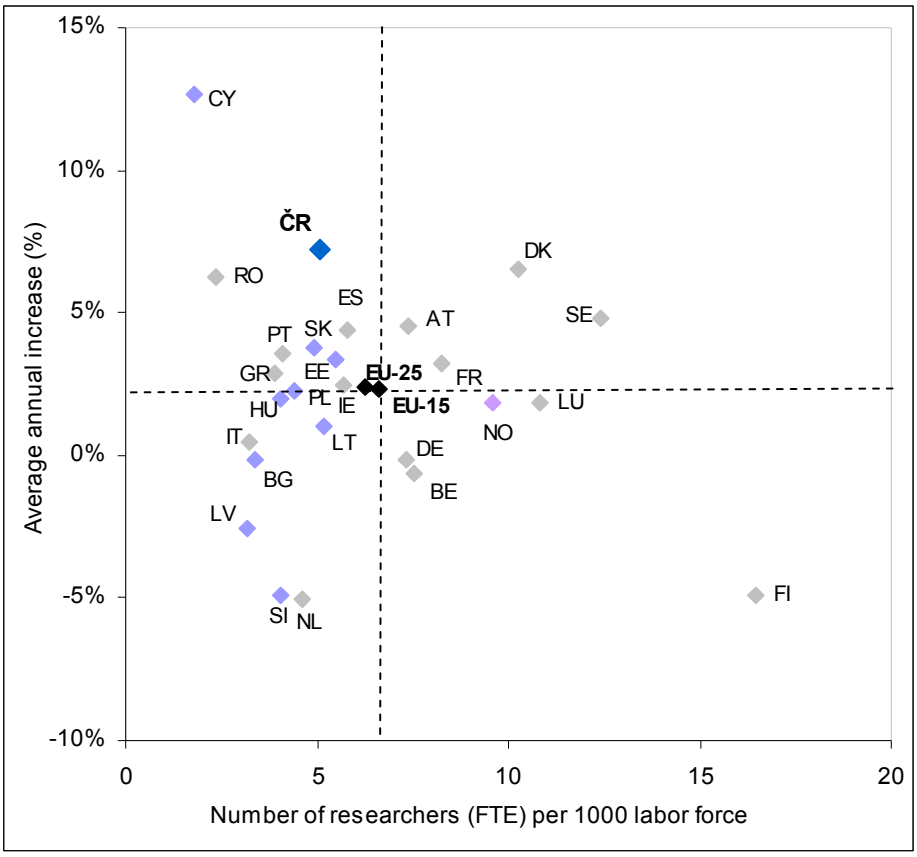
Source: CZSO

Analysis, comments and other information:

- In 2006, there were more than 20 thousand R&D personnel employed in the business sector in the Czech Republic (in FTE), which is approx. one half of all R&D personnel. It is less however than the average of the EU-15, where the share in the business sector in the total number of R&D personnel is close to 56 %, and also in the EU-25, where the share in the business sector is approx. 54 %.
- The share of R&D personnel in the **government sector** in the total number of R&D personnel (in FTE) in 2006 was approx. 22 % (approx. 10 thousand recalculated persons). The share of the **higher education sector** in the total number of R&D personnel in 2006 was close to 27 %, which corresponds to almost 13 thousand R&D personnel in FTE. In the Czech Republic there is a higher share of R&D personnel in the government sector in comparison with the EU-15 (the average for the EU-15 is approx. 13 % of R&D personnel) and in contrast a lower share in the university sector (the average for the EU-15 in this sector is almost 30 % of R&D personnel). This situation is given by the traditionally strong Academy of Science of the Czech Republic. The **private non-profit sector** represented only 0.3 % of the total number of R&D personnel in 2006 and therefore was not represented in the graph.
- In 2006, the majority of R&D personnel worked in **engineering and technical sciences** (48.4 %), followed by **natural sciences** (25.4 %), **social sciences and humanities** (12.4 %), **medical sciences** (8.4 %) and finally **agricultural sciences** (5.5 %). Between 2001 and 2006, the highest increase in the number of R&D personnel was in medical and social sciences and humanities (2.2 times), technical and natural sciences in the same period recorded an increase in R&D personnel of 1.7 times and agricultural sciences 1.4 times.

3.3.1.3 Total number of researchers

Total number of researchers in 2005 in FTE per 1 000 labour force and its average annual increase between 2001 and 2005



Source: Eurostat

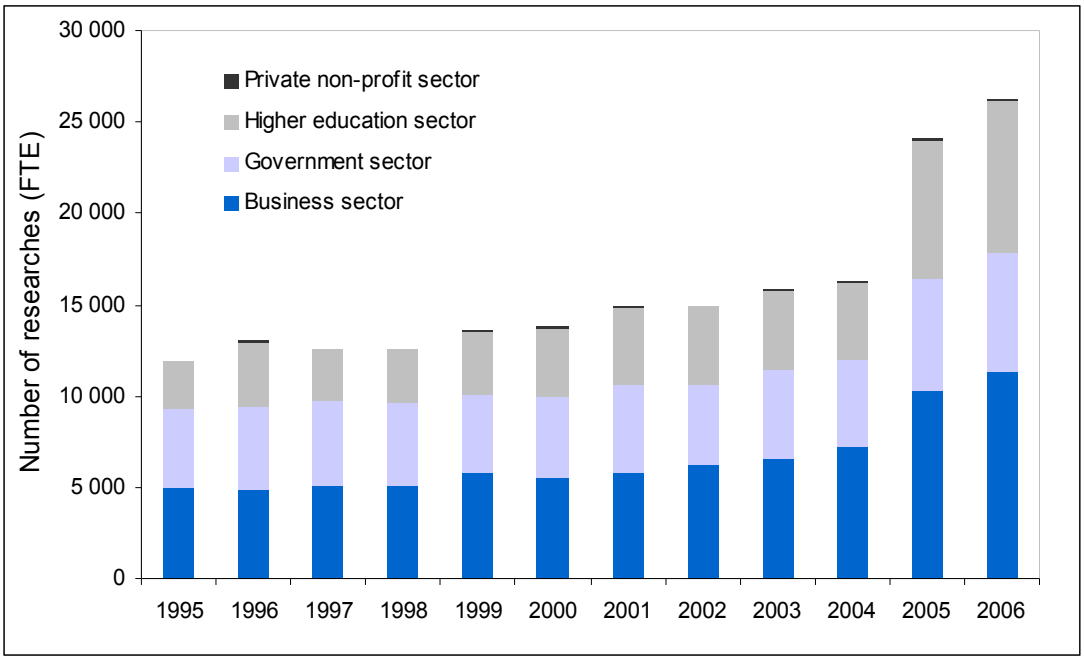
Analysis, comments and other information:

- In 2006, there was a total of 11 295 **researchers** (HC) working in the Czech Republic which equals 6 652 researchers in FTE. The number of researchers increased year on year over the last two years[1] (e.g. 2006 and 2005) by more than 7 % (FTE).
- Even if the growth in the number of **researchers** is significantly higher than in most EU countries, from the point of view of an international comparison the Czech Republic is still under the average of the EU-15 and EU-25. In 2006 approx. 5.4 researchers per 1 000 labour force (in FTE) worked in the Czech Republic, whereas in the EU-15 there were approx. 6.6 researchers per 1 000 labour force (2004, latest available data on the average of the EU-15). The Czech Republic is at an approx. level of 80 % of the EU-15 average in the number of researchers.
- The highest number of researchers in 2005 was in Scandinavian countries (Island and Finland has approx. 20 researchers per 1 000 labour force, e.g. more than 2 %) and Japan (more than 12 researchers per 1 000 labour force). The Czech Republic vastly lags behind these countries; the number of researchers working in the Czech Republic is only 30 % and 40 % of that in Finland or Sweden, respectively. Similar to in the case of R&D personnel however the number of researchers in the Czech Republic is higher than in the other new EU member states.

[1] A comparison of the data from 2005 with previous years for persons in FTE is not possible because in 2005 CZSO changed their method of calculating FTE, which caused a jump in the number of R&D and research personnel in 2004 and 2005. In addition, CZSO data for FTE has been in conformity with the Eurostat method since 2005 and is comparable with statistical offices of EU member states.

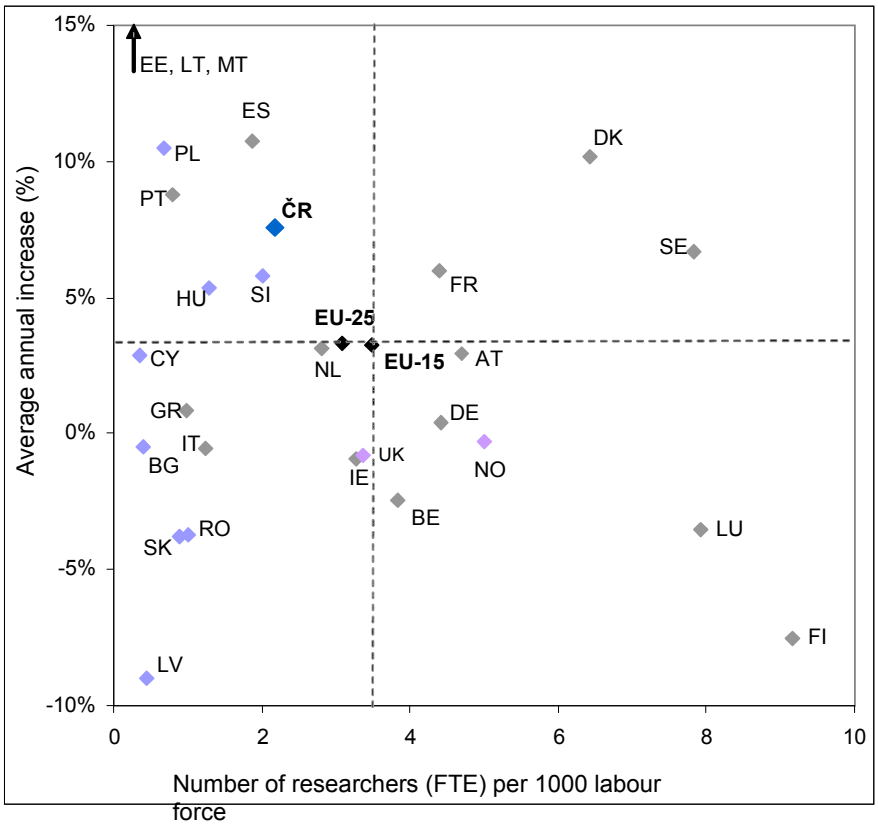
3.3.1.4 Research personnel – sector of performance

Total number of researchers in the Czech Republic in FTE by sectors of performance between 1995 and 2006



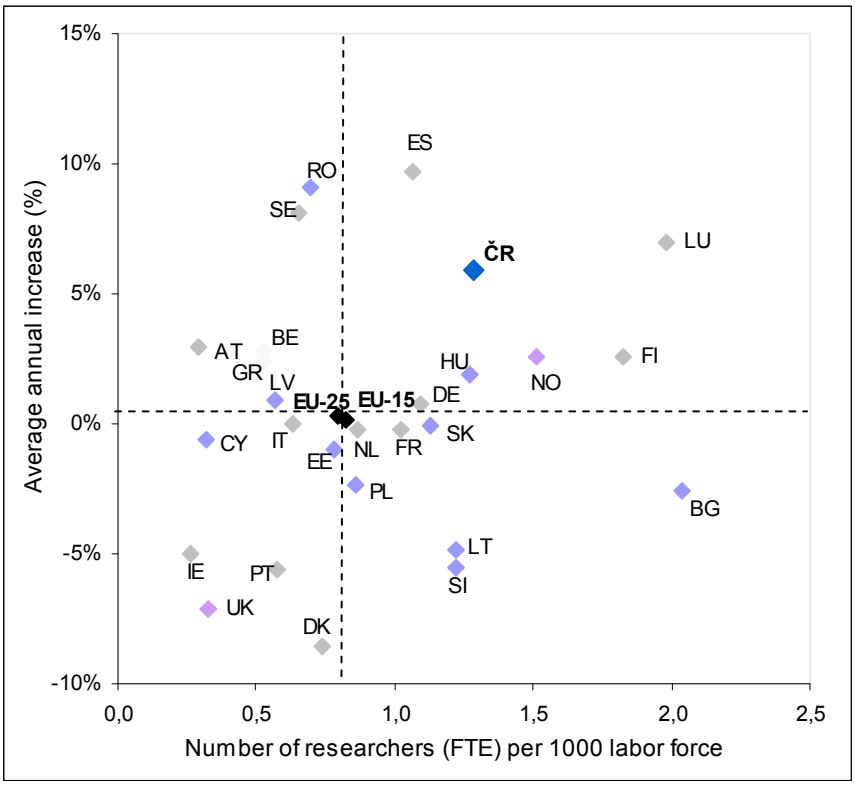
Source: CZSO

Number of researchers in 2005 in FTE per 1 000 labour force in the business sector and its average annual increase between 2001 and 2005



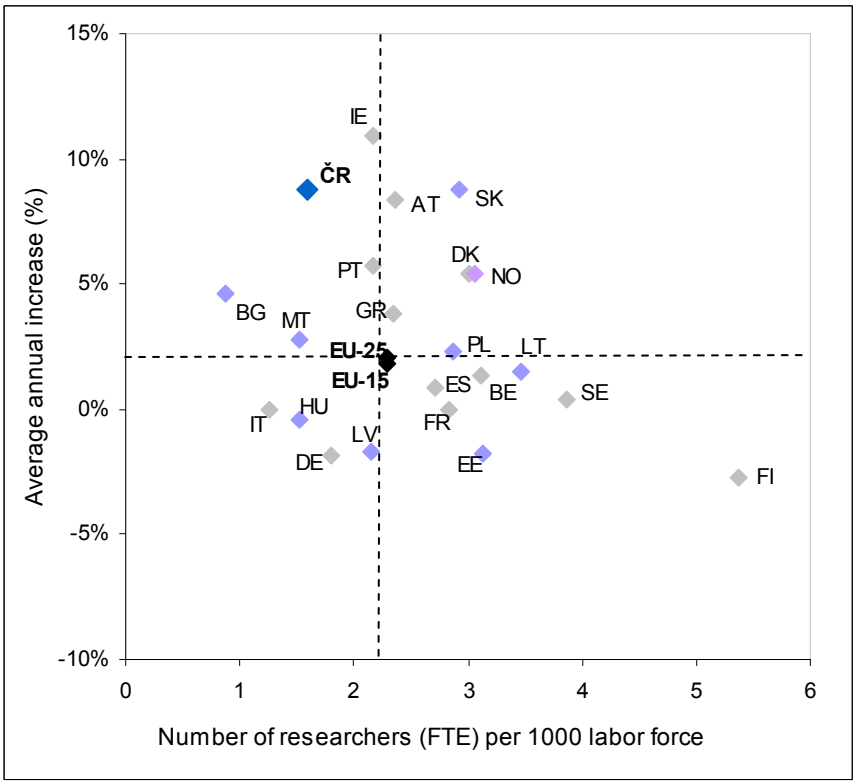
Source: Eurostat

Number of researchers in 2005 in FTE per 1 000 labour force in the government sector and its average annual increase between 2001 and 2005



Source: Eurostat

Number of researchers in 2005 in FTE per 1 000 labour force in the higher education sector and its average annual increase between 2001 and 2005



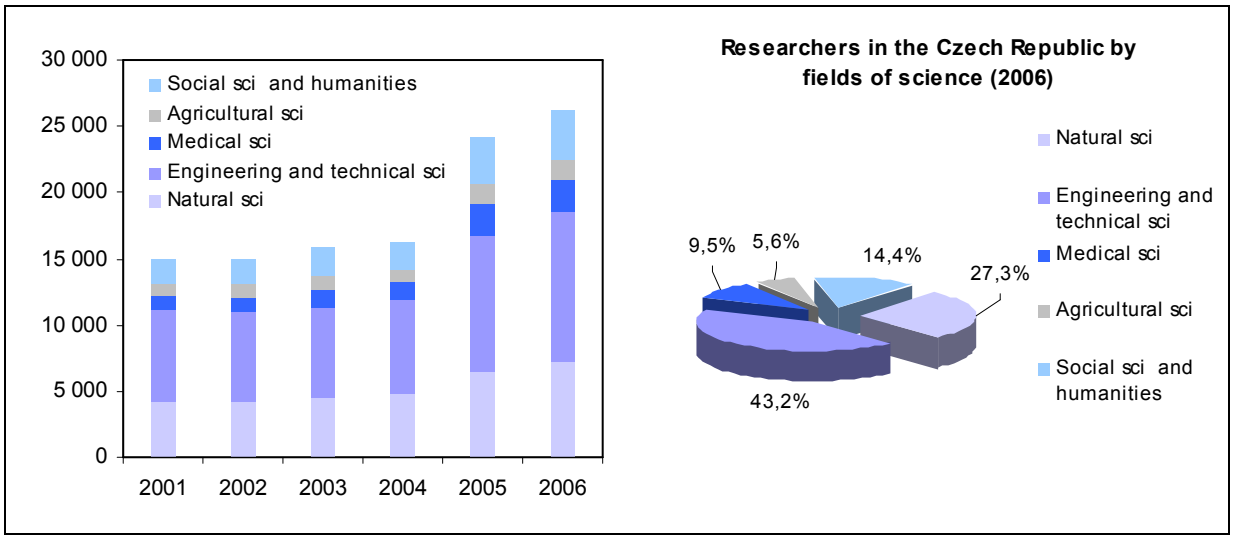
Source: Eurostat

Analysis, comments and other information:

- The highest share of researchers is in the business sector which increased slightly from 41.4 % in 1995 to the current 43 % of the total number of researchers. The annual increase in researchers in the business sector in the Czech Republic is quicker than the EU-15 average (in the Czech Republic between 2005 and 2006 the number of researchers in the business sector increased by 7.7 %, the EU-15 average between 2003 and 2004 increased by 3.5 %). Nevertheless, in 2006 the number of researchers in the business sector in FTE per 1 000 inhabitants was only 67 % of the EU-15 average in 2004 (the latest available information from the EU), which is less than in the case of the total number of researchers (and the number of researchers in the public sector). This shows that the business sector is more undersized than the public sector from the point of view of human resources for R&D.
- **The government sector** recorded a decrease in the share of research personnel in the same period from 36 % in 1995 to 25 % in 2006. The significant decrease in the share of the government sector in the total number of researchers is caused by significant strengthening of other sectors of R&D (in particular higher education sector) to the determent of the previously dominant Academy of Science the Czech Republic. Despite this decrease, the number of research personnel in the government sector in the Czech Republic is still higher than the EU-15 average (in 2006 there were almost 1.4 researchers in FTE per 1 000 labour force in the Czech Republic, whereas in the EU-15 there were only 0.8 researchers in FTE).
- A relatively high increase in the number of research personnel was recorded by the **higher education sector** (an increase of almost 9 % between 2006 and 2005), which corresponds to the increase in the percentage share of researchers in the **higher education sector** from 22.5 % in 1995 to almost 32 % in 2006. Despite this relatively dynamic increase, the number of researchers in the higher education sector is still profoundly under the EU-average for the EU-15. In 2006 there were approx. 1.7 researchers per 1 000 labour force in the Czech Republic, whereas the average for the EU-15 and EU-25 in 2004 (the latest available information) was 2.3 researchers (FTE). The Czech Republic ranges at a level of approx. 70 % of the EU average, 32 % of Finland or 45 % of Sweden. The lack of researchers in universities can negatively influence preparation of graduates, in particular future researchers and professionals for the top positions in industrial branches.
- **The private non-profit sector** recorded no researchers in 1995; today the share of researchers in this sector is 0.2 %.

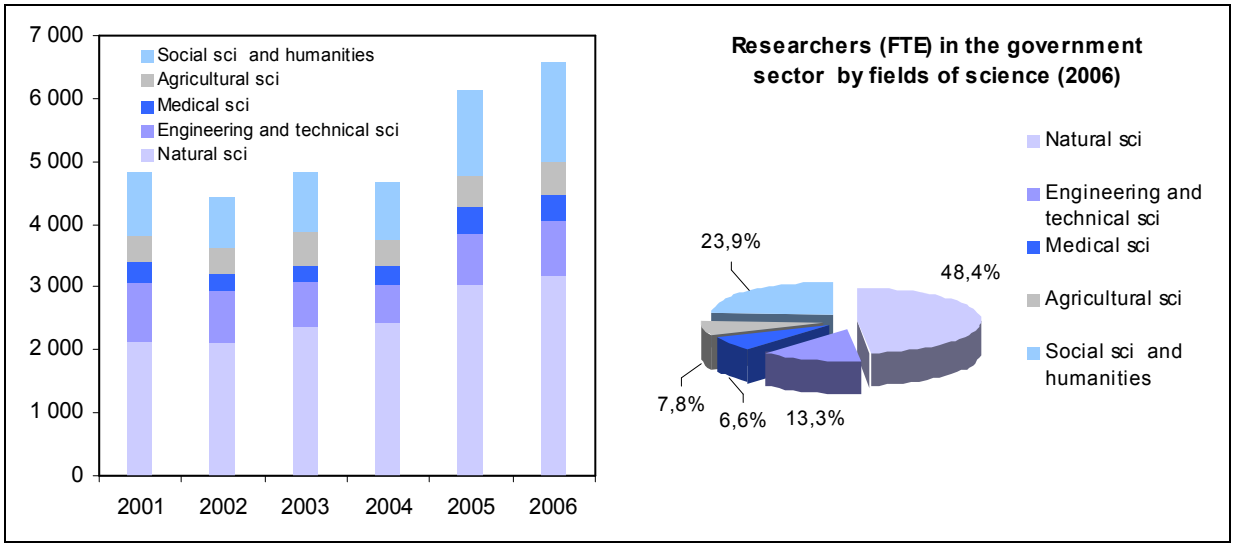
3.3.1.5 Researchers in the Czech Republic by fields of science and NACE

Total number of researchers (FTE) in the Czech Republic by fields of science between 2001 and 2006



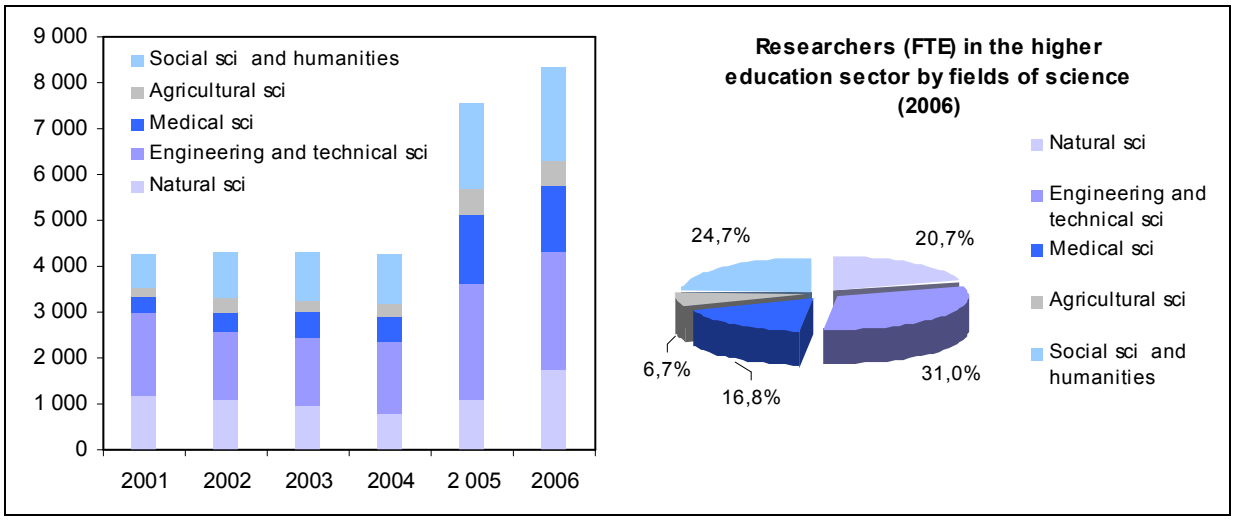
Source: CZSO

Researchers (FTE) in the government sector by fields of science between 2001 and 2006



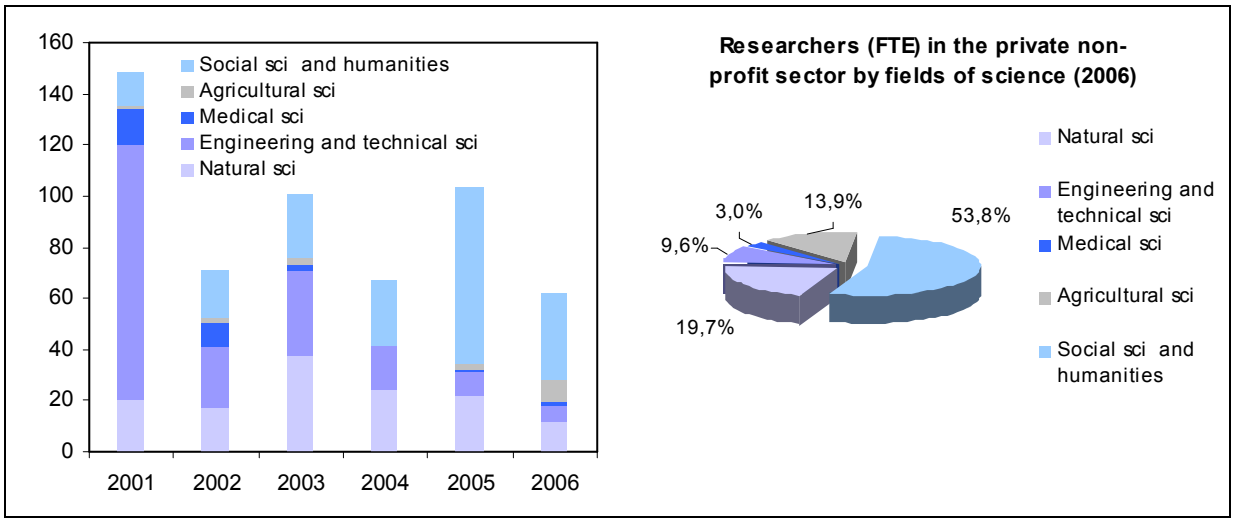
Source: CZSO

Researchers (FTE) in the higher education sector by fields of science between 2001 and 2006



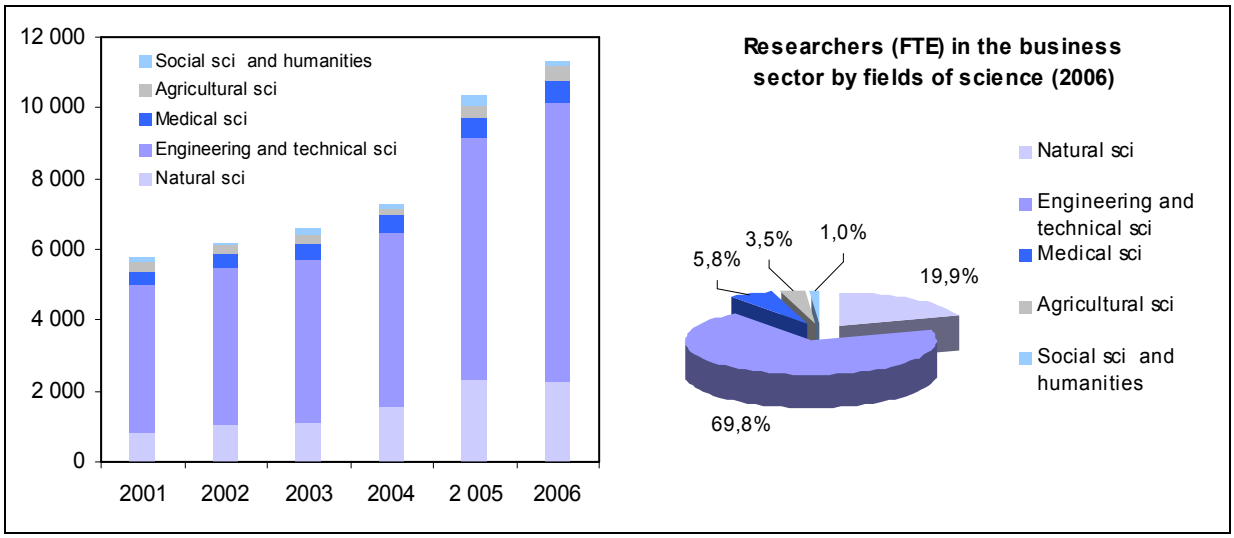
Source: CZSO

Researchers (FTE) in the private non-profit sector by fields of science between 2001 and 2006



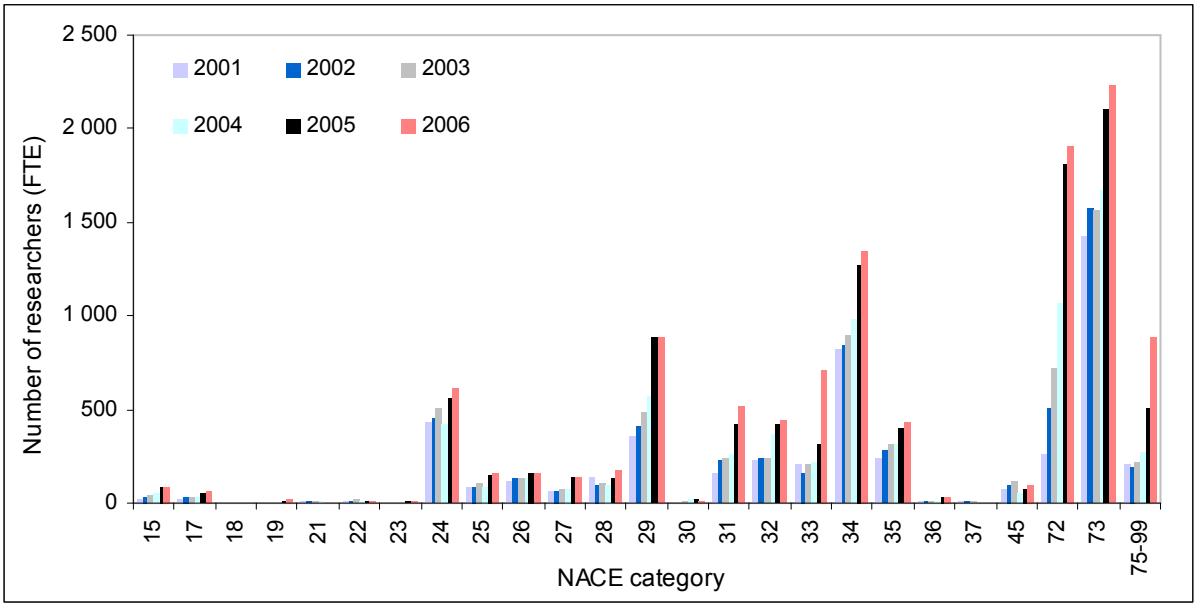
Source: CZSO

Researchers (FTE) in the business sector by fields of science between 2001 and 2006



Source: CZSO

Researchers (FTE) in the business sector by NACE between 2001 and 2006



Analysis, comments and other information:

- Most researchers in the Czech Republic are employed in **engineering and technical sciences** (43.2 % in 2006). The second highest number is in **natural sciences** (27.3 %), social sciences and humanities have 14.4 %, medical sciences 9.5 % and agricultural sciences only 5.6 %. The highest **percentage increase** from 2001 to 2006 was recorded by medical sciences (2.4 %), then social sciences and humanities (2.2 %), natural and agricultural sciences in contrast slightly decreased (0.5 %) and the highest decrease in share was recorded by technical sciences (3.2 %).
- The share of researchers in **technical sciences** has shown a long-term decrease in all the sectors of performance. The highest share of researchers in technical sciences is in the business sector (more than 70 %), in which there has been a decrease since 2001 of approx. 2 %. Technical sciences are also most represented in the higher education sector (more than 30 %), where their share decreased between 2001 and 2006 by more than 12 %. In the non-profit sector technical sciences represent approx. 10 %, which is the second lowest share after medical sciences in this sector. Technical sciences have the lowest share of all the sectors in the government sector with 13.3 % in 2006.
- **Natural sciences** and their representation in all sectors, with the exception of the higher education sector, have been increasing since 2001. In all the sectors of performance, natural sciences researchers are represented by approx. one fifth; the exception is the **government sector**, where natural sciences have the highest share of all scientific fields with more than 48 %.
- The share of researchers in **medical sciences** in the Czech Republic slightly increased between 2001 and 2006. A high increase (from 8% to 16.8 % in 2006) was recorded in particular in the **higher education sector**, the private non-profit sector recorded a slight increase, and share of medial sciences in the government sector stagnated at 6.6 % and in the business sector slightly decreased to 5.8 % in 2006.
- **Social sciences and humanities** dominate the **non-profit sector** (54 % in 2006) are represented by approx. one quarter in the university sector and government sector. In the business sector research in these scientific areas has only 1 % and their share has slightly decreased.
- **Agricultural sciences** are most represented in research in **the non-profit sector**, in which there has been an increase since 2001 from almost zero to 13.9 % in 2006. Their share also slightly increased in the university sector, however in the government and business sector share research personnel in these sciences decreased recently.
- The most research personnel in the business sector between 2001 – 2006 were in the category NACE 73 – Research and Development and NACE 72 - computer and related activities, and NACE 34 - Manufacturing of motor vehicles, trailers and semi-trailers (medium high-tech branches), NACE 29 - Manufacturing of machinery and equipment (medium high-tech branches). The highest increase in the number of research personnel in this period was in branches NACE 72 - computer and related activities (more than 7x) and NACE 75-99 – activity in public administration and defence, social security, learning and health and social care (more than 4x). More than 3x increase in research personnel in this period was also recoded in NACE 31 - Manufacturing of electrical machines and instruments and NACE 33 - Manufacturing of medical, precision, optical and time measuring instruments.

3.3.1.6 Human resources for R&D in regions

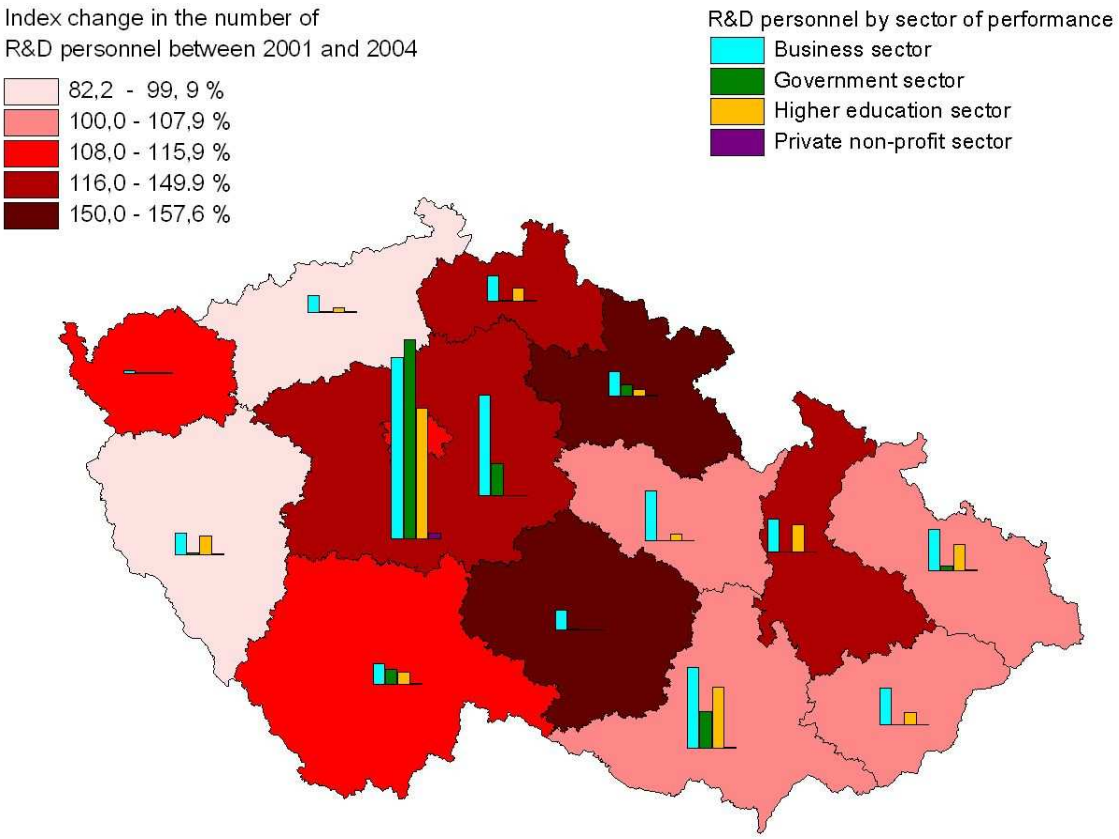
Number of R&D personnel (FTE) in regions of the Czech Republic (2001-2005), index changes* 2001-2004 and share of individual regions on the total number of R&D personnel in the Czech Republic (2001-2005)

Region	Number of R&D personnel					Index changes* 2001-2004	Share in the Czech Republic				
	2001	2002	2003	2004	2005		2001	2002	2003	2004	2005
Praha	10 805	10 945	11 831	11 832	17 584	109.5	41.4	42.0	42.3	41.1	40.5
Středočeský	2 857	3 173	3 637	3 498	4 513	122.4	10.9	12.2	13.0	12.2	10.4
Jihočeský	1 009	1 007	1 103	1 111	1 644	110.1	3.9	3.9	3.9	3.9	3.8
Plzeňský	883	881	694	776	1 432	87.9	3.4	3.4	2.5	2.7	3.3
Karlovarský	104	90	121	115	70	110.3	0.4	0.3	0.4	0.4	0.2
Ústecký	533	388	370	438	697	82.2	2.0	1.5	1.3	1.5	1.6
Liberecký	655	691	665	767	1 295	117.1	2.5	2.7	2.4	2.7	3.0
Královéhradecký	678	729	800	1 050	1 365	154.8	2.6	2.8	2.9	3.6	3.1
Pardubický	1 154	1 138	1 102	1 201	1 936	104.1	4.4	4.4	3.9	4.2	4.5
Vysočina	316	419	438	498	699	157.6	1.2	1.6	1.6	1.7	1.6
Jihomoravský	3 757	3 250	3 652	3 791	6 036	100.9	14.4	12.5	13.1	13.2	13.9
Olomoucký	924	947	1 015	1 145	2 058	124.0	3.5	3.6	3.6	4.0	4.7
Zlínský	786	886	844	829	1 665	105.5	3.0	3.4	3.0	2.9	3.8
Moravskoslezský	1 646	1 488	1 684	1 714	2 376	104.1	6.3	5.7	6.0	6.0	5.5
CR total	**26 107**	**26 032**	**27 957**	**28 765**	**43 370**	**110.2**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

* Index changes 2001-2004 = (value 2004 / value 2001) *100.

Source: CZSO, our own calculations

Change in the number of R&D personnel (2001-2004) and R&D personnel by sector of performance (2005) in Czech regions



Source: CZSO, our own calculations

Share of regions in the total number of R&D personnel (FTE) in the Czech Republic (2005) by sector of performance (in %)

R&D Sector	Region													
	AB	SČ	JČ	PL	KV	UL	LI	HK	PA	VY	JM	OL	ZL	MS
Business	27.9	15.5	3.1	3.2	0.3	2.5	3.9	3.7	7.7	3.0	12.3	5.1	5.6	6.2
Government	66.4	10.5	5.0	0.5	0.1	0.1	0.1	3.4	0.0	0.2	12.1	0.0	0.0	1.4
Higher education	41.3	0.0	3.9	5.9	0.0	1.3	4.0	1.9	2.1	0.0	19.2	8.5	3.8	7.9
Private non-profit	75.7	0.9	6.4	9.1	0.0	0.0	0.4	0.2	1.4	0.0	2.2	1.7	0.0	2.1

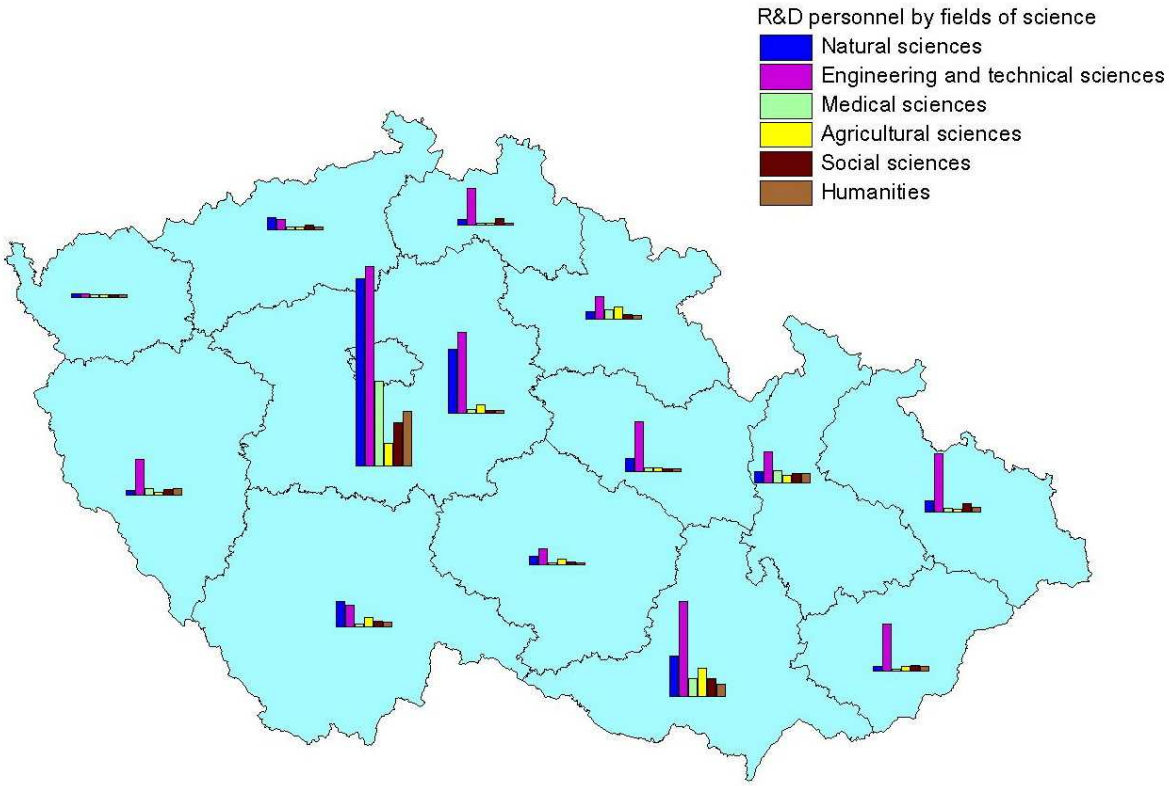
Legend: AB = Praha, SČ = Středočeský region, JČ = Jihočeský region, PL = Plzeňský region, KV = Karlovarský region, UL = Ústecký region, LI = Liberecký region, HK = Královéhradecký region, PA = Pardubický region, VY = Vysočina, JM =Jihomoravský region, OL = Olomoucký region, ZL = Zlínský region, MS = Moravskoslezský region. Source: CZSO, our own calculations

Share of regions in the total number of R&D personnel (FTE) in the Czech Republic (2005) by fields of science (in %)

Sector R&D	Region													
	AB	SČ	JČ	PL	KV	UL	LI	HK	PA	VY	JM	OL	ZL	MS
Natural sciences	50.3	16.8	6.2	0.7	0.2	2.9	0.9	1.3	3.1	1.6	10.5	2.4	0.6	2.6
Technical sciences	29.2	11.6	2.9	4.9	0.2	1.1	5.1	3.0	7.0	2.0	13.7	4.2	6.6	8.4
Medical sciences	66.2	0.9	0.3	3.1	0.0	0.2	0.0	5.5	1.2	0.0	12.9	8.3	0.1	1.3
Agricultural sciences	24.3	7.5	7.9	0.1	0.1	1.4	0.1	11.6	2.0	3.6	31.2	6.3	2.7	1.5
Social sciences	44.8	0.8	3.1	3.4	0.0	3.0	4.9	2.2	1.2	0.4	16.8	8.2	4.1	7.2
Humanities	62.1	0.2	2.5	4.8	0.3	0.6	0.3	1.4	1.0	0.0	12.4	8.8	2.5	3.1
Region total	**40.5**	**10.4**	**3.8**	**3.3**	**0.2**	**1.6**	**3.0**	**3.1**	**4.5**	**1.6**	**13.9**	**4.7**	**3.8**	**5.5**

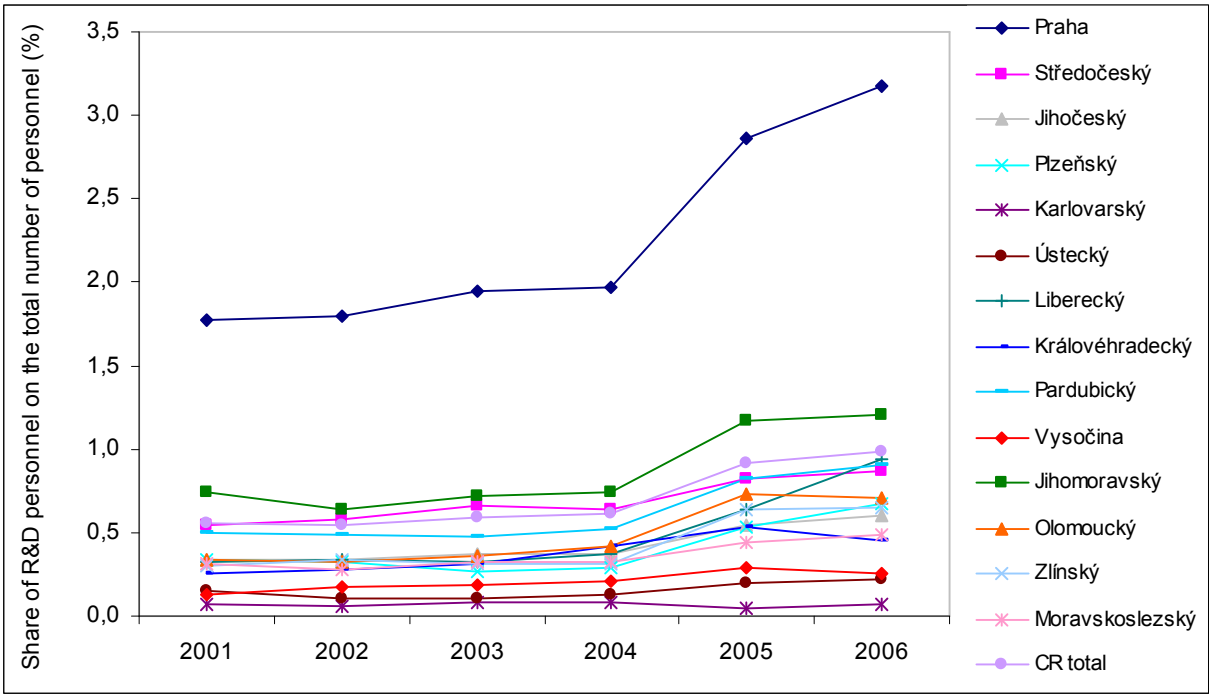
Legend: AB = Praha, SČ = Středočeský region, JČ = Jihočeský region, PL = Plzeňský region, KV = Karlovarský region, UL = Ústecký region, LI = Liberecký region, HK = Královéhradecký region, PA = Pardubický region, VY = Vysočina, JM =Jihomoravský region, OL = Olomoucký region, ZL = Zlínský region, MS = Moravskoslezský region. Source: CZSO, our own calculations

R&D personnel in Czech regions by fields of science



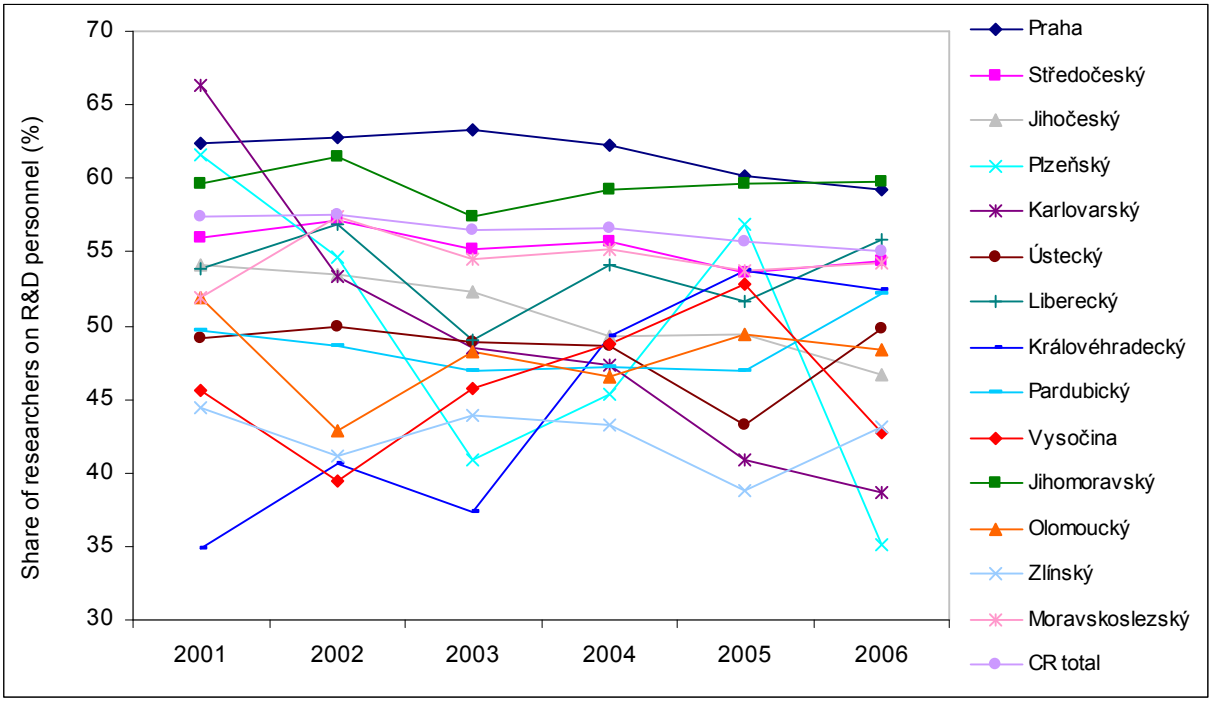
Source: CZSO, our own calculations

Share of R&D personnel on the total number of employees in Czech regions between 2001 and 2006



Source: CZSO, our own calculations

Share of researchers on R&D personnel (in FTE) in Czech regions between 2001 and 2006



Source: CZSO, our own calculations

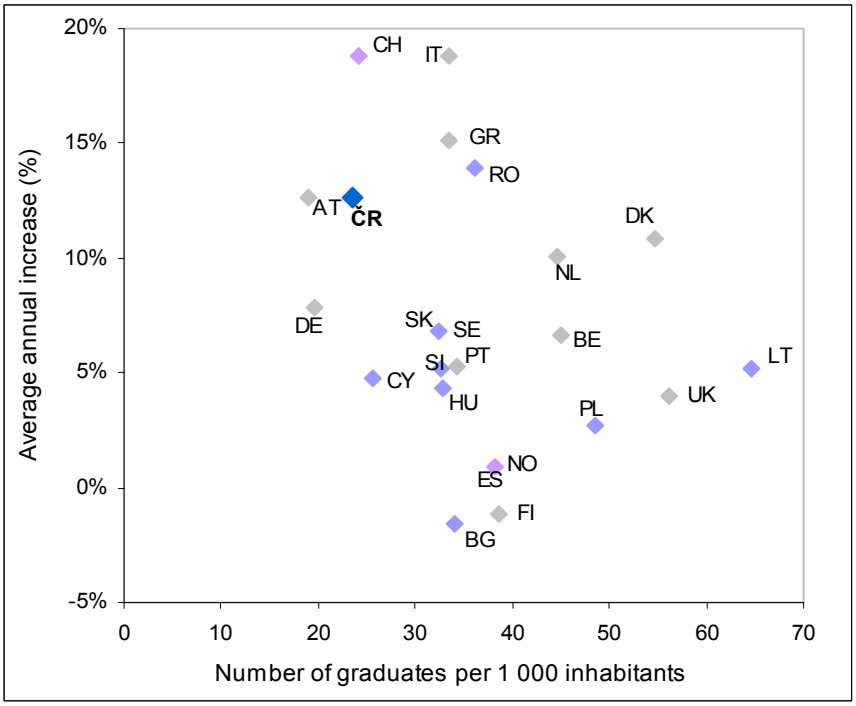
Analysis, comments and other information:

- **The unequal representation of R&D personnel (in FTE)** in the Czech regions corresponds to the uneven localization of research institutes. The capital of Praha holds a completely dominant position having more than 40 % of all R&D personnel in the Czech Republic in 2005. Together with the neighbouring region of Středočeský, Praha has more than half, and with Středočeský and Jihočeský regions almost 65 % of all the human resources in R&D. Ústecký and Vysočina regions on the other hand have low shares followed only by the Karlovarský region which has the lowest share in the total number of R&D personnel in the Czech Republic (0.2 %).
- The concentration of research and development to the capital is also revealed in the **share of R&D personnel in the total number of employees** in the regions. With a 3.2% share of R&D personnel on the total employment (2006), Praha is significantly ahead of other regions, including the second highest ranked Jihomoravský region (1.2% share). Apart from Středočeský region which has a major research basis the regions of Liberecký and Pardubický have been placed highly over the past few years. Karlovarský region has the lowest share of R&D on employment (0.1%) followed by the Ústecký and Vysočina regions.
- The number of R&D personnel increased less than the expenditure on R&D between 2001 and 2004. In Ústecký and Plzeňský regions there was a decrease in the number of R&D personnel (in FTE) during this period. The most prominent, more than 50%, **increase in the number of R&D personnel** was recorded in the regions of Vysočina and Královéhradecký, with the Olomoucký region and Středočeský also having a significant increase in the number of R&D personnel (more than 20 %).
- In 2005, the region of Praha had more than one quarter of all R&D personnel **in the business sector** in the Czech Republic, together with Středočeský and Jihomoravský regions this was 55 %. Nevertheless, the human resources in R&D are more unevenly distributed in the business sector.
- **In the government sector** the dominance of the capital city, mainly due to the presence of most of the institutes of the Academy of Sciences and departmental research institutes, is much more prominent than in the business sector – two thirds of the government R&D personnel of the whole of the Czech Republic work in Praha, and combined with the regions Středočeský and Jihomoravský this figure is almost 90 %.
- The most R&D personnel in the university sector are, apart from Praha and Jihomoravský regions which have more than 60 % of university research personnel in the Czech Republic, concentrated in Olomoucký and Moravskoslezský regions. Majority of all R&D personnel (more than three quarters) in the **private non-profit** sector are concentrated to the capital, which is the same as for expenditure on R&D.

- When comparing **concentration of R&D personnel in individual regions by fields of science** it follows that R&D personnel are most regionally concentrated in **medical sciences** – almost two thirds work in the region of Praha, and the share together with Jihomoravský, Olomoucký and Královéhradecký regions makes up 93 % of all personnel in medical sciences in the Czech Republic. The concentration of personnel in the area of **humanities** is also very high – Praha, Jihomoravský, Olomoucký and Plzeňský region have 88 % of all the human resources in these fields. **Social sciences** are slightly less concentrated, after Praha and Jihomoravský regions the most personnel in these fields work in Olomoucký Moravskoslezský and Liberecký regions. More than 50 % of R&D personnel in the area of **natural sciences** work in the region of Praha and together with Středočeský, Jihomoravský and Jihočeský the share is almost 84%. R&D personnel in technical and agricultural sciences are distributed much more unevenly throughout the Czech Republic in contrast to the other mentioned scientific fields. The majority of R&D personnel in the field of **technical sciences** apart from Praha are concentrated in Jihomoravský, Středočeský and Moravskoslezský regions. From the other regions, Pardubický, Zlínský, Liberecký and Plzeňský have a high representation of personnel in this scientific field. R&D personnel in **agricultural sciences** are represented more in Jihočeský region than in Praha. A significant number of personnel in this specialization is located in Královéhradecký, Jihočeský, Středočeský and Olomoucký regions.

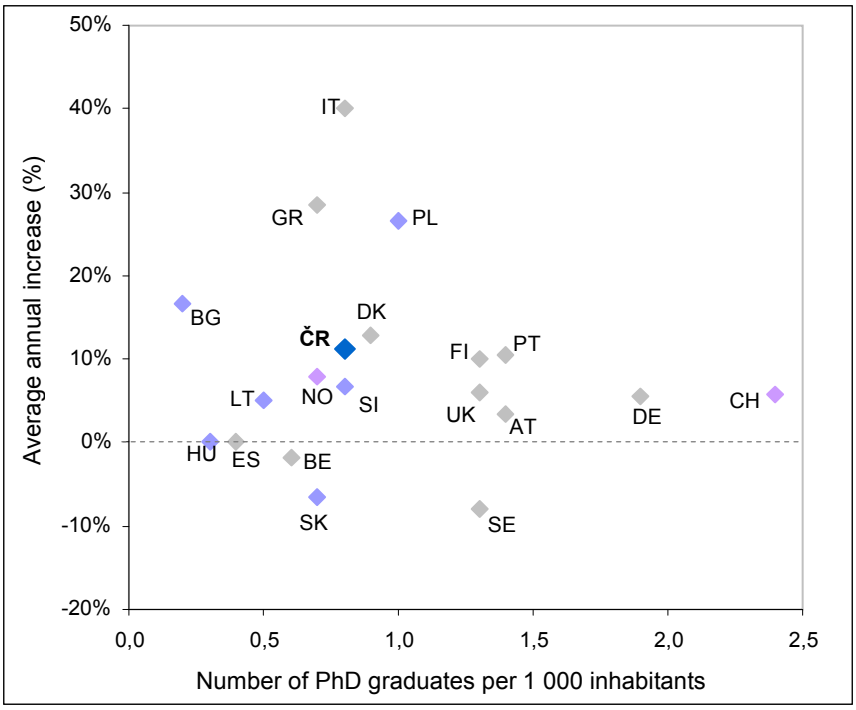
3.3.1.7 Total number of university graduates (ISCED 5-6 and 6) – international comparison

Total number of university graduates (ISCED 5-6) aged between 20 and 29 per 1 000 inhabitants of this age group and its average annual increase between 2001 and 2005



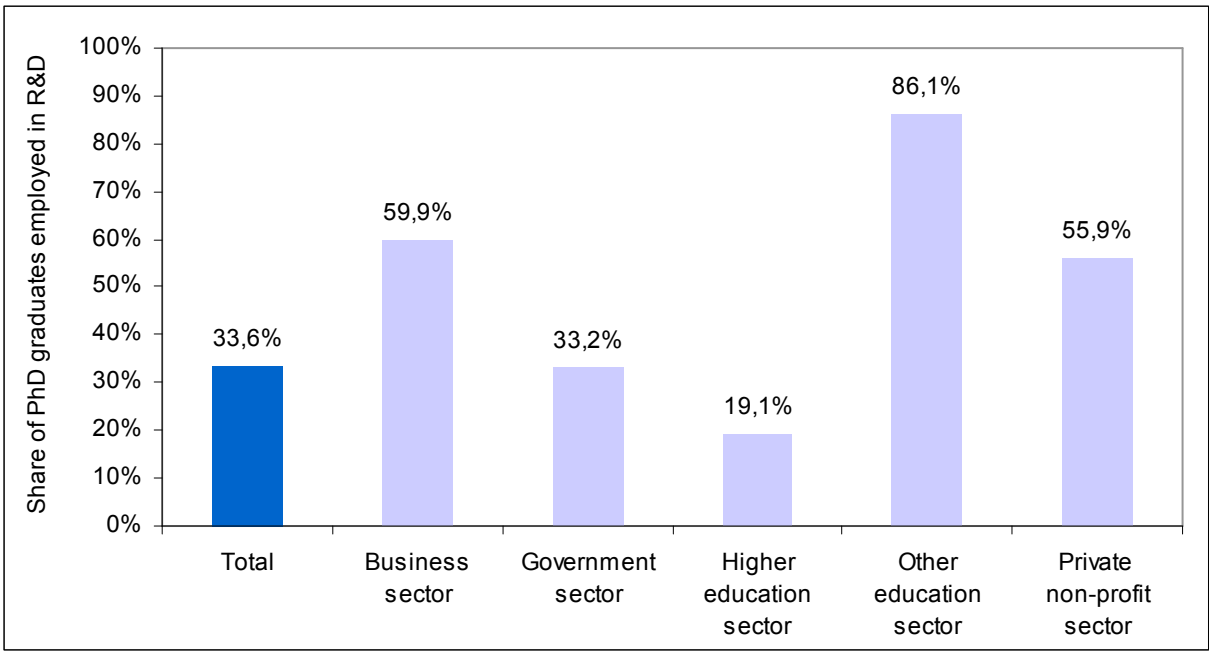
Source: Eurostat

Total number of PhD graduates (ISCED 6) aged between 25 and 34 per 1 000 inhabitants of this age group and its average annual increase between 2001 and 2005



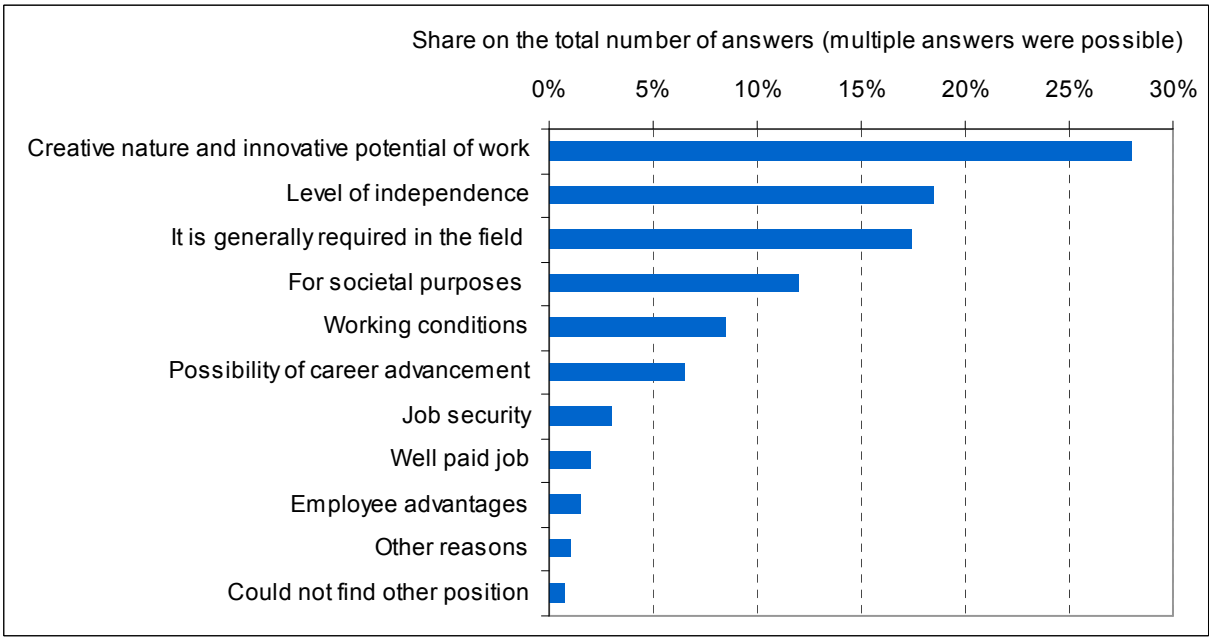
Source: Eurostat

Percentage share of PhD graduates employed in the field of R&D on total number of PhD holding respondents in total and by sectors of performance in 2006



Source: CZSO – Results of the Pilot survey of the professional growth of PhD holders

Reasons for choosing research career (in % on the total number of answers to the question asked), 2006



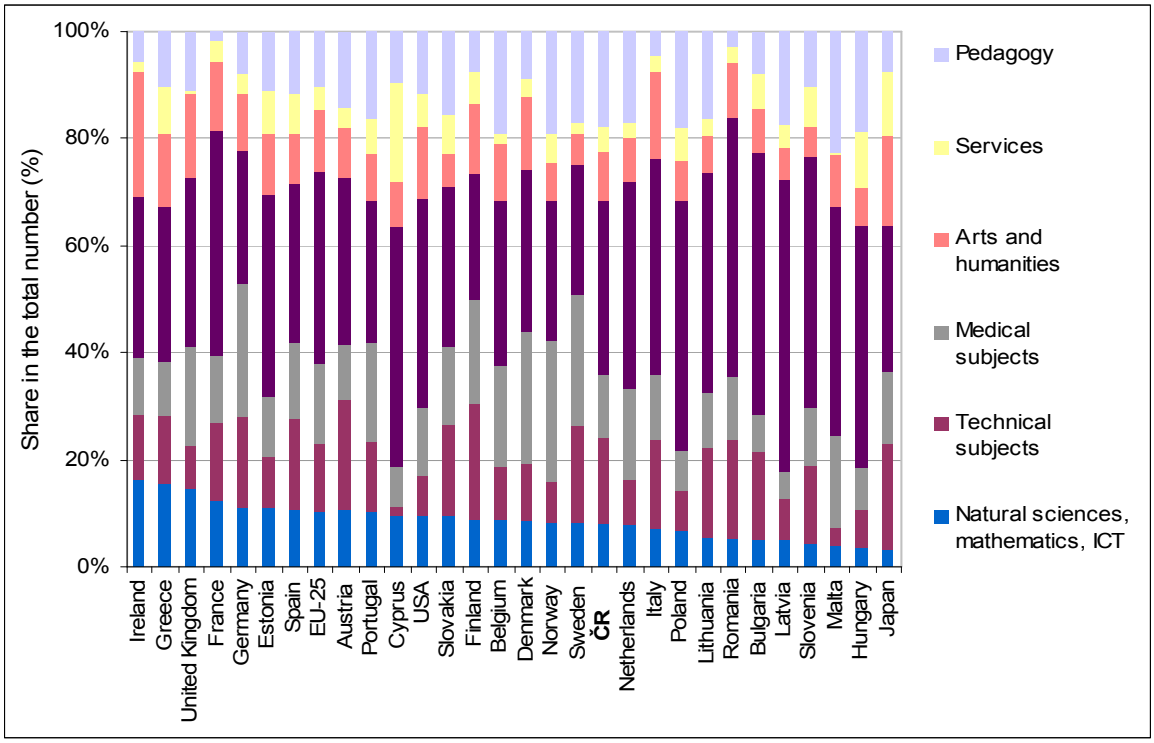
Source: CZSO – Results of the Pilot survey of the professional growth of PhD holders

Analysis, comments and other information:

- The total **number of university graduates** in the Czech Republic is still lower than in most of the monitored countries even though the number of students and university graduates in the Czech Republic has continuously increased over the past few years. In the 20 to 29 age group the Czech Republic has 26.4 graduates per 1 000 inhabitants, nevertheless the average annual increase was 12.7%, the same as for Austria.
- An international comparison of the **number of PhD graduates** aged between 25 and 34 per 1 000 inhabitants in this age group is another key indicator for the flow of human resources in R&D and innovation. In the Czech Republic there has been an average increase in the number of PhD graduates of 11.1 % since school year 2001/2002, which is an above-average increase together with Italy, Greece, Denmark and the new member states Bulgaria and Poland. Despite this, the Czech Republic along with most countries, has yet to reach the level of 1 PhD graduate per 1 000 inhabitants aged between 25 and 34. More than one PhD graduate per 1 000 inhabitants aged between 25 and 34 years old can be found in Switzerland (2.4), Germany (1.9), Austria and Portugal (1.4), Finland, Sweden and the United Kingdom (1.3).
- **PhD graduates** employed in research and development make up approx. one third of all PhD holders. The most significant share of personnel in R&D among PhD graduates is in other sectors than in the education sector e.g. R&D is performed by approx. 60% of all PhD holders employed in the business sector. The most important **motive for a research career** for PhD graduates is the nature and innovation potential of the work. The high level of independence of the work also represents a relatively strong motivation factor for PhD graduates to begin on the research circuit. In contrast, a decisive factor would generally not be salary or working conditions.

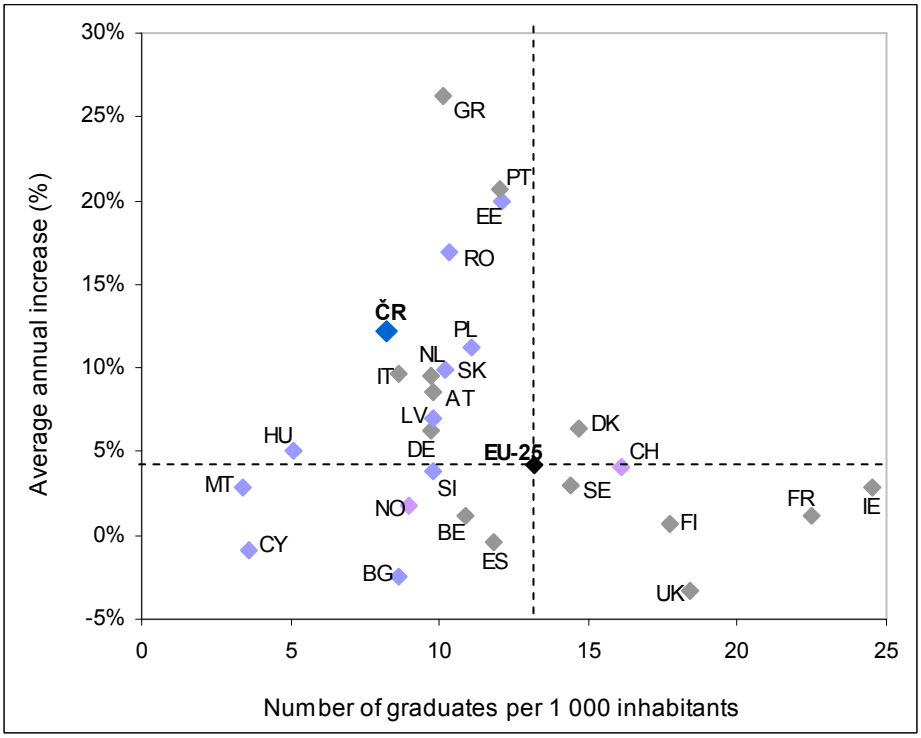
3.3.1.8 University graduates (ISCED 5-6) based on subjects studied

University graduates (ISCED 5-6) in 2005 based on subjects studied



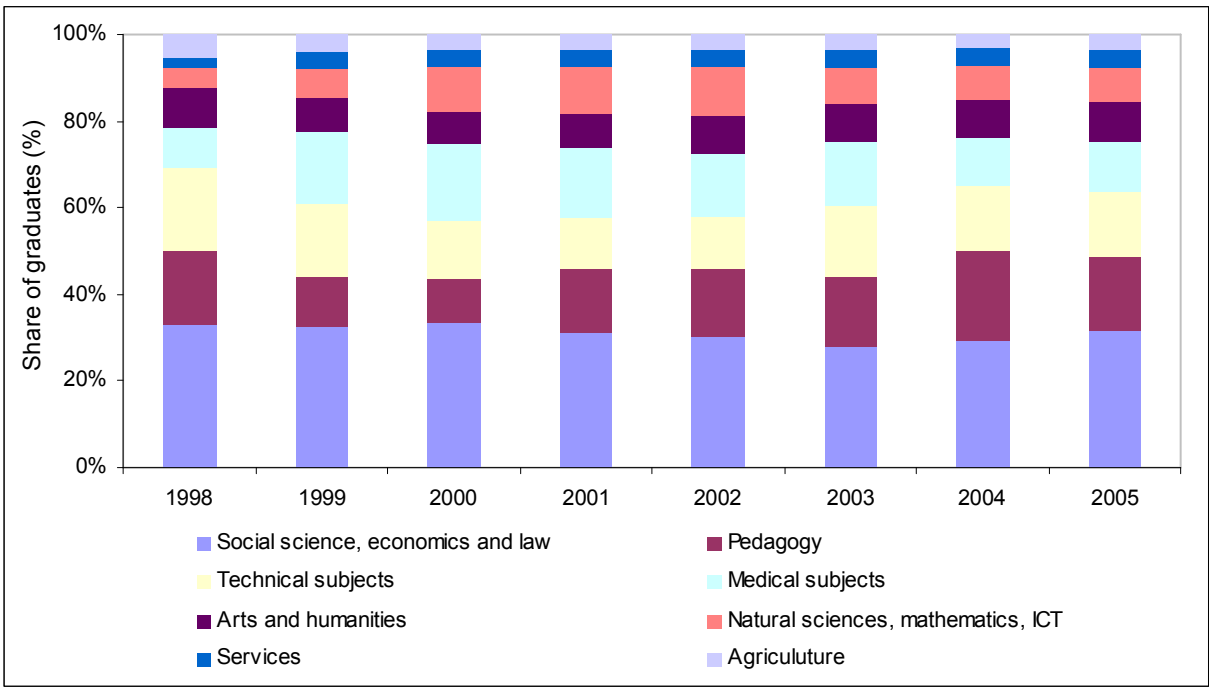
Source: Eurostat

Total number of university graduates (ISCED 5-6) aged between 20 and 29 per 1 000 inhabitants of this age group in natural science subjects and its average annual increase between 2001 and 2005



Source: Eurostat

University graduates (ISCED 5-6) in the Czech Republic based on subjects studied between 1998 and 2005



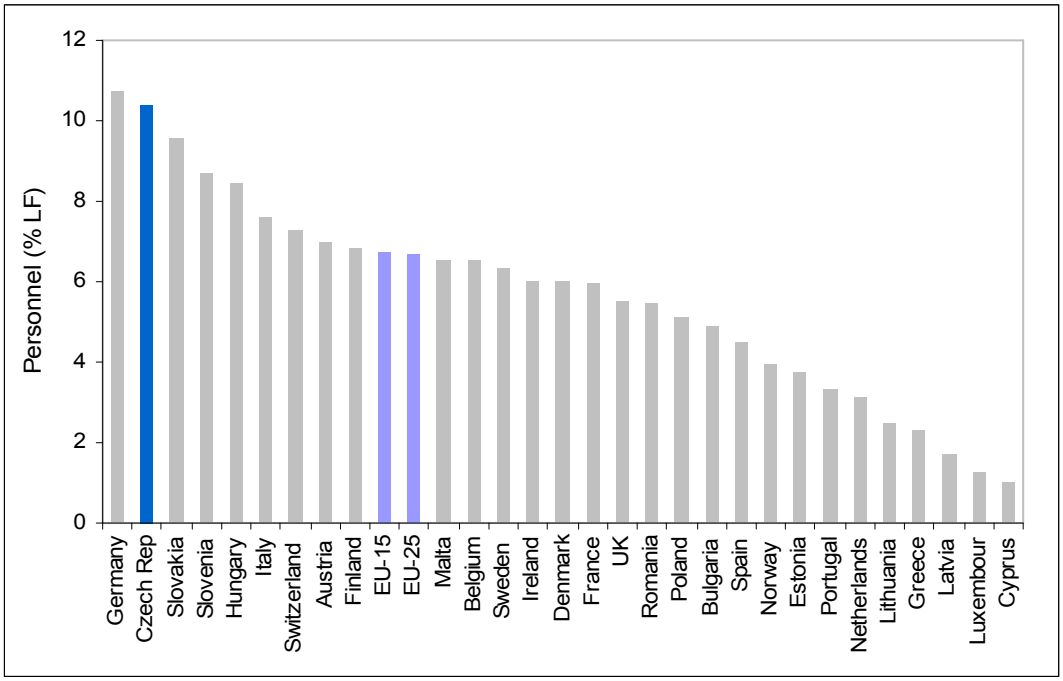
Source: Eurostat

Analysis, comments and other information:

- In 2005, the number of **university graduates** was most represented in the Czech Republic, the same as for most other countries, by social sciences, economics and law (31.6 %), followed by pedagogical subjects (17.1 %). In third place were technical subjects (15.3 %), then medical subjects (11.3 %), humanities and arts subjects (9 %), natural science subjects, mathematics and ICT (7.8 %) and in last place services (4.4 %).
- If we com[pare the percentage representation of graduates of technical and natural science subjects in the monitored countries, Finland and Austria and Japan (approx. 20 %) have the highest **share of technical subjects**, followed by Sweden (18 %), Germany, Spain, Italy and the new member states of Slovakia, Lithuania and Bulgaria (more than 16 %). The Czech Republic has 15.3 % of graduates of technical subjects and the EU-25 average is 12.5 %. USA has only 7.4 %.
- In 2005, 7.8 % of all university graduates graduated in **natural sciences, mathematics or ICT** in the Czech Republic. Ireland (16.2 %) and United Kingdom (14,3 %) lead unequivocally in natural science subjects, mathematics and ICT followed by France (12,3 %) and Germany, Spain, Estonia, Austria and Portugal have more than 10 % of graduates in natural science (which is also the EU-25 average).
- in 2005 there were only 8.2 graduates aged between 20 and 29 per 1 000 inhabitants in this age group graduated in **natural science subjects** which is one of the worst results of the monitored countries after Malta, Cyprus and Hungary. The average of the EU-25 is 13.4 graduates per 1 000 inhabitants, USA has 10.6 and Japan 13.7 graduates per 1 000 inhabitants. It is encouraging that the Czech Republic recorded in this field between 2001 and 2005 an average annual increase of 12.2 %, whereas the EU-25 average increased by only 4.2 %, in Japan 1.8 % and USA only 1.1 %. The highest increase during this period was in Greece (26.3 %), Portugal and Estonia (more than 20 %).
- The share of graduates of **technical science** subjects decreased 19.5 % to 15.3 % between 1998 and 2005. The share of graduates of **natural science** subjects since 1998 increased from 5 % to 7.8 % of all graduates of tertiary education in the Czech Republic in 2005.

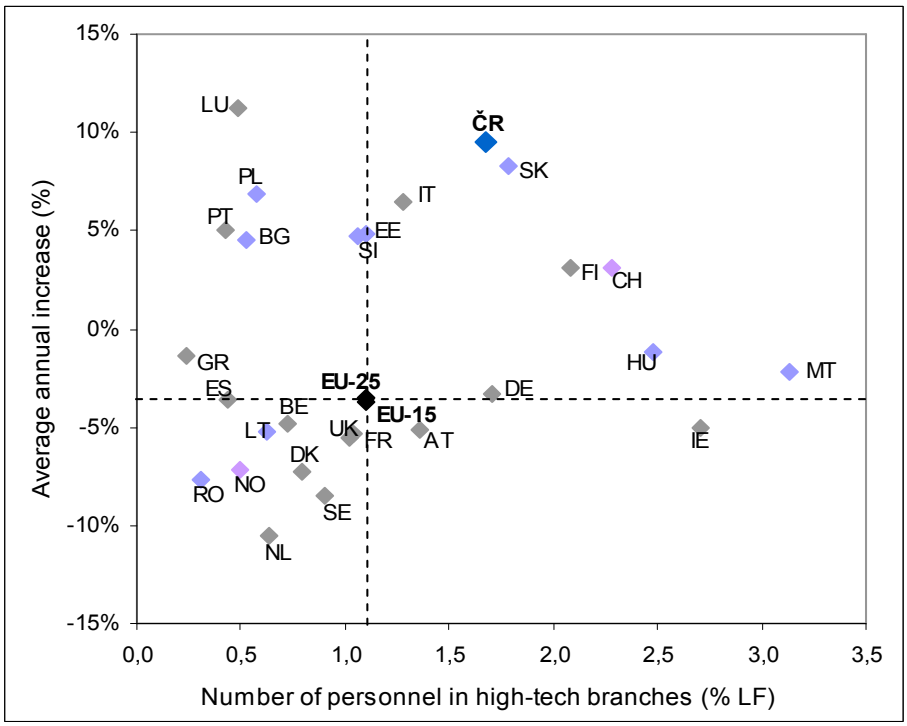
3.3.1.9 Total number personnel in high- and medium high-tech branches – international comparison

Percentage share of personnel in high- and mid-tech branches of manufacturing industry (NACE 24, 29-35) in the labour force in 2006



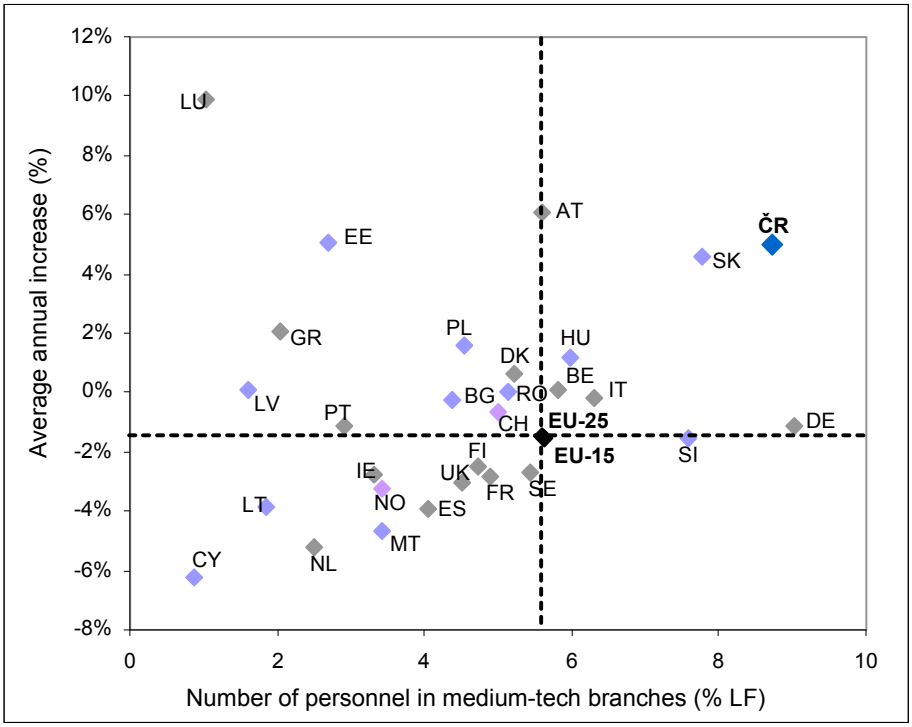
Source: Eurostat

Percentage share of personnel in high-tech branches of manufacturing industry (NACE 24, 29-35) in the labour force and its increase between 2002 and 2006



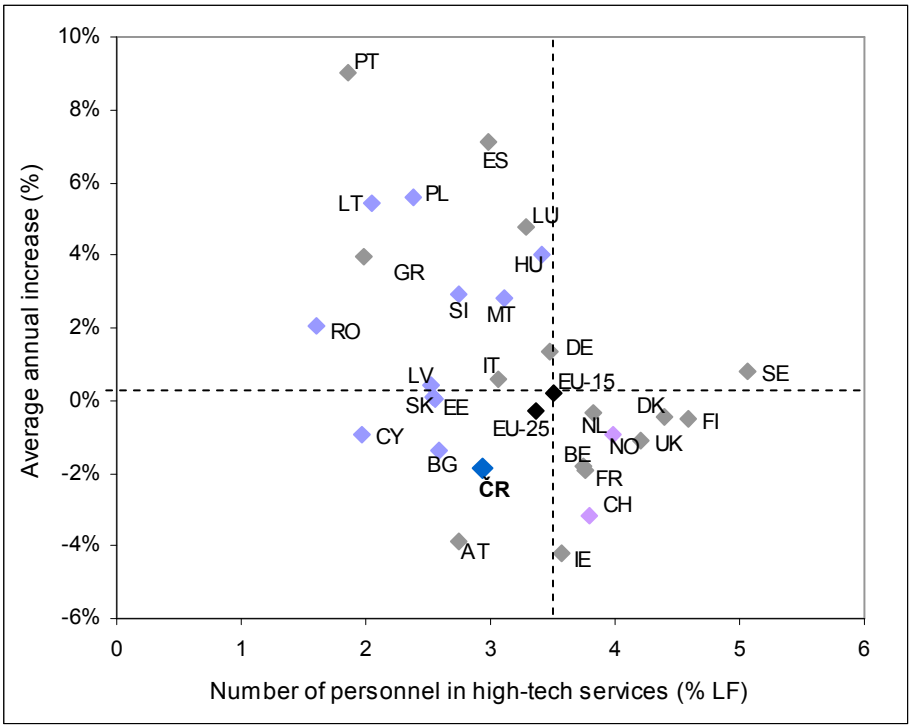
Source: Eurostat

Share of personnel in medium high-tech branches of manufacturing industry (NACE 24, 29-35) in the labour force and its increase between 2002 and 2006



Source: Eurostat

Share of personnel in high-tech branches of knowledge intensive services (Knowledge Intensive Services, NACE 64, 72, 73) in the labour force and its increase between 2002 and 2006



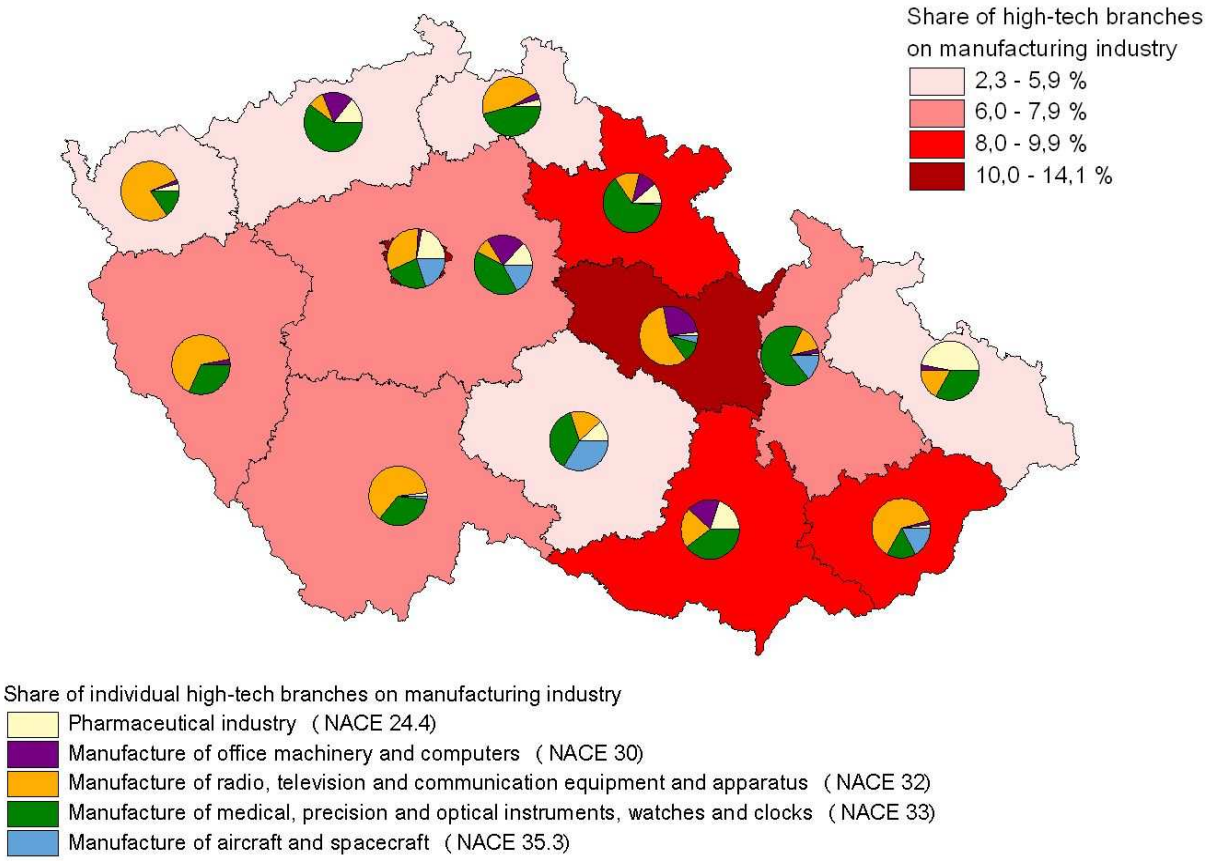
Source: Eurostat

Analysis, comments and other information:

- In 2006 the share of **personnel in high- and mid-tech manufacturing industry** in the Czech Republic was approx. 10.4 % of the labour force, which markedly exceeds the average of the EU-25 and EU-15 (6.7 % of the labour force) and nears the share of personnel in high- and mid-tech manufacturing industry in Germany (10.7 % of the labour force). The lowest share of personnel in high- and mid-tech manufacturing industry in the monitored countries was in Greece (2.3 %) and in Poland (5.1 % of the labour force).
- On average 1.1 % of the labour force works in **high-tech branches** in the EU-25 and EU-15 and during the period 2002 – 2006 this share decreased on average by approx. 3.5 % annually. In 2006 in the Czech Republic the share of personnel in high-tech branches reached 1.7 % and its annual increase in this area was 9.5 %, which is the highest after Luxemburg (11.2 %). The situation is similar in Slovakia. The highest percentage of employment in high-tech branches was reached in Malta (3.1 %), Ireland (2.7 %), Hungary, Switzerland and Finland (more than 2 %).
- 8.7 % of the labour force works **in branches of medium high-tech** industry in the Czech Republic and the increase between 2002 and 2006 was on average 5 %. The Czech Republic is in second place, the same as for the sum of high and mid-tech branches, behind Germany (9 %) and has one of the highest percentage increases after Luxemburg (9.9 %), Austria (6.1 %) and Estonia (5.1 %).
- In 2006, the share of **personnel in knowledge-intensive services** (NACE 64 – Post and Communications, 72 – Computers and Related Activity, 73 - Research and Development) in the Czech Republic was approx. 2.9 % of the labour force, which is less than the EU-25 average (3.4 % of the labour force in 2006). From the statistical data it also follows that the share of personnel in high-tech services in the Czech Republic has decreased over the past few years (2 % annually on average between 2002 and 2006), whereas the average in the EU-25 and EU-15 in this period stagnated. The highest level of employment in high-tech services is in Sweden (5.1 % of the labour force), Finland (4.6 %), Denmark (4.4 %) and the United Kingdom (4.2 %). The highest increase (albeit from a low base) was in Portugal (9 %), Spain (7.1 %) and Poland (5.6 %).

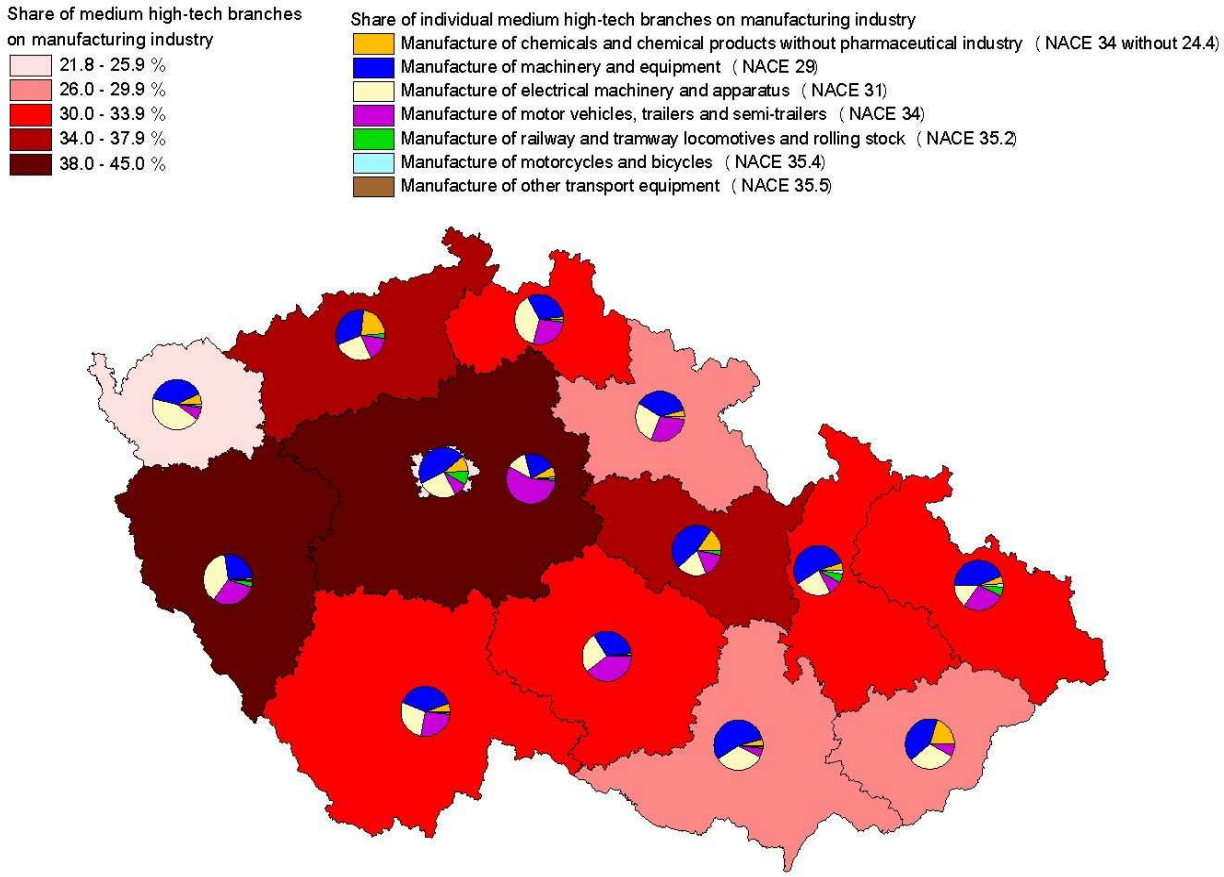
3.3.1.10 Human resources in high-tech and mid-tech branches in regions

Employment in high-tech branches of manufacturing industry in Czech regions (2005)



Source: CZSO, our own calculations

Employment in medium high-tech branches of manufacturing industry in Czech regions (2005)



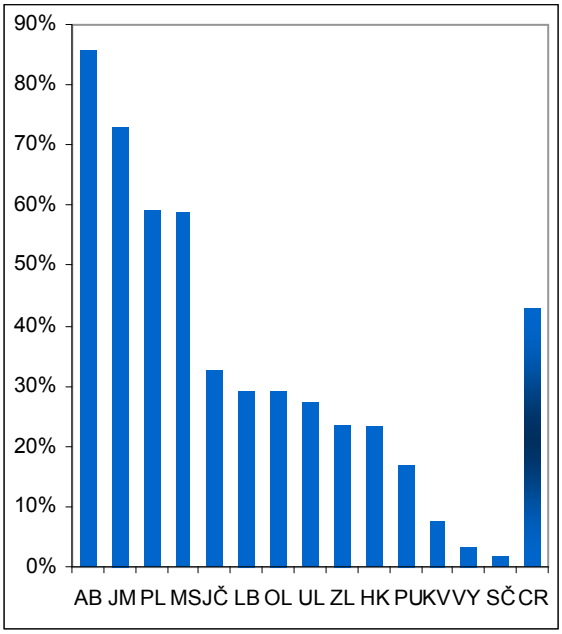
Source: CZSO, our own calculations

Analysis, comments and other information:

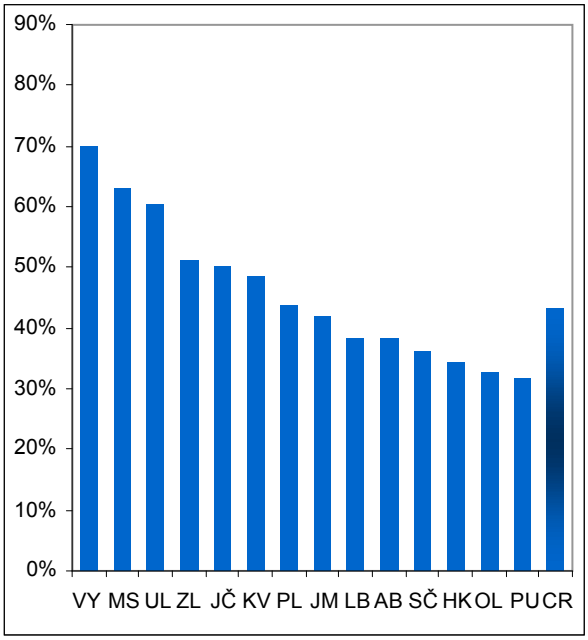
- Praha's economy is the most specialized **in high-tech** branches of manufacturing industry (14.1% share of high-tech branches in employment in manufacturing industry in 2005) and **high-tech services** (9.5% share in employment in services) of all the regions of the Czech Republic. **Employment in medium high-tech** branches in Praha on the other hand is the **lowest in the Czech Republic** (21.8% share in manufacturing industry), which corresponds with the process of relocating space intensive production, personnel and materials away from the capital and the development of advanced branches of industry and services.
- **The Pardubický region has a high share of employment** in high-tech and medium high-tech branches of manufacturing industry (13.4% and 36.8%, respectively) and in high-tech services (9.2% share in services). The sectoral structure of employment in the Pardubický region can also be hidden by the assembly activity of foreign investors (Foxconn etc.).
- **Středočeský, Plzeňský and Ústecký region** are regions with a strong focus on **medium high-tech** branches of manufacturing industry (45.0%, 40.6% and 35.8%, respectively) and also with a low level of specialization in high-tech branches.
- **The region with the least progressive sectoral structure of employment is the Karlovarský region**, in which the employment values in high-tech and medium-high branches of manufacturing industry (4.7% and 25.4%, respectively), the same as in high-tech services (3.3% share in services) are some of the lowest in the Czech Republic.

3.3.1.11 Mobility of human resources in the Czech Republic

Share of university students that study in the region where they have permanent residence (school year 2005/2006)



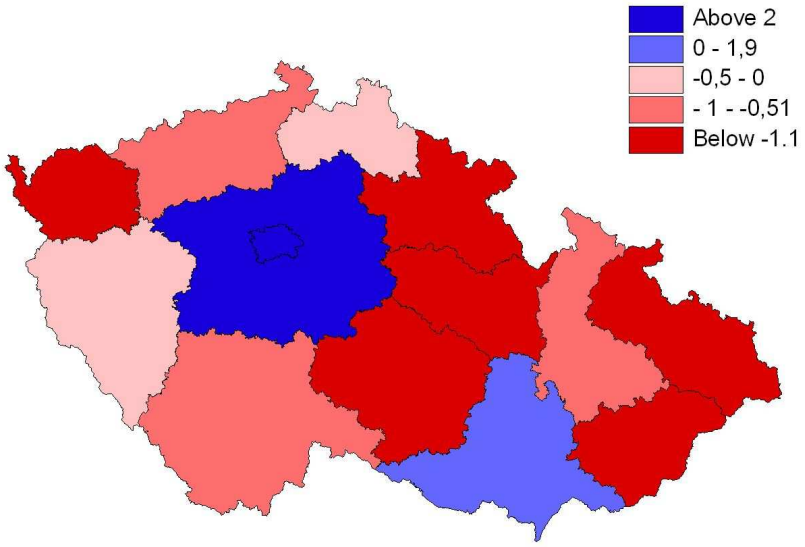
Share of university students with permanent residence in regions where they study in the total number of university students in regions (school year 2005/2006)



Legend: AB – Praha, SČ – Středočeský region, JČ – Jihočeský region PL – Plzeňský region, KV – Karlovarský region, UL – Ústecký region, LB – Liberecký region, HK – Královéhradecký region, PU – Pardubický region, VY – Vysočina region, JM – Jihomoravský region, OL – Olomoucký region, ZL – Zlínský region, MS – Moravskoslezský region

Source: ÚIV

Summary net level of migration of the university educated population aged between 25 and 34 in between Czech regions between 2001 and 2004 (in ‰)



Source: CZSO

Analysis, comments and other information:

- The attractiveness of the study subjects offered by universities in the regions for students which have permanent residence in these regions can be seen from the left hand graph. The more attractive the home university is, the less university students look for subjects in other regions and the less their migration mobility is. **The least mobile are** university students from the region of **Praha** and **Jihomoravský region** because Praha and Brno are the leading educational centres in the Czech Republic. Low mobility is also shown in university students from Plzeňský and Moravskoslezský regions. In this case – apart from the presence of strong regional educational centres – their peripheral location in the Czech Republic is pertinent. In contrast, almost all university students with their permanent residence in Středočeský, Vysočina and the Karlovarský region leave to study in other regions of the Czech Republic, in particular due to the very limited choice of university subjects offered.
- **The factor of peripheral location of regional education centers** is even more distinct in the values on the right hand graph, which show the share of university students with permanent residence in the region where they study in the total number university students in the region. In addition to this factor, the resulting values are also influenced by the total number of university students in the region, both local (having their permanent residence in the region of study) and incoming.
- The region of Vysočina has a high share in particular due to the fact that the offer of university subjects in this region does not attract students from surrounding regions. This attractiveness is low because the region of Vysočina is located between the two main education centres of the Czech Republic, i.e. Praha and Brno. The higher share of local students in Moravskoslezský, Ústecký, Zlínský and Jihočeský regions is also caused by the peripheral location of these regions in the Czech Republic.
- In the period between 2001 and 2004 **Praha was he most profitable region** (3.47 ‰) from the point of view of migration of these groups of inhabitants followed by **Středočeský** region (2.27 ‰). The only other profitable region from the point of view of migration was **Jihomoravský** (0.42 ‰).
- From the point of view of the direction of individual migration flows of groups of inhabitants between Czech regions the following picture emerges: **Praha** is the **most attractive center of migration**, drawing university educated inhabitants aged between 25 and 34 from all of the other regions. The positive migration balance of Středočeský region is caused by an influx of the studied group of inhabitants from the city of Praha (in particular to areas surrounding Praha), which make up approx. 2/3 of all incoming individuals of the studied group.
- Another centre of positive migration is Jihomoravský region (mainly **Brno**), which attracts individuals particularly from Moravian regions and Vysočina.
- **The lowest** total net level of migration is shown in peripherally located regions of Karlovarský, Zlínský and Vysočina.

3.3.1.12 Mobility of human resources - international comparison

Gross level of internal migration in selected countries EU in 19991

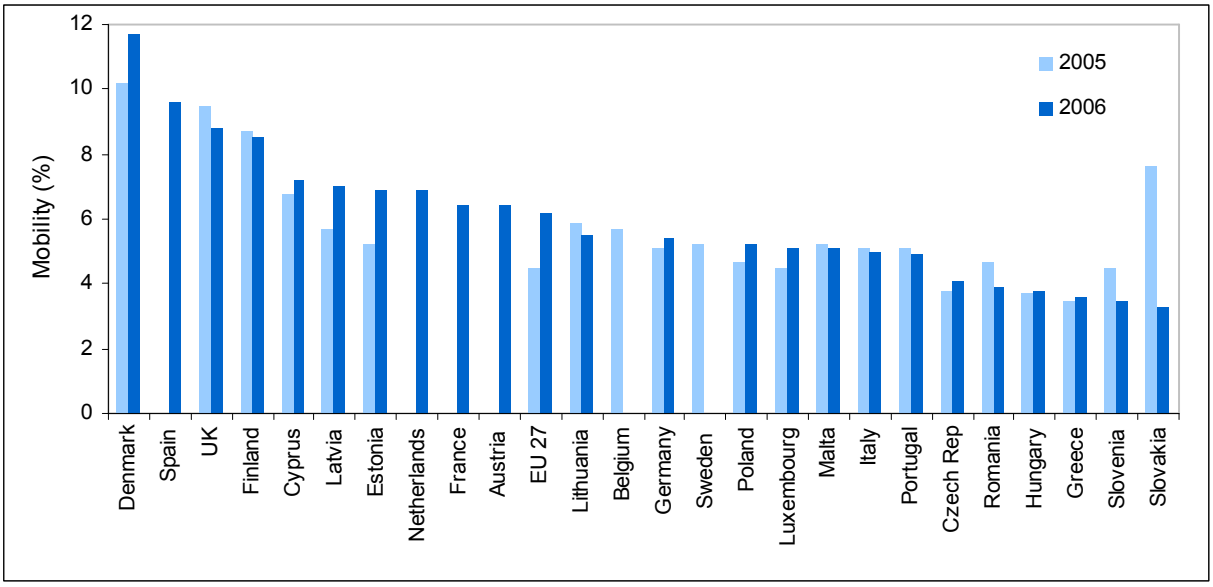
	1999	
	gross level of migration	net level of migration
United Kingdom	3.50	---
Denmark	3.41	0.095
Sweden	1.79	0.182
Hungary	1.69	0.063
Hungary	1.32	0.054
Belgium	1.28	0.086
Romania	1.23	0.013
Austria	0.94	0.054
Finland	0.90	---
Spain	0.76	0.099
Italy	0.54	---
Czech Republic	**0.50**	**0.063**
Slovenia	0.30	0.021
Slovakia	0.22	0.023[2]
Poland	---	0.033

Legend:

[1] values of gross and net levels of migration were calculated based on data from Eurostat on internal migration between NUTS 2 regions.
[2] data from 2000.

Source: Lux et al. (2006): Analysis of housing policy measures towards the support of labour flexibility in the Czech Republic

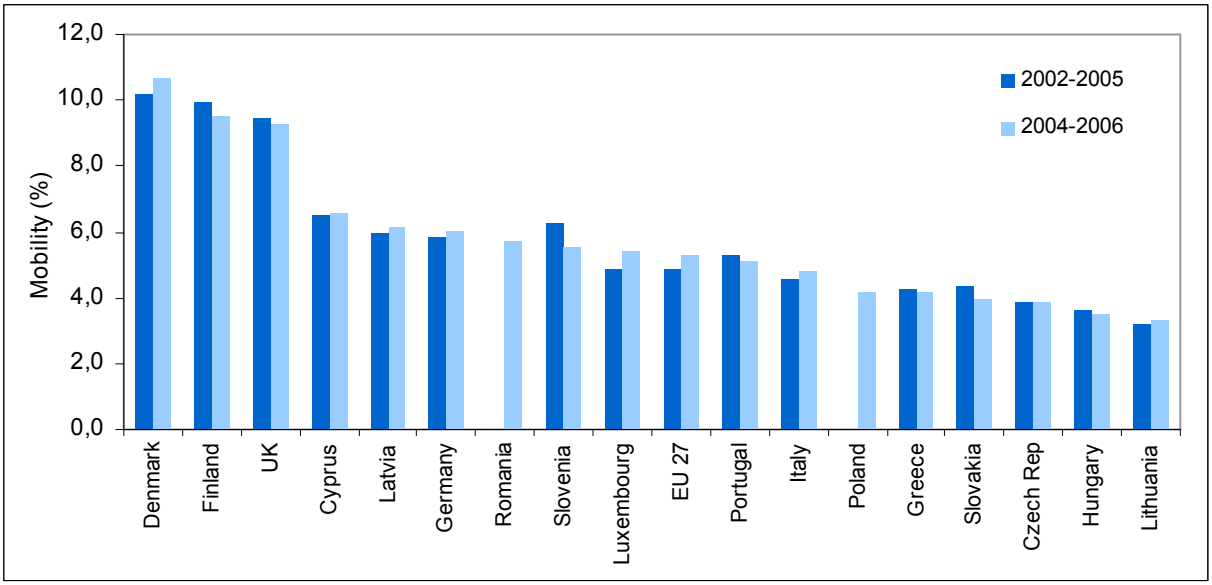
Labour mobility of qualified human resources (Human Resources in Science and Technology, HRST) in all NACE branches (three year averages)



Legend: The resulting values show the share of the number of HRST that changed their employment in the total number of HRST. HRST can be defined as individuals with a completed university education (ISCED 5A, 5B, 6) employed in scientific and technical professions (KZAM 2, 3).

Source: Eurostat

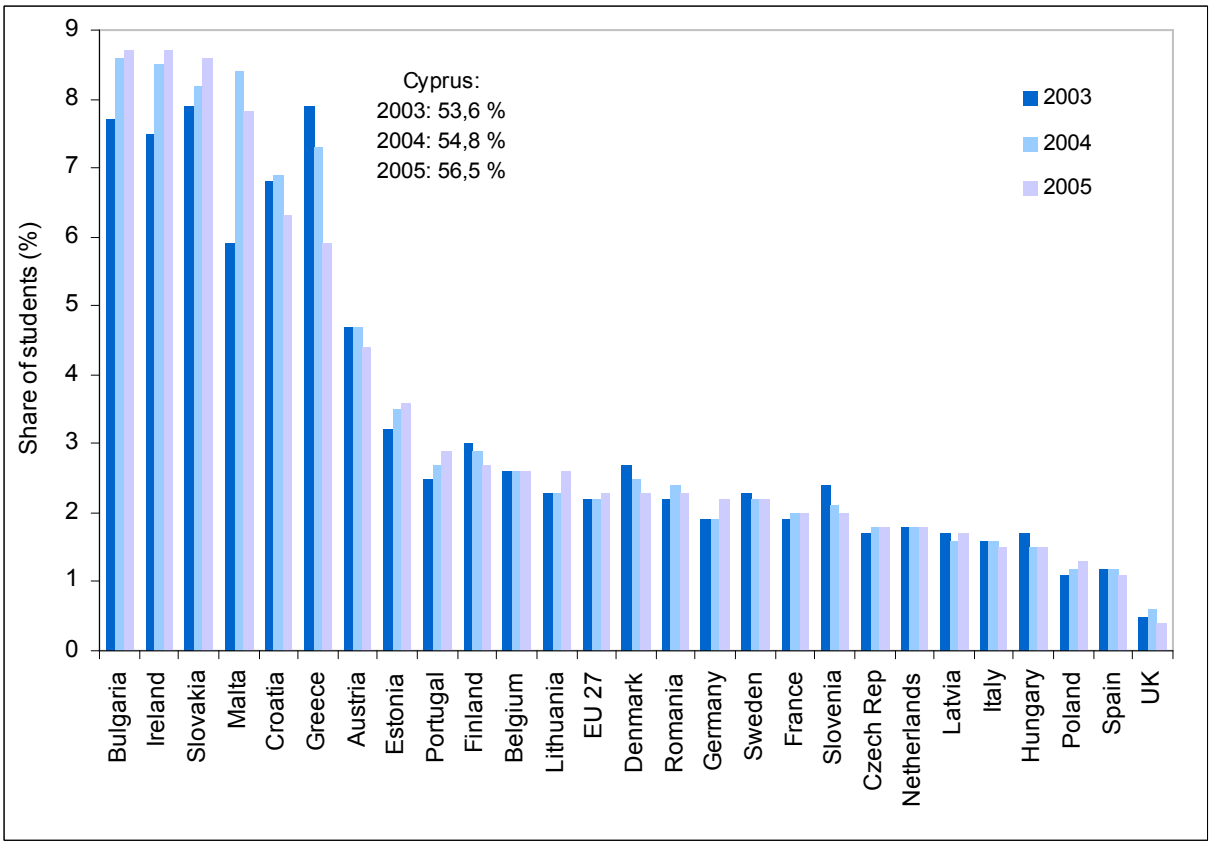
Labour mobility of HRST in knowledge based NACE branches (three year averages)



Legend: knowledge based branches of NACE: NACE 61, 62, 64-67, 70-74, 80, 85, 92.

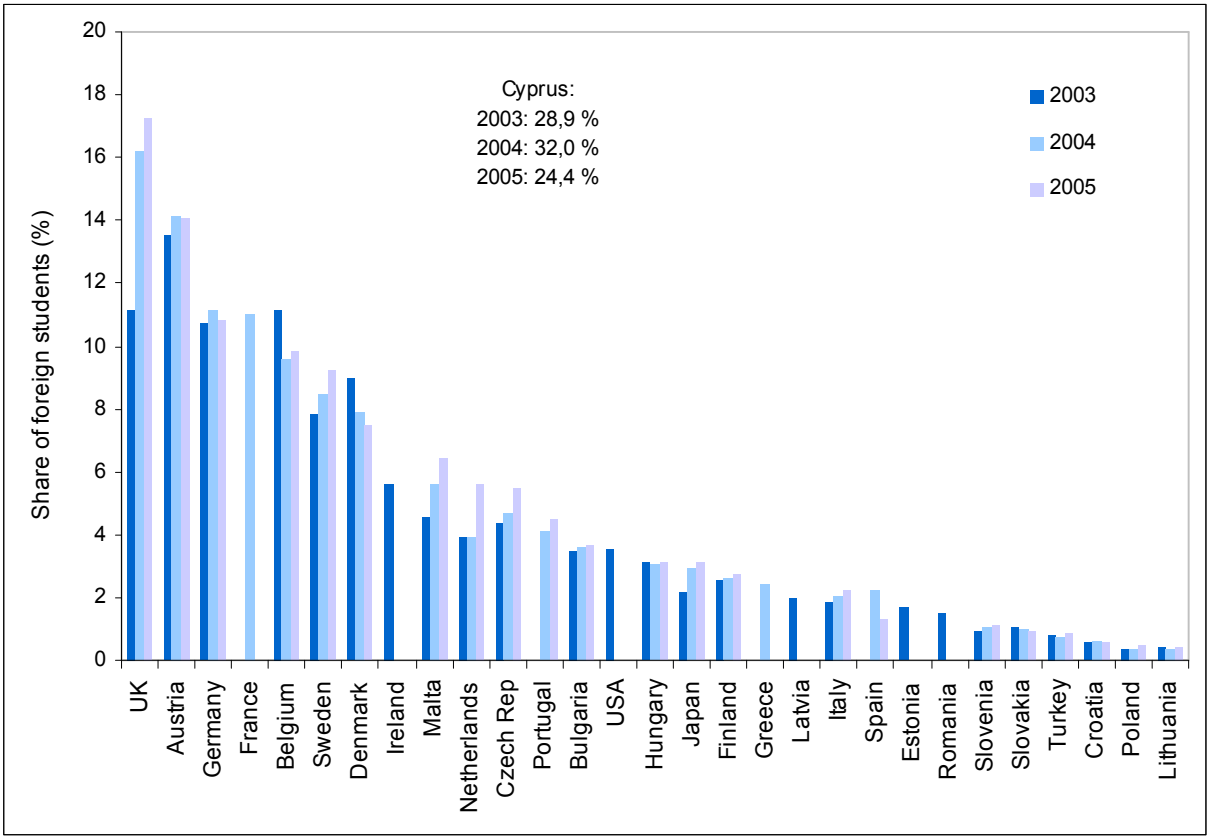
Source: Eurostat

Share of students studying in other EU 27, EEA or candidate countries



Source: Eurostat

Share of foreign university students in the total number university students in the country



Source: Eurostat

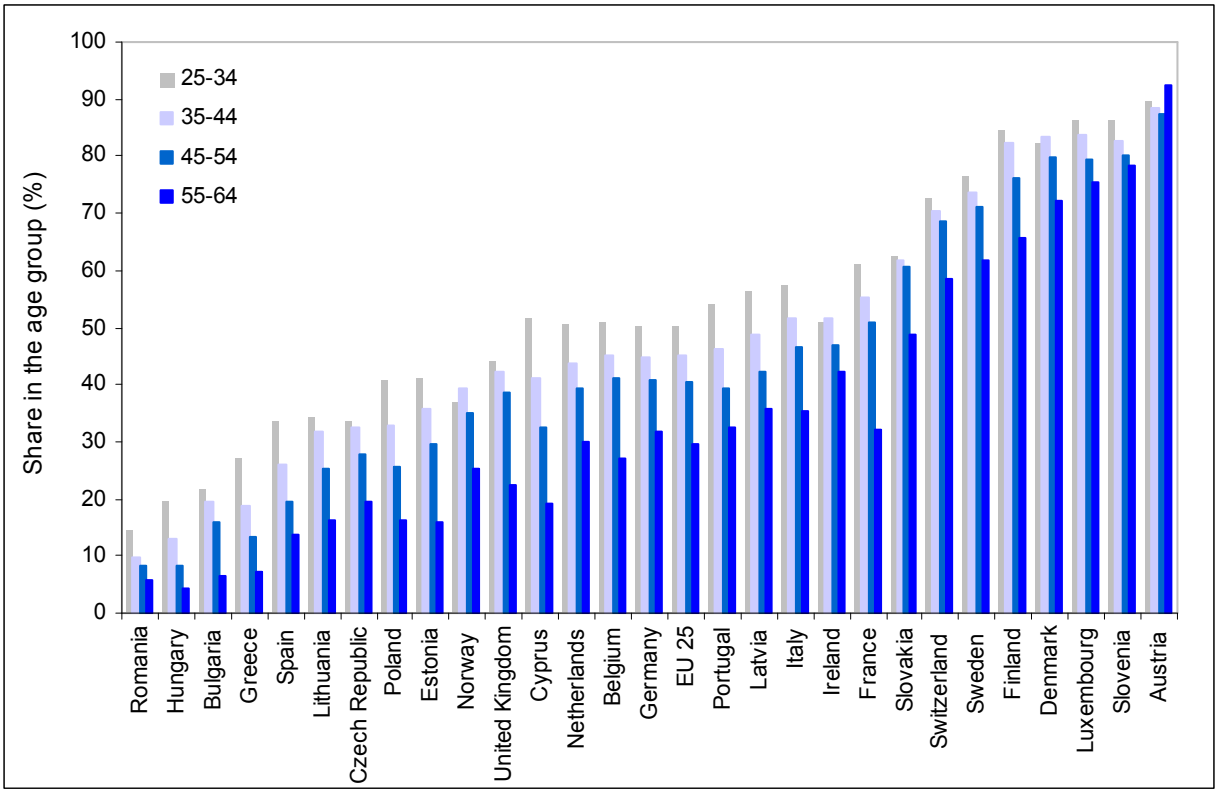
Analysis, comments and other information:

- The Czech Republic is a country with **low level of intensity of internal migration** together with other post-communist countries (with the exception of Hungary and Romania) and several countries in Southern Europe (Spain, Portugal and Italy).
- Although the Czech Republic is a country with a **low level of internal migration**, the net levels of migration in the Czech Republic significantly exceed its post-communist neighbours'. The high level of net migration is caused in particular by **more marked migration to certain regions**, in particular to Praha and its wider surroundings and to a lesser extent to Brno.
- **Differences** between Western Europe and post-communist countries are clear in the development of the intensity of internal migration; whereas in the 1990s the level of migration increased in Western Europe, in post- communist countries this was the **opposite**[2].
- Between 1999 and 2005 the gross level of migration in the Czech Republic slightly increased. A similar indicator of the level of migration is *migration Intensity (number of migrants per 1 000 inhabitants)*. Whereas in 1999 this was at the level of 19.6 ‰, in 2005 it was up to 20.9 ‰.
- In an international comparison of human resources in science and technology (HRST) in all branches and in technological and knowledge intensive branches of NACE it follows that the highest mobility of qualified personnel is in Scandinavian countries (Denmark, Sweden) and the United Kingdom. The Czech Republic has low mobility in this group of the labour force.
- The share of Czech students studying in the EU 27 or countries of the European Economic Area (EEA) in the total number of Czech students between 2004 and 2005 ranged **under the level of 2 percent** (approx. 5 600 students). In an international comparison this is a below-average value which indicates the low mobility of Czech university students. There is no statistical data on the number of Czech university students studying in countries outside of Europe (in particular in the USA and Canada) during the monitored period. The most mobile university students are students from Cyprus and also from Bulgaria, Ireland, Slovakia and Malta. In contrast students from the United Kingdom, Spain and Poland have the lowest mobility.
- Since 2003 the Czech Republic has **one of the lowest increases** in the share of foreign university students in the total number of university students in the country in comparison with the situation in other countries. In 2005 this share was **5.5 %**. Most of the foreign students in the Czech Republic are from Slovakia. In an international comparison Cyprus is again in first place (in 2005 foreign university students made up nearly a quarter of all students in Cyprus) followed by the United Kingdom, Austria and Germany. The lowest share of foreign university students in the total number university students were registered in Turkey, Croatia, Poland and Lithuania.

[2] Lux et al. 2006

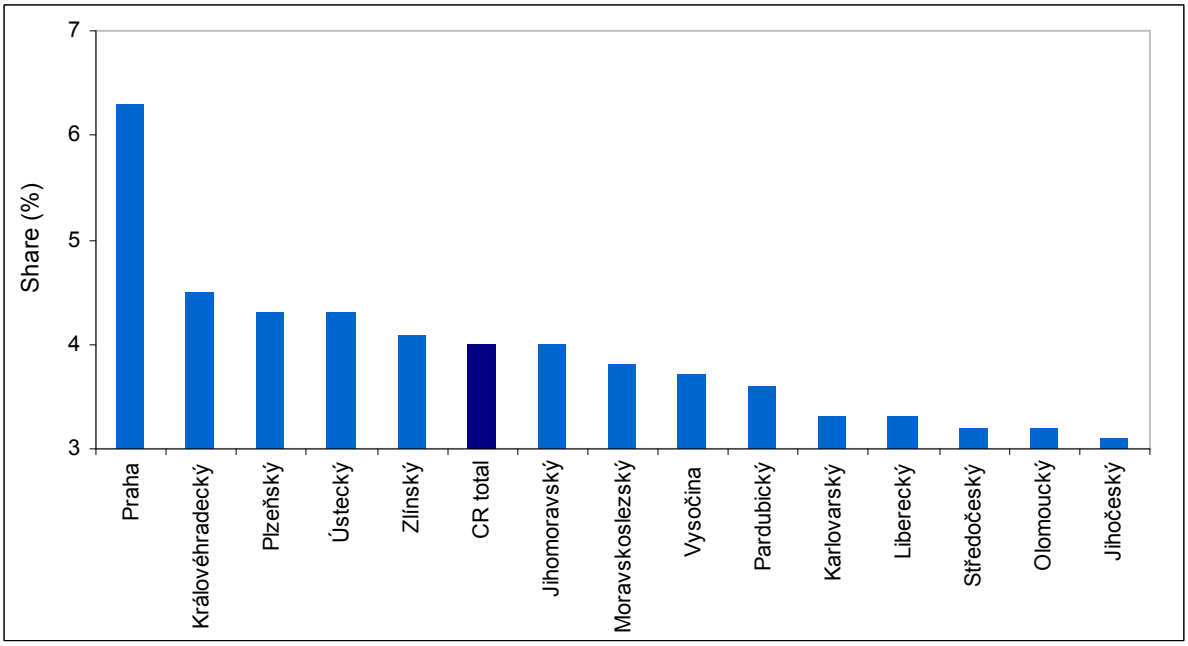
3.3.1.13 Lifelong learning

Share of persons aged 25+ participating in the education process in the number of persons in the relevant age group in 2005



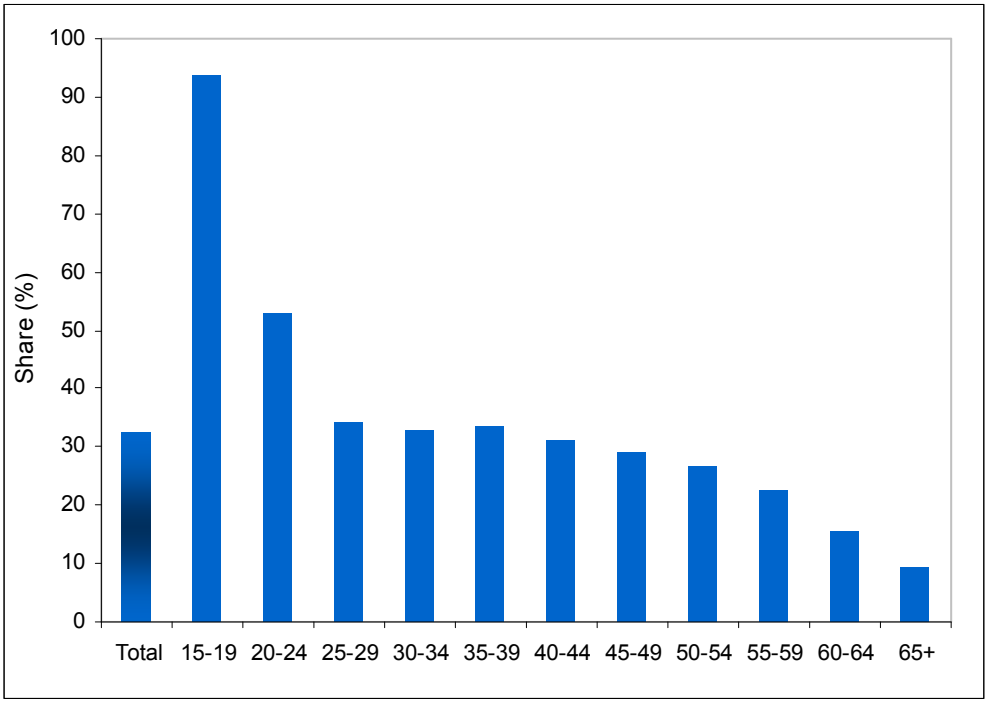
Source: Eurostat

Participation of the population aged 15+ in informal learning based on regions in 2003



Source: Results ad hoc module 2003 on lifelong learning for 2003 (CZSO)

Share of persons aged 15 and more participating during a single year in the education process in the number of persons in the relevant age group in 2003



Source: Results ad hoc module 2003 on lifelong learning for 2003 (CZSO)

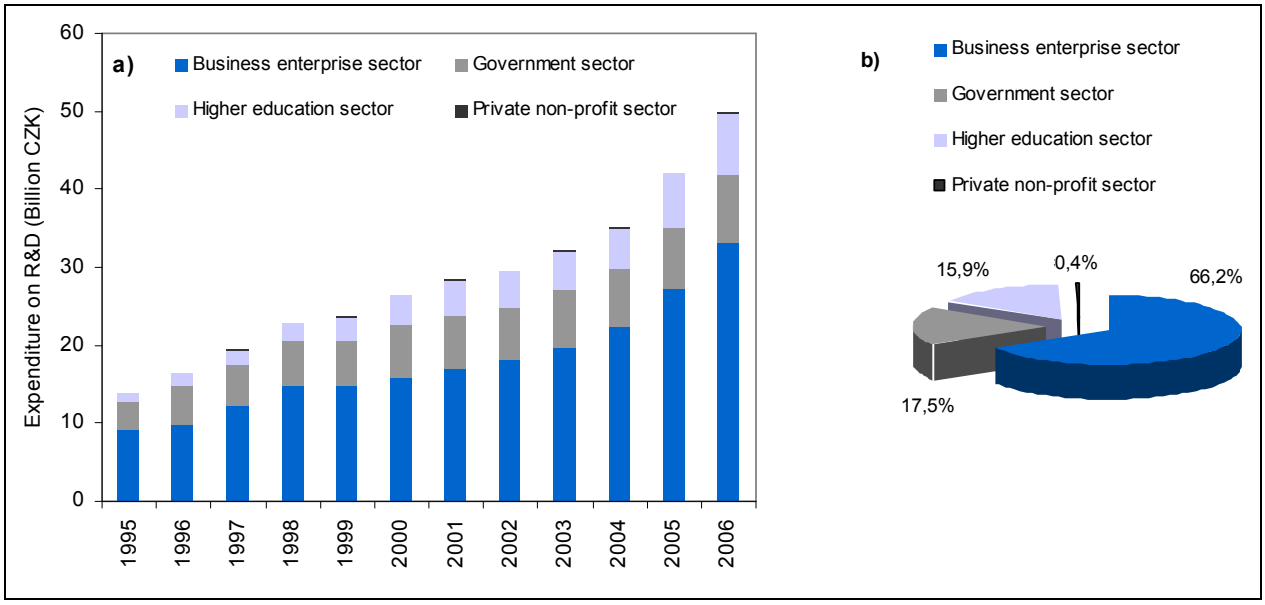
Analysis, comments and other information:

- The Czech Republic has a low share of persons taking part in lifelong learning. The highest share **of inhabitants participating in at least one educational activity** (formal, informal) in the relevant age group is in Scandinavian countries and also Austria and Slovenia, the lowest share is in selected countries of Southern Europe and several post-communist countries.
- To assess the **inter-regional differences** in the level of inhabitants of regions participating in educational activity it is sufficient to compare informal educational activity i.e. only one subgroup of lifelong learning activity. By far the highest level of inhabitants participating in informal learning is in the region of Praha (6.3 %). The level of participation in other regions ranges from 3.1 % in Jihočeský region to 4.5 % in the Královéhradecký region.
- From the point of view of the **age structure** of participants in educational activity, the highest share as expected is among young people aged between 15 and 24, for which educational activity is connected with high school and university studies. For a study of the level of participation in lifelong learning it is interesting to monitor the age groups from 25 years and higher, where there is a gradual decrease in participation from 34.2 % in the age group 25 to 29 to 22.5 % in the pre-retirement age group of 55 to 59.

3.3.2 Funding of research and development

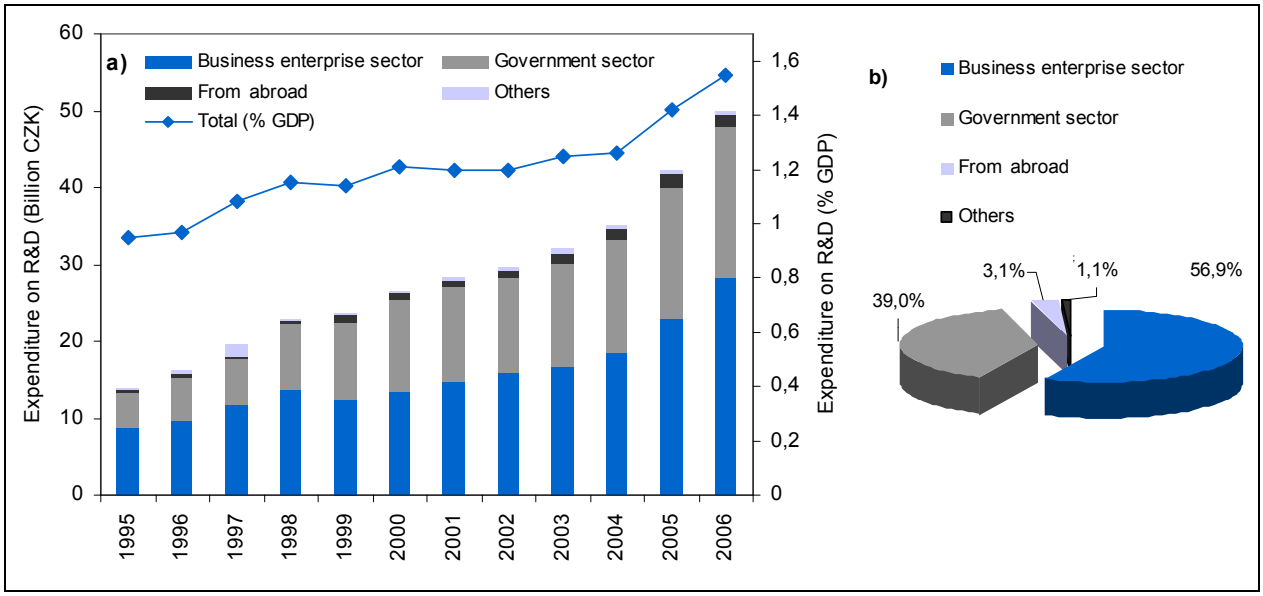
3.3.2.1 Gross domestic expenditure on research and development – basic trends

Gross domestic expenditure on research and development (GERD) in the Czech Republic in billions of CZK by sectors of performance between 1995 and 2006 (a) and share of sectors in the performance of R&D in 2006 (b)



Source: Eurostat, CSO

Gross domestic expenditure on research and development (GERD) in the Czech Republic in billions of CZK by financial sources and as a share of the total gross domestic product between 1995 and 2006 (a), and share of sectors in the financing of research in 2006 (b)



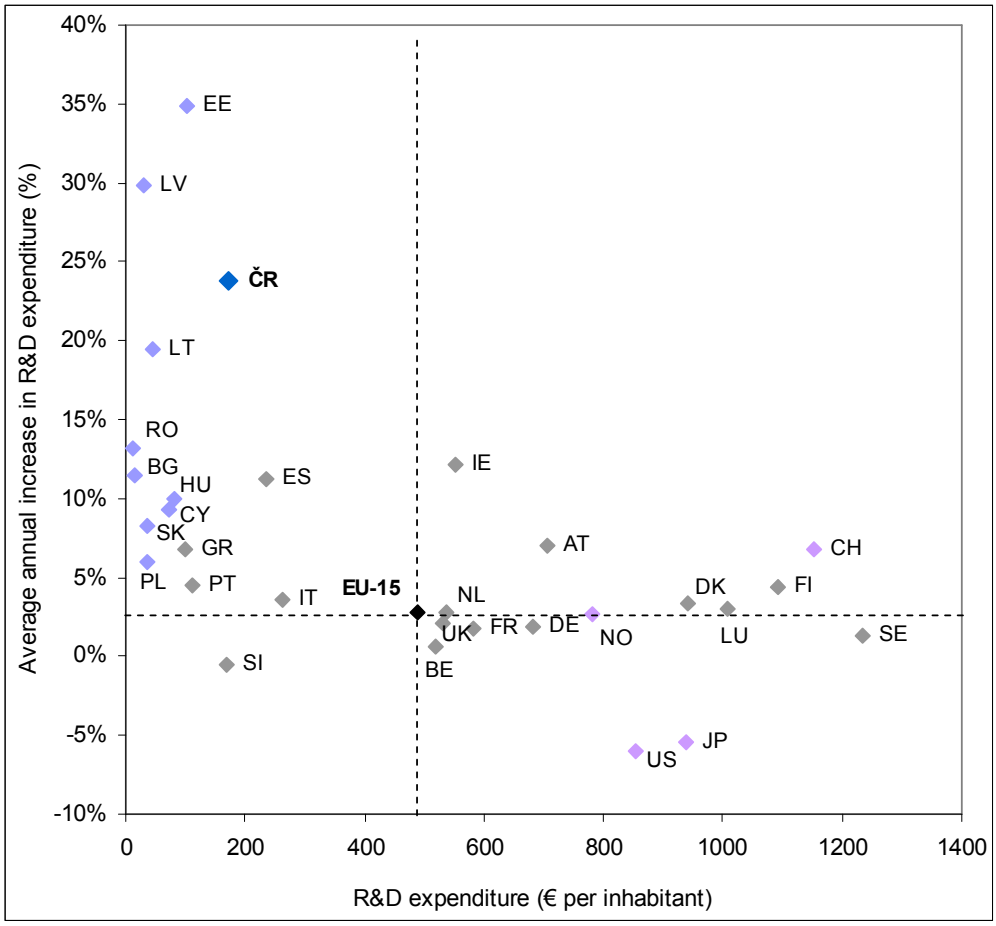
Source: Eurostat, CSO

Analysis, comments and other information:

- **The gross domestic expenditure on R&D** (GERD) in 2006 in the Czech Republic exceeded 49 billion CZK, which is approx. 1.55 % GDP. Despite the fact that expenditure is increasing more rapidly than the average for the EU-27, fulfilment of the main objective of the Lisbon strategy, by which the total expenditure on R&D in the EU should be at a level of 3 % GDP by 2010, is still far away. At the current rate of grown this objective will probably not be met even if it is high in comparison with most European countries.
- In 2006 about 66 % of the total expenditure on R&D was carried out in the **business sector** and the share of this sector in the amount of research performed over the past few years is still rising. 17.5 % of the total expenditure on R&D was carried out in the **government sector** and in the **university sector** almost 16 %. However, the share of research performed in the university sector has increased over the past few years. The share of **private non-profit sector** in research is very low and does not exceed 1 % in the long-term.
- **Financial resources from the business sector** (i.e. private funding for R&D) made up approx. 57% of the total expenditure on R&D in 2006. Even with the share of private sources in 2006 higher than in 2005, it still does not reach 2/3 of the total expenditure on R&D, which is an objective of the Lisbon strategy. The situation is similar however in most EU countries. In 2005 the average share of financing from the business sector in the total expenditure on R&D in the EU-25 was approx. 55 %.
- The share of **public funding of R&D** (i.e. financial resources from the government sector) in 2006 was approx. 39 %. Despite the share of public funding in 2006 decreased in comparison with 2005 (in 2005 the share of public resources was 41 %), it is still higher than the average for the EU-15.
- The share of **financial resources from abroad** in 2006 was approx. 3 %, which is nearly half of the average share of foreign resources in the EU-25 (8.5 % in 2005). The share of funding from abroad in 2006 decreased in comparison with 2005.
- Contributions from **other financial sources** (funding from private non-profit and higher education sectors) are approx. 1 %.

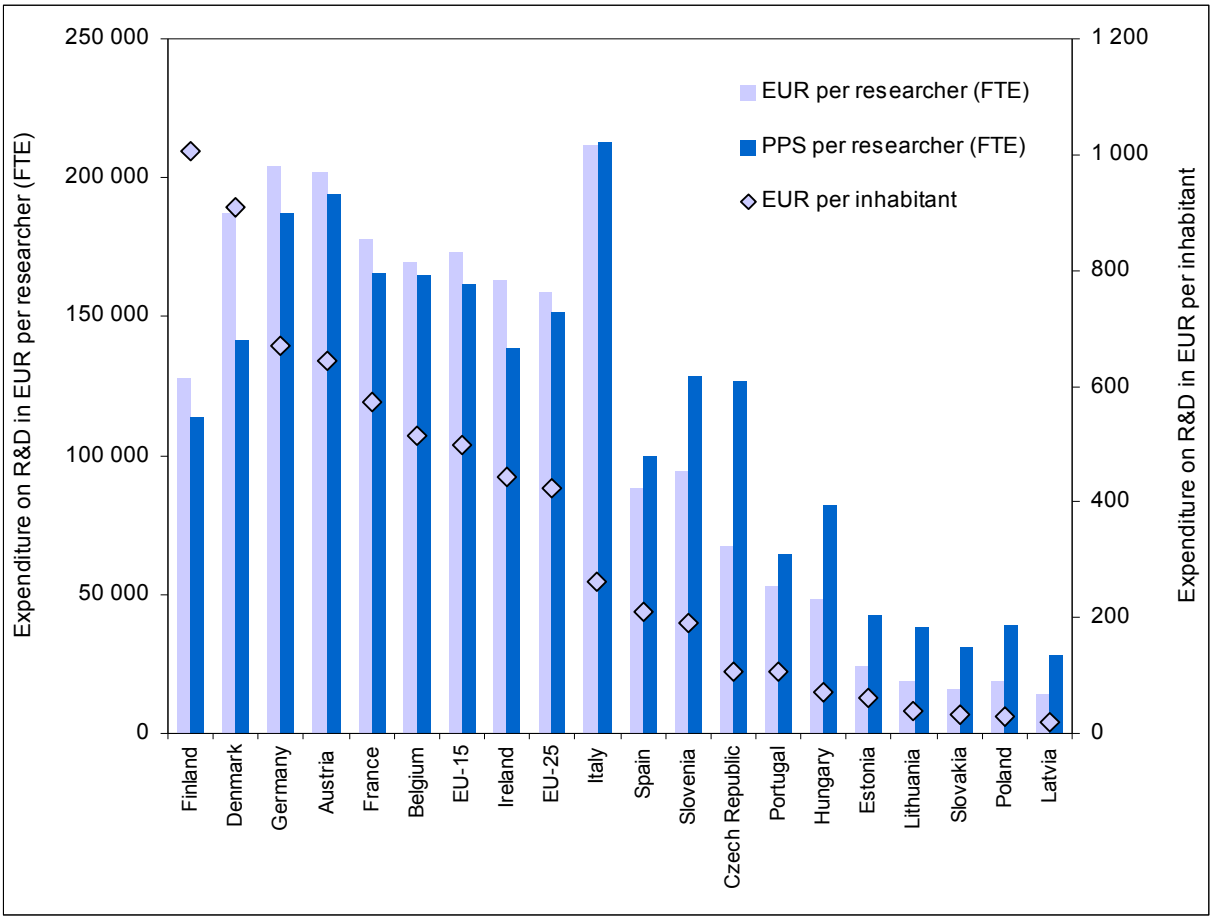
3.3.2.2 Gross domestic expenditure on research and development – international comparison

Gross domestic expenditure on R&D (GERD) in EUR per inhabitant in 2005 and its trend between 2001 and 2005



Source: Eurostat

Comparison of the Czech Republic with selected European countries in the total expenditure on R&D in EUR per inhabitant, EUR per researcher in FTE and in purchasing power parity (PPP) per researcher in FTE (information from 2004).



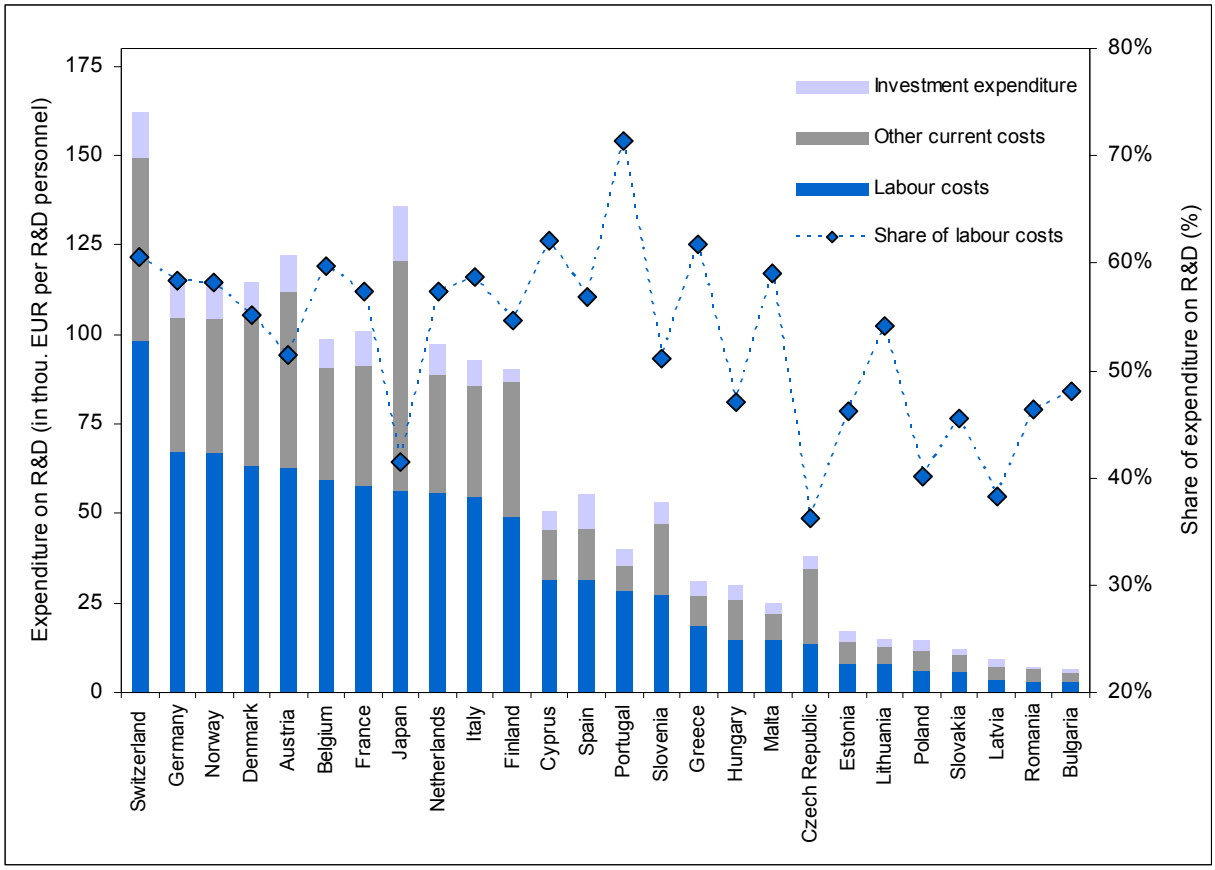
Source: Eurostat

Analysis, comments and other information:

- Expenditure on R&D in the Czech Republic is lower than the average from the EU-25 and in particular in developed countries of the EU-15. The **total expenditure on R&D (GERD) in EUR per inhabitant** in the Czech Republic is only one third of the average expenditure on R&D in the EU-25 and at the level of approx. 11 % of the expenditure on R&D in Sweden or 13 % of the expenditure on R&D in Finland. In purchasing power parity (PPS), which to a certain extent reflects the economic performance of a country, the situation is slightly better, the total expenditure on R&D per inhabitant in 2006 was approx. 60 % of the EU-25 average and nearly 30 % of the expenditure on R&D in Finland or Sweden, although the Czech Republic still greatly lags behind. A slightly more encouraging fact is that the total expenditure on R&D per inhabitant in the Czech Republic in EUR based on PPS is higher than in other new member states of the EU (with the exception of Slovenia).
- In the **expenditure on R&D per researcher** (in Full-Time Equivalent, FTE) the position of the Czech Republic is better. Based on PPS the Czech Republic reaches almost 85 % of the EU-25 average, exceeding the level in Spain, Portugal and with the exception of Slovenia, is in a better position than the other new EU member states. The low total expenditure on R&D in the Czech Republic also has a certain correlation with the low number of research personnel active in the Czech Republic.

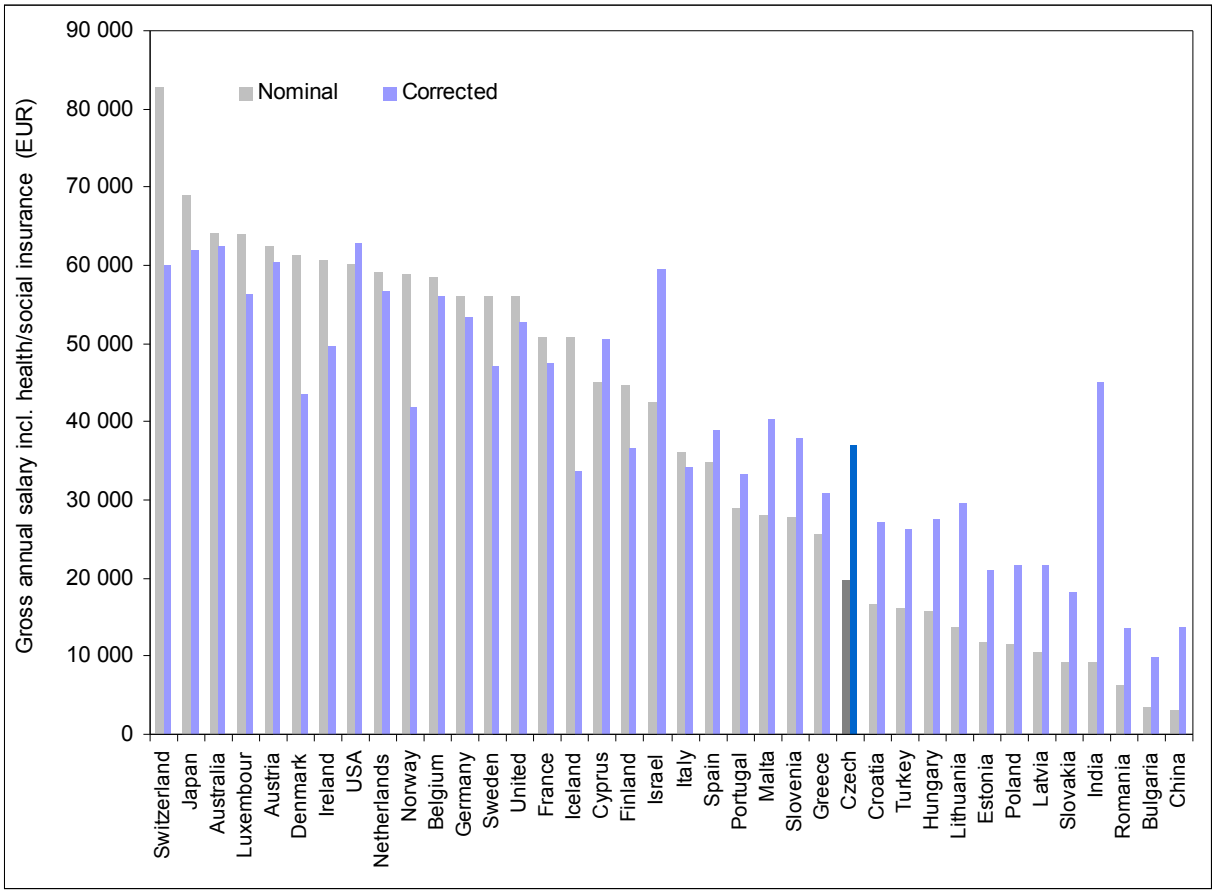
3.3.2.3 Gross domestic expenditure on research and development based on type of costs

Comparison of the Czech Republic with selected European countries in the total expenditure on R&D by type of costs in 2004.



Source: Eurostat

Average salary of research and development personnel (in EUR)



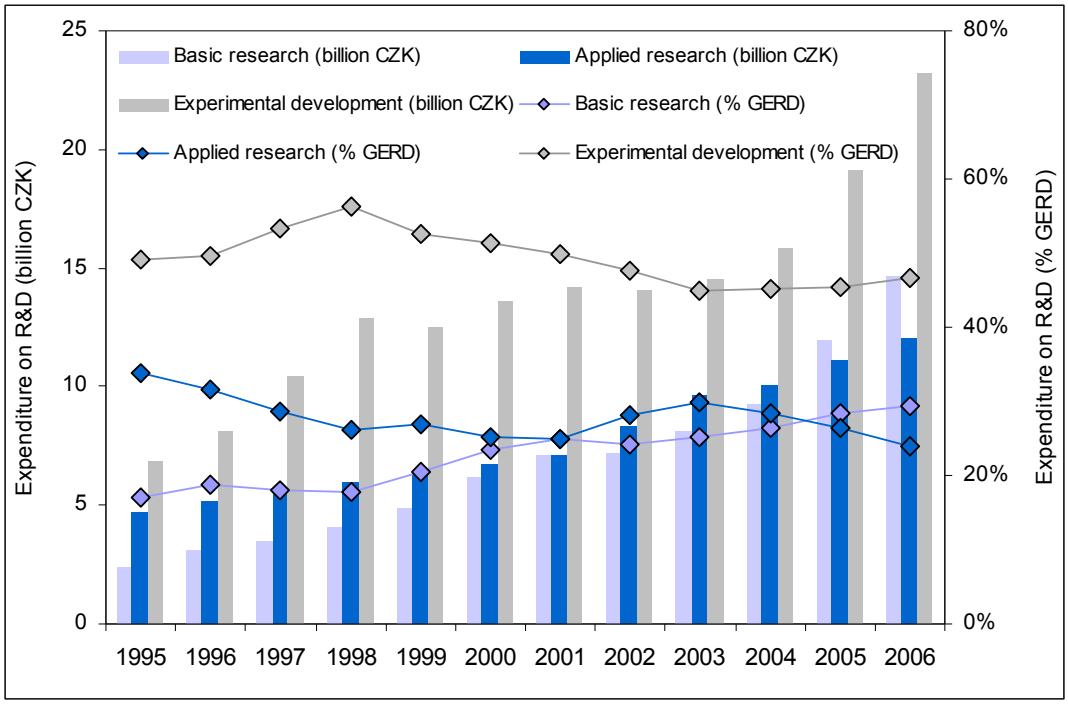
Source: Remuneration of Researchers in the Public and Private sectors, EC 2007 (http://ec.europa.eu/eracareers/pdf/final_report.pdf)

Analysis, comments and other information:

- In comparison with other EU countries **there is a low share of labour costs** in the total expenditure on R&D in the Czech Republic. In 2004 labour costs made up approx. 36 % of the total expenditure on R&D, which the lowest of all European countries (in developed EU-15 countries salary expenditure makes up approx. 50 % to 60 % of the total expenditure on R&D).
- The low expenditure on human resources corresponds to the **low salaries of research and development personnel**. In 2006 the salaries of R&D personnel in the Czech Republic in EUR were approx. 30 % of the remuneration of R&D personnel in the EU-15. When the salaries are corrected based on the economic level of a country (e.g. in PPS) the situation is somewhat better, with salaries of Czech R&D personnel being approx. 60 % of the salaries of R&D personnel in EU-15 countries. This comparison should only be considered as a rough guide however because the data does not yield 100% comparability.
- Analysis of the results of research shows that R&D personnel in the Czech Republic are not as productive as R&D personnel in most EU-15 countries, both from the point of view of publication activity and based on the number of patent applications.
- The low salaries of R&D personnel in the Czech Republic and the insufficient correlation between the results of research work (e.g. publication activity) and remuneration of R&D personnel and research teams is one of the major weaknesses of public research in the Czech Republic. This is reflected in **the brain-drain of quality R&D personnel** abroad or to better paid positions and difficulties in obtaining foreign professionals (barrier for brain-gain).
- Insufficient remuneration of R&D personnel reduces the prestige of this occupation and negatively influences the number of students (graduates) studying scientific and technical subjects, which can be reflected in a critical lack of R&D personnel in the near future both in the public sector (e.g. in relation to the new R&D capacity built in the framework of the Operational Programme Research and Development for Innovations - OP RDI) and the private sector, for instance as a result of further development in industry (in particular in branches with high or medium-high technological intensity) and in high-tech services).

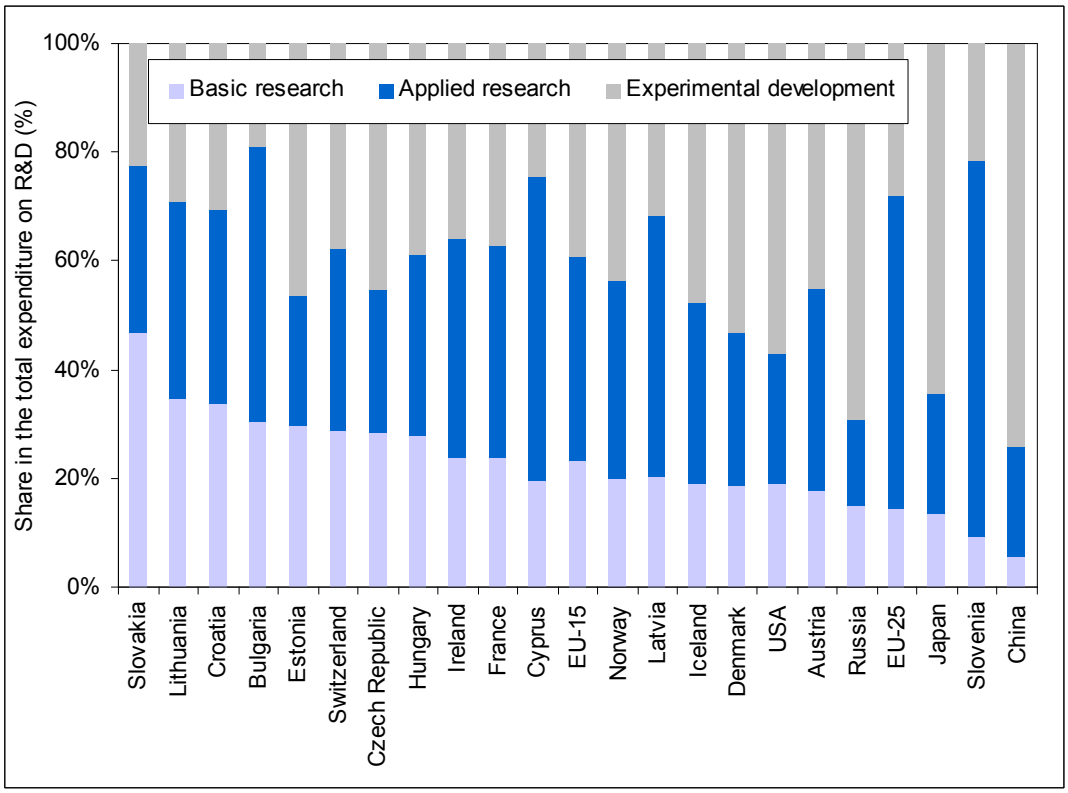
3.3.2.4 Gross domestic expenditure on research and development – structure of expenditure on research and development

Share of basic research, applied research and experimental development on the total expenditure on R&D in the Czech Republic between 1995 and 2006



Source: CSO

Comparison of the structure of total expenditure on R&D in selected countries in 2005 (or 2004)



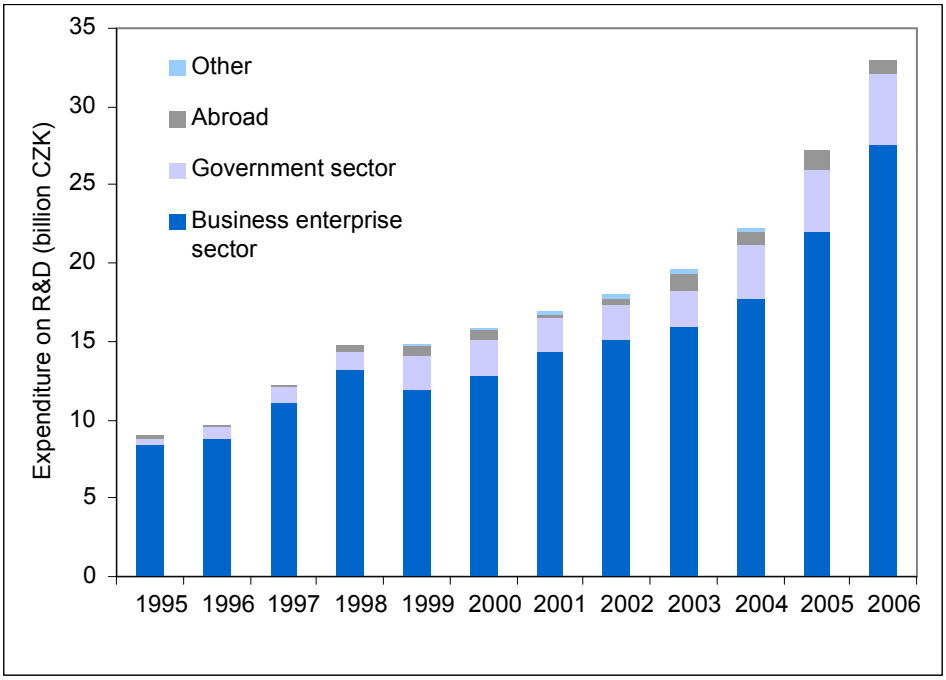
Source: Eurostat

Analysis, comments and other information:

- In the Czech Republic there is a relatively **high share of basic research** in the total expenditure on R&D (in 2006 its share was almost 30 % of the total expenditure on R&D in the Czech Republic), which is more than the EU-15 and EU-25 averages. The share of basic research in the total expenditure on R&D has slightly increased over the past few years.
- **The share of applied research** in the total expenditure on R&D is lower than the share of basic research over the past few years (the situation is opposite in EU-25, USA and Japan). The share of applied research in the Czech Republic has decreased since 2003 and in 2006 was only 24 % of the total expenditure on R&D. The low share of applied research is in research performed both in the government sector and university sector, and also in research performed in the business sector. Statistical data shows that the share of applied research has slightly declined in all sectors of performance over the past few years (more detailed information is in the analysis of research in individual sectors of performance).
- **The share of experimental development** in the total expenditure on R&D has slightly increased over the past few years and in 2006 the expenditure on experimental development was almost 47 % of the total expenditure on R&D (GERD) in the Czech Republic. Experimental development is particularly prevalent in the business sector.
- This **unfavourable research structure** can influence negatively the development of a knowledge-based economy. The prevalence of basic research and a low share of applied research in public expenditure on R&D can be the possible causes for the lack of effectiveness in the area of commercialization of the results of research (low patent activity and lack of knowledge for utilization in practice). The low share of applied research in the business sector (with experimental development prevailing) and the public sector (with basic research prevailing) can result in the lack of interest of the business and public sectors in cooperation in R&D. If we consider that patents are the main result of applied research, in which the Czech Republic greatly lags behind most other EU-25 countries, we can state that applied research clearly represents the greatest weakness of research and development in the Czech Republic.

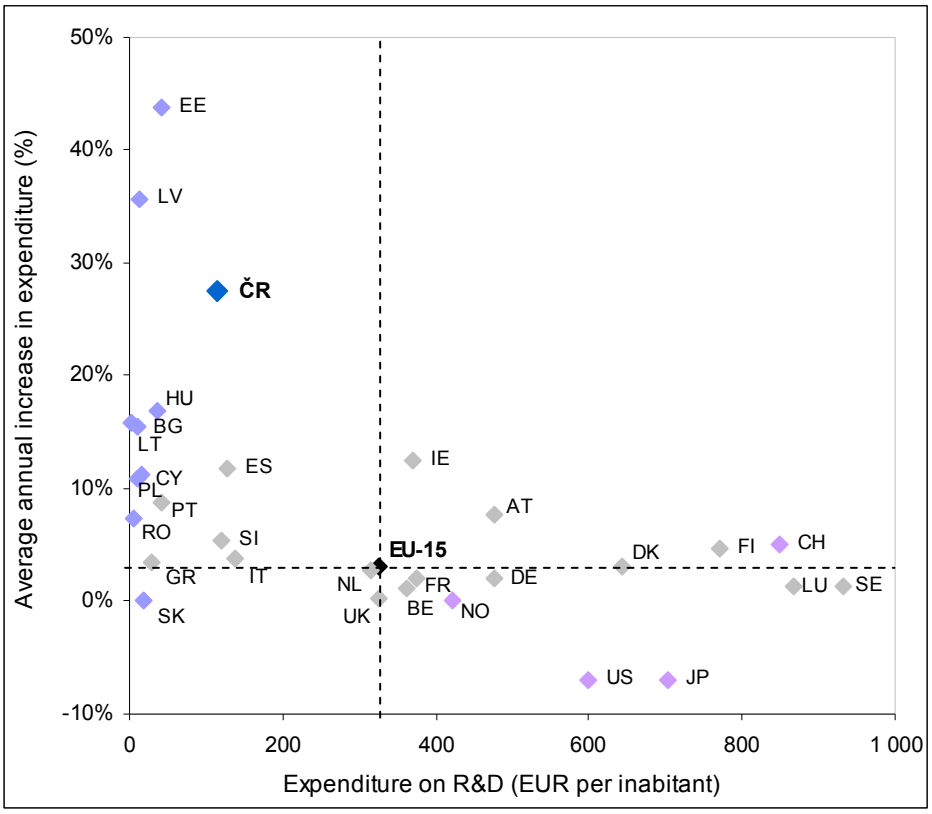
3.3.2.5 Expenditure on R&D in the business sector – basic information

Total business enterprise expenditure on R&D (BERD) by source of funds between 1995 and 2006



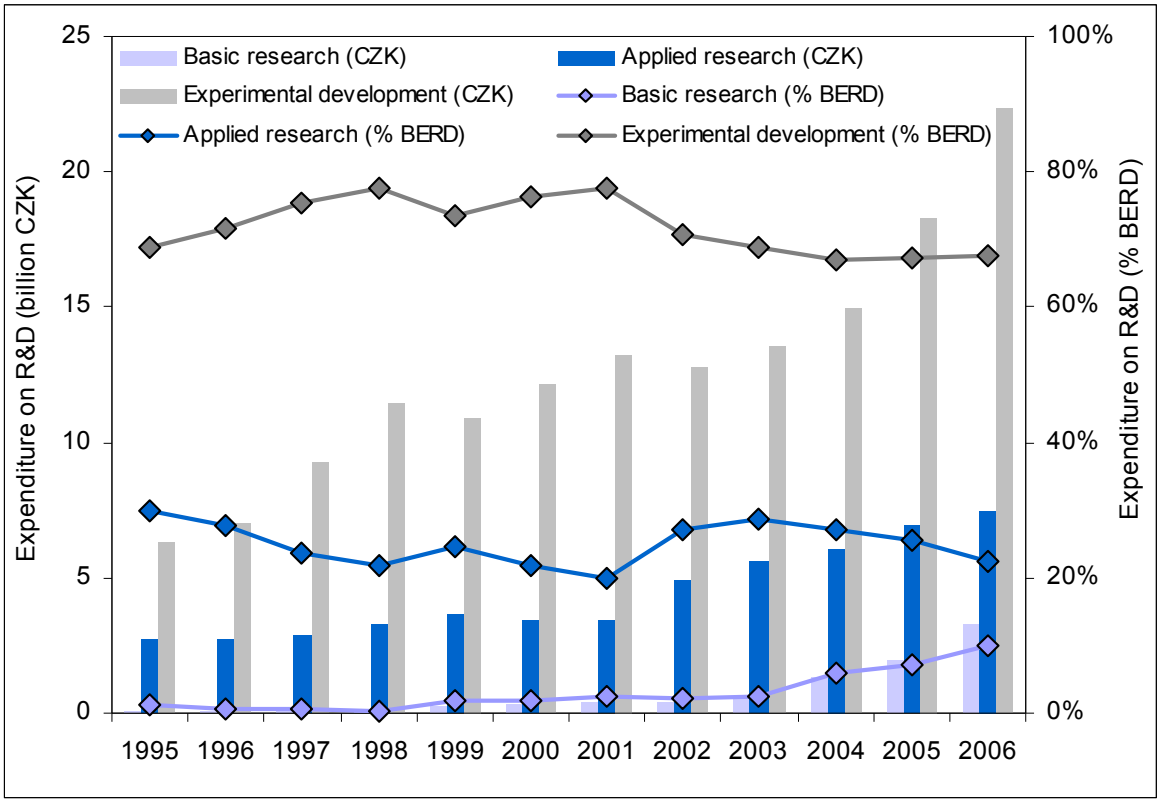
Source: Eurostat

Total business enterprise expenditure on R&D (BERD) in EUR per inhabitant in 2005 and its trend between 2001 and 2005



Source: Eurostat

Share of basic research, applied research and experimental development in business enterprise expenditure on R&D in the Czech Republic between 1995 and 2006



Source: Eurostat

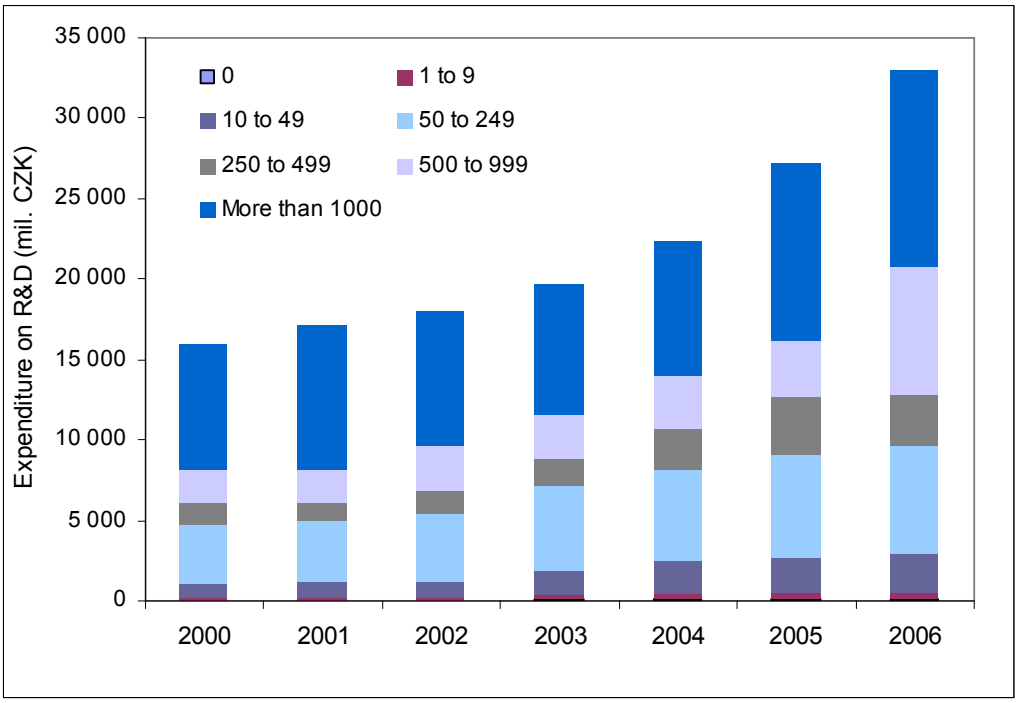
Analysis, comments and other information:

- In 2006, approx. 66 % of the total expenditure on R&D (GERD) was in the **business sector**. This percentage corresponds roughly to the EU-25 average, although in comparison with EU-15 countries Finland, Germany and Sweden, the share of research performed in the business sector is lower (in these countries approx. 70 % to 75 % of research was performed in the business sector). The share of research performed in the Czech Republic in the business sector between 2005 and 2006 increased by almost 2%.
- Even if expenditure on R&D in the business sector increased between 2005 and 2006 by more than 20%, recalculated into EUR per inhabitant the Czech Republic reached only a third of the EU-15 average and approx. 20 % of the expenditure on R&D in this sector in Austria and Germany and only 10 % of the business enterprise expenditure on R&D in Sweden and Finland in 2005. In PPS the position of the Czech Republic is somewhat better but still greatly lags behind the EU-15. It is also important to mention that expenditure on R&D in the business sector in the Czech Republic is higher than in most new EU member states (with the exception of Slovenia), and the average annual increase significantly exceeds the increase in most European countries.
- In funding of research in the business sector **own financial resources** prevail (approx. 84 %). The share of public resources in 2006 was approx. 14 %. Even though the share of public resources has slightly decreased since 2003, the share of public funding in the expenditure of the business sector on R&D the Czech Republic is still relatively high in comparison with other EU countries (the EU-25 average in 2005 was approx. 7.7 %). In contrast there is a higher share of financial resources from abroad in the EU-25 average (the Czech Republic 4.5%, EU-25 10.4%).
- Approx. 90 % of expenditure on R&D in the business sector is **expenditure of a non-investment nature**. The share of non-investment expenditure approx. corresponds to the values in other European countries, although in comparison with other European countries there is a lower share of expenditure on human resources in the Czech Republic. Expenditure on human resources per researcher (FTE) in the business sector in the Czech Republic is less than half of expenditure on one research worker in Germany.
- In expenditure on R&D in the business sector **expenditure on experimental development prevails**. The share of experimental development ranges over the past few years at the level of 2/3 of the total expenditure on R&D (BERD) in the business sector. The share of applied research in 2006 was approx. 23%. The share of basic research is the lowest and in 2006 was approx. 10 % of the total expenditure on R&D in the business sector.
- Expenditure on experimental development, applied and basic research has been on the increased in the business sector for many years. Expenditure on experimental research has increased significantly, and consequently the share of experimental development in the total business enterprise expenditure on R&D has increased. Expenditure on applied research has increased less and therefore the share of applied research in the business sector has systematically decreased since 2003. Expenditure on basic research (although low) has also increased more rapidly than expenditure on applied research and therefore the share of basic research has increased in business research. The low share of applied research in the business sector and the marked prevalence of experimental development mean that the businesses concentrate more on adapting products (e.g. for the needs of the market) and not on obtaining new knowledge. This can also form a barrier for the commercialization of knowledge from public research because the results of several studies have shown that businesses give priority to results (e.g. new technology or products) followed through to the prototype or semi-operational stage[3].

[3] Barriers to the Growth of Competitiveness of the Czech Republic. Final report of the project 4/04 of CSF Evaluation, Prague 2005 (http://www.tc.cz/dokums_novinka/Zprava_Bariery_final_pdf_1523.zip)

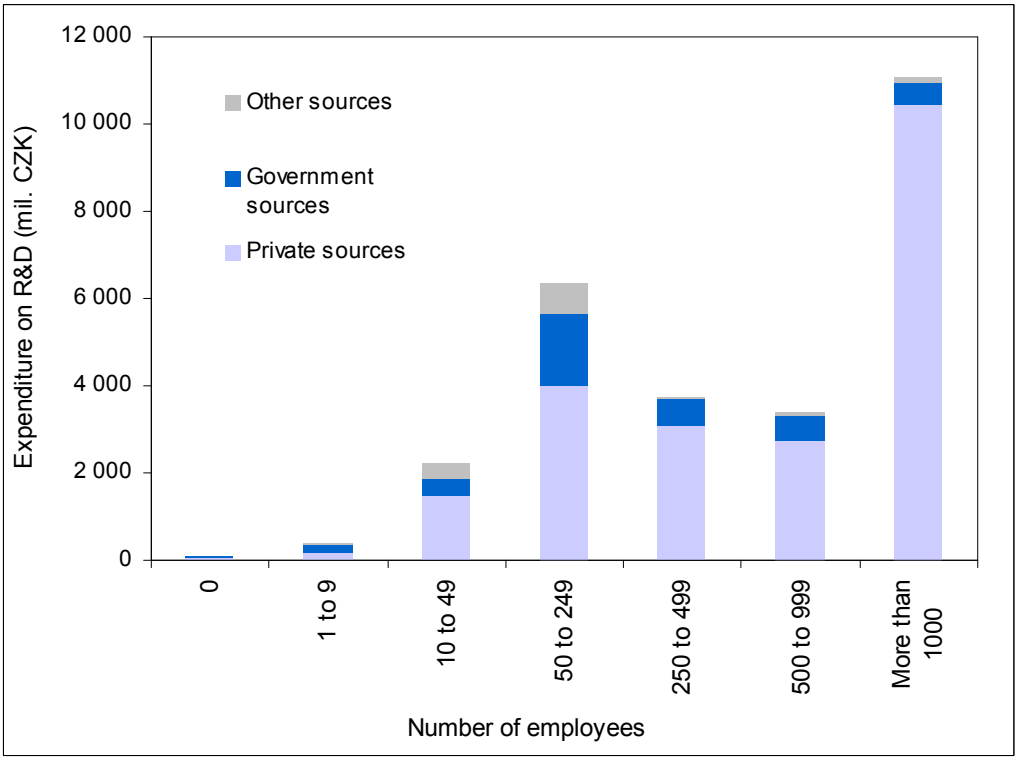
3.3.2.6 Business enterprise expenditure on R&D in selected size-groups of enterprises by source of funds

Expenditure on R&D in the business sector by size of enterprises between 2000 and 2006



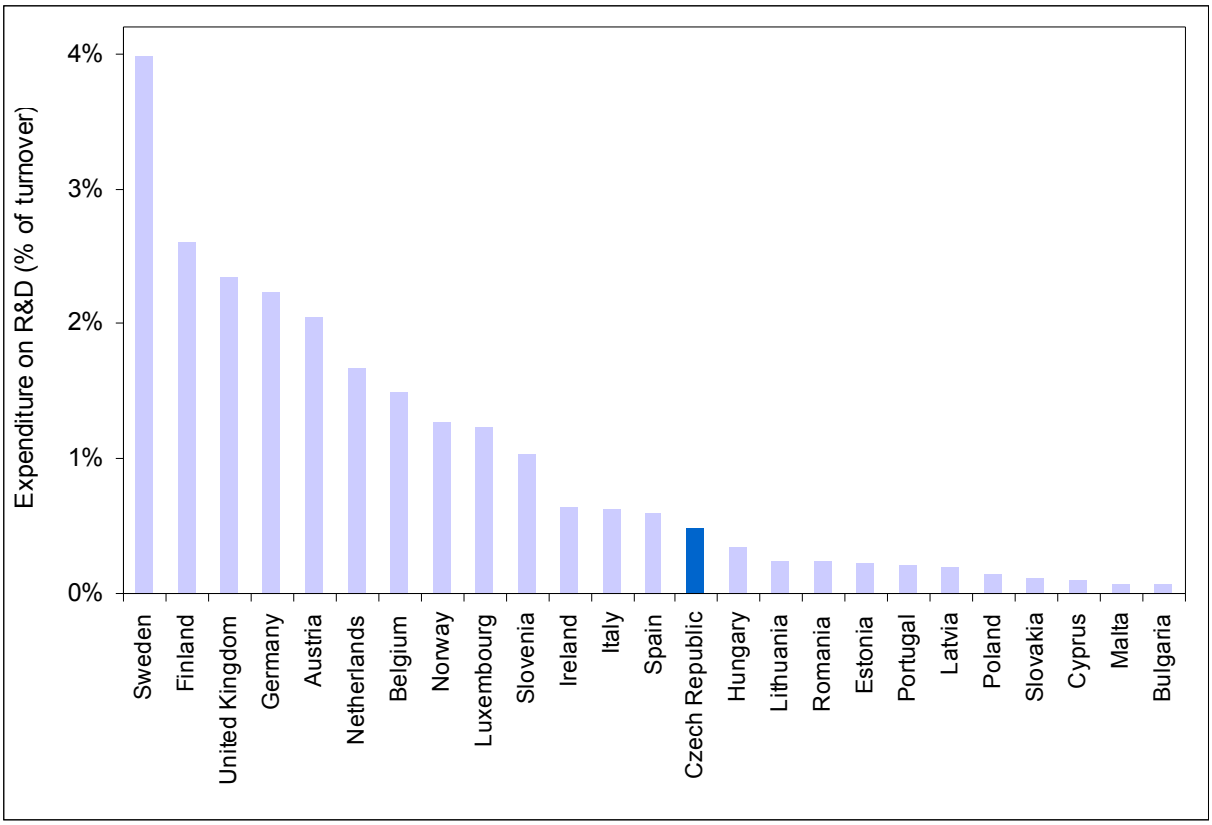
Source: Eurostat.. In 2006 information was only available from businesses with 500 or more personnel.

Business enterprise expenditure on R&D by size of enterprises and source of funds in 2005



Source: Eurostat

Comparison of R&D intensity (share of R&D expenditure on turnover) in selected countries in 2004



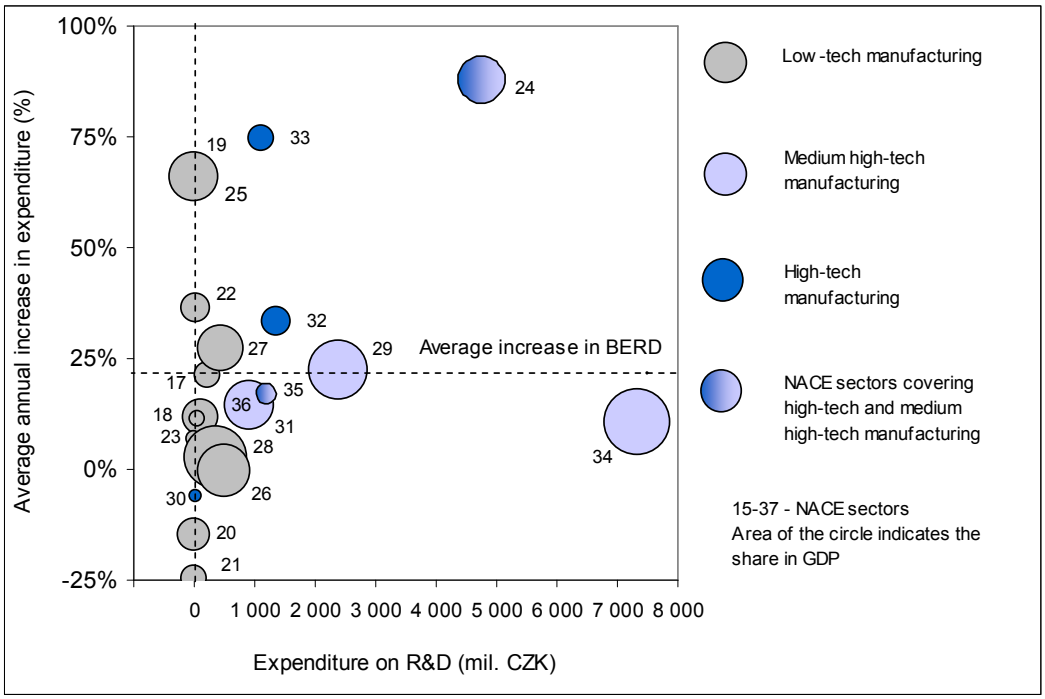
Source: Eurostat

Analysis, comments and other information:

- In 2005 more than 60 % of expenditure on R&D was in enterprises with more than 500 employees and more than 20 % in enterprises with between 50 and 249 employees. Expenditure in other size groups was less significant. The share of R&D performed in individual size groups has not significantly changed over the past few years.
- In 2006 almost 14% of the expenditure of the business sector on R&D was funded from public resources. The highest share of public resources is in expenditure on R&D in small enterprises with up to 10 employees (44 %) and in medium-sized enterprises with between 250 and 499 employees (26 %). The share of public resources in research is particularly low in large enterprises with more than 1 000 employees (approx. 5 %). A high share of public funding of R&D in small enterprises (in particular micro-enterprises) can show the lack of own funds for R&D or the lack of willingness of these enterprises to invest their own money into R&D.
- A major weakness in business research in the Czech Republic is the low amount of turnover that businesses in the Czech Republic invest into R&D (intensity of R&D). In 2004 Czech businesses invested half of a percent of their turnover into R&D whereas in advanced EU-15 countries businesses regularly invest from 1 % to 3 % (although in Sweden businesses invested almost 4% of their turnover into R&D in 2003). However, with the exception of Slovenia the intensity of research in Czech enterprises is higher than in other new EU member states.
- The low level of investment in R&D could result in a reduction of the competitiveness of businesses in the future when the Czech Republic gradually loses its advantage of lower labour costs.

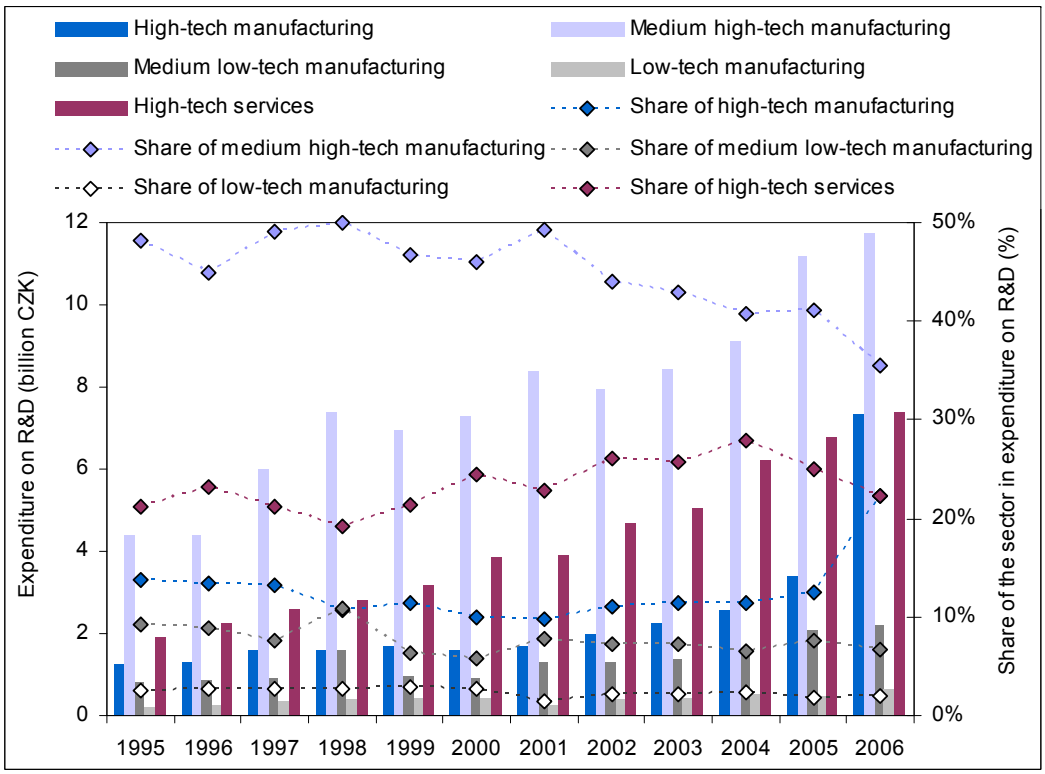
3.3.2.7 Business enterprise expenditure on research and development – sectoral structure

Business enterprise expenditure on R&D in the Czech Republic in 2006 by technology intensity and its average annual increase



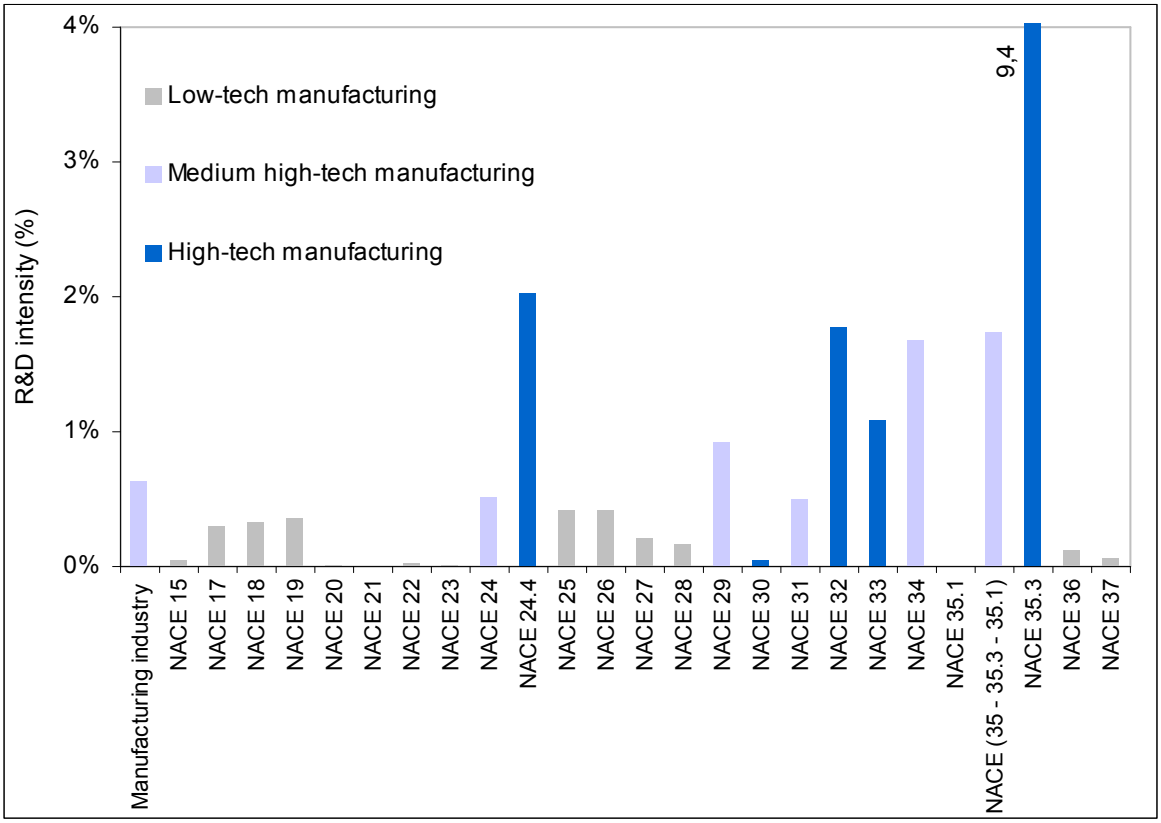
Source: CSO, Eurostat, MIT of the Czech Republic, our own calculations

Expenditure on R&D in manufacturing industry and services by technology intensity and their share in total business enterprise expenditure on R&D between 1995 and 2006



Source: CSO, Eurostat

Intensity of R&D (share of expenditure on R&D and turnover) by economic activity (CZ-NACE) in the Czech Republic in 2005



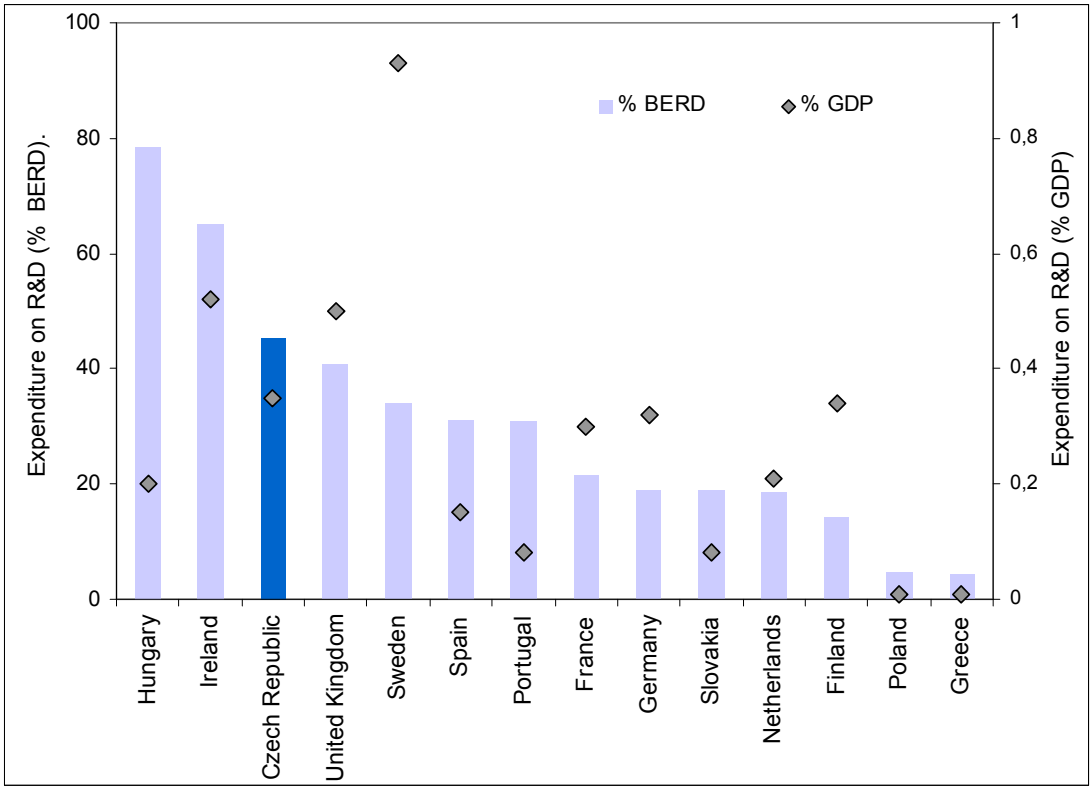
Source: Eurostat

Analysis, comments and other information:

- More than 22 % of the total business enterprise expenditure on R&D (BERD) in 2006 was in the automobile industry (NACE 34), however, expenditure on R&D in this branch has increased more slowly over the past few years than the total business enterprise expenditure on R&D (BERD). There is also a high level of expenditure on R&D in NACE 24 - Manufacturing of chemicals and chemical products (almost 15 % BERD in 2006). Expenditure on R&D in this branch has increased over the past five years by almost 6 % annually and between 2005 and 2006 expenditure on R&D increased by more than three times. More than 85 % of expenditure on R&D from NACE 24 is made up of expenditure in NACE 24.4 Manufacture of pharmaceuticals, medicinal chemicals and botanical products.
- In 2006, approx. 35 % BERD was in the medium high-tech manufacturing industry. Approx. 22 % BERD was in expenditure in the high-tech manufacturing industry, and almost 9 % BERD in medium low-tech and low-tech sectors of manufacturing industry. High-tech services accounted for approx. 22 % of business enterprise expenditure on R&D (BERD).
- The share of expenditure on R&D in the high-tech manufacturing has increased over the past few years particularly in NACE 33 - Manufacture of medical, precision and optical instruments, watches and clocks and NACE 24.4 - Manufacture of pharmaceuticals, medicinal chemicals and botanical products. The share of expenditure on R&D in the medium high-tech sector has decreased since 2001. The share of expenditure on R&D in the medium low-tech and low-tech sectors has not changed significantly in the past few years; however the share of high-tech services has decreased.
- Even though the expenditure on R&D in the high-tech sector has increased over the past few years, in comparison with most EU-15 countries the share is low as expenditure on R&D in the high-tech sectors in Holland, Ireland or Austria for instance makes up 30 to 40 % of expenditure on R&D in manufacturing industry. The intensity of research (share of turnover businesses invest back into R&D) in the Czech Republic in high-tech sectors (and in medium high-tech sectors) is significantly lower than in the EU-15.
- The gross value added created in the manufacturing industry in the Czech Republic per employee is significantly lower than in advanced EU-15 countries. This could be as a result of a lack of expenditure on R&D. The Czech Republic lags behind the EU-15 in gross value added created per employee in particular in high-tech sectors.

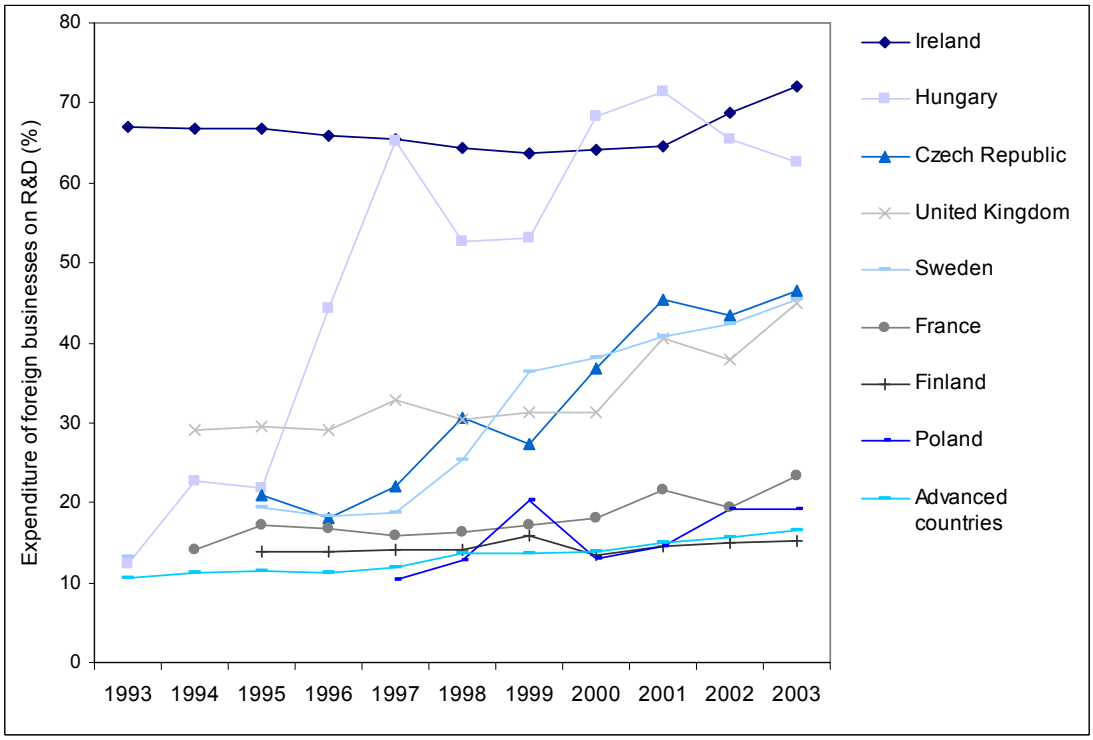
3.3.2.8 Globalization of industrial R&D

Business enterprise expenditure on R&D – share of foreign enterprises in expenditure on R&D



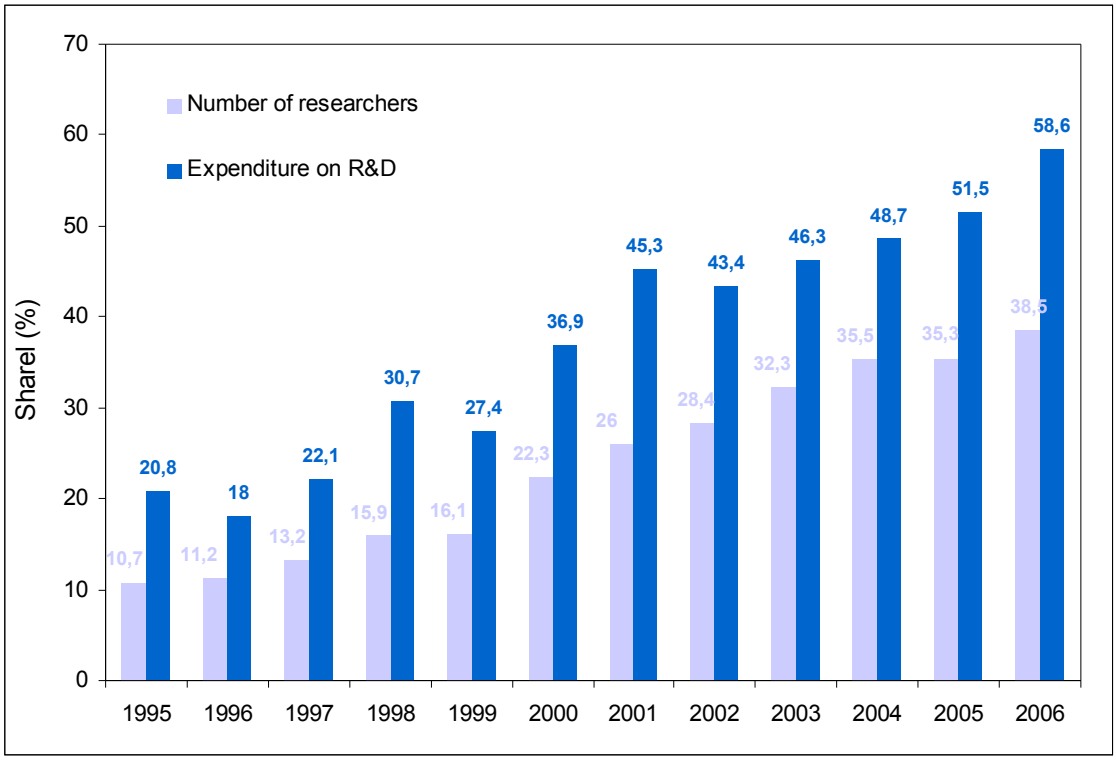
Source: OECD, MSTI database, 2004 (data from 2001 and 2000)

Share of subsidiaries of foreign enterprises in expenditure on R&D in the business sector in selected countries between 1993 and 2003



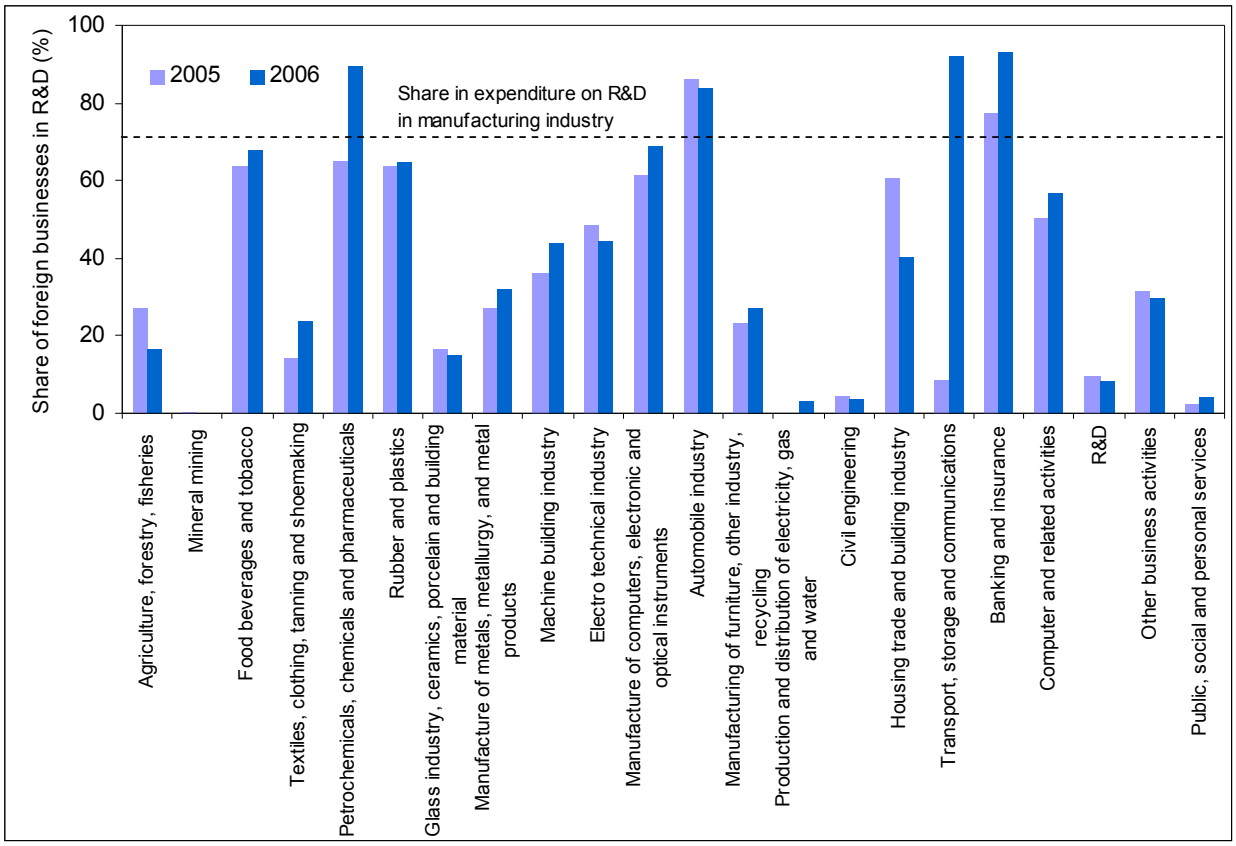
Source: UNCTAD 2006

Share of subsidiaries of foreign enterprises in the number of researchers and business enterprise expenditure on R&D in the Czech Republic between 1995 and 2006



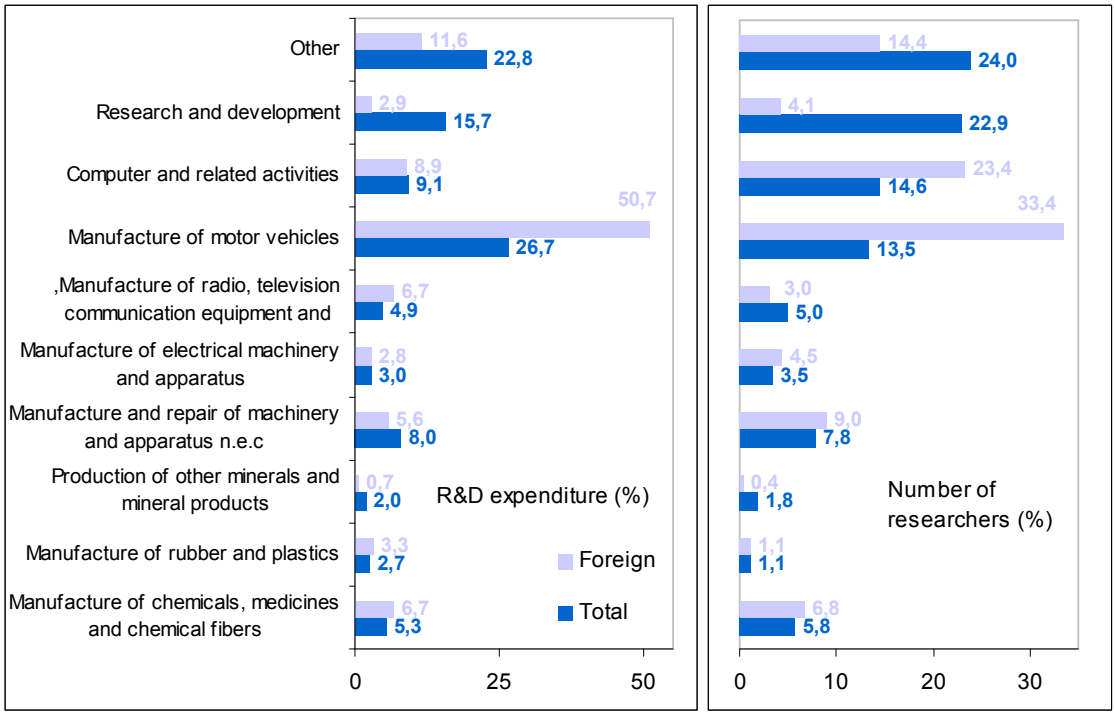
Source: CSO, research and development indicators 2005

Share of subsidiaries of foreign enterprises in business expenditure on R&D in manufacturing industry in 2005 and 2006



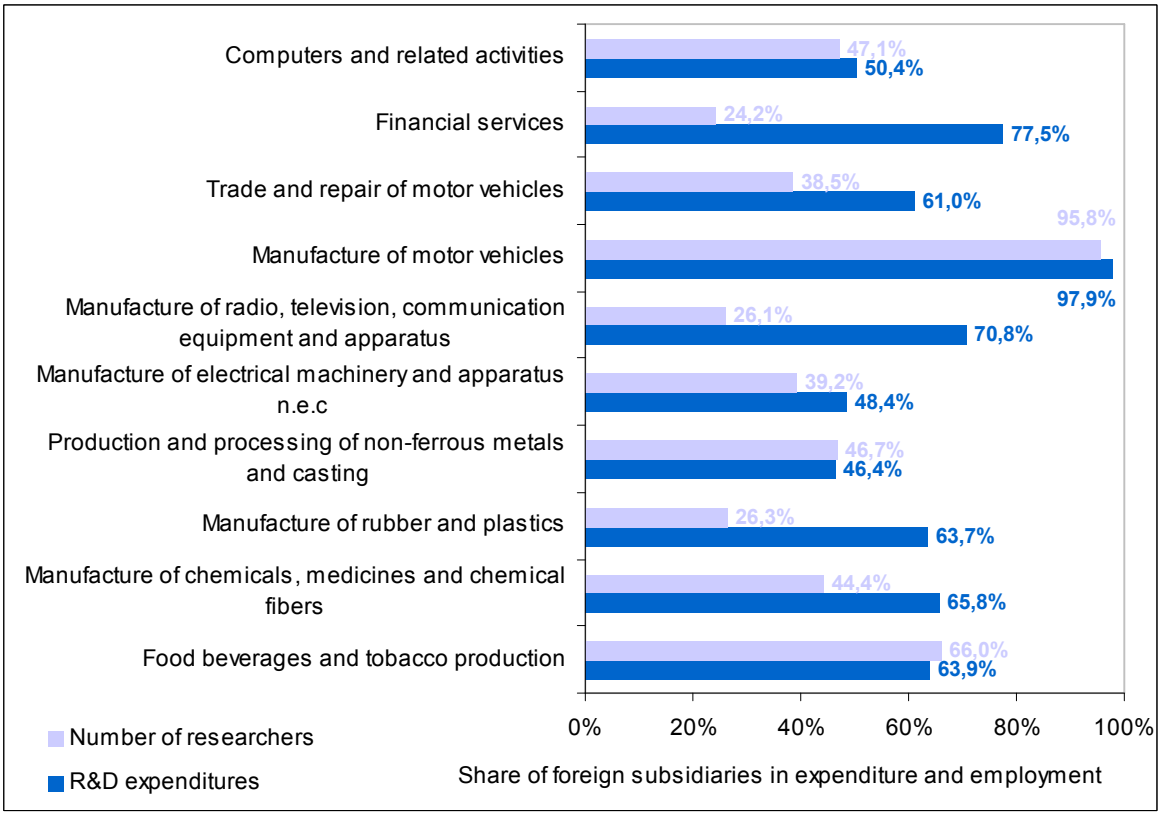
Source: CSO

Comparison of the sectoral structure of expenditure on R&D and number of researchers in subsidiaries of foreign enterprises in the Czech Republic and in all enterprises in the Czech Republic in 2005



Source: CSO, Indicators research and development 2005

Share of subsidiaries of foreign enterprises in employment in R&D and business expenditure on R&D in individual branches in the Czech Republic in 2005



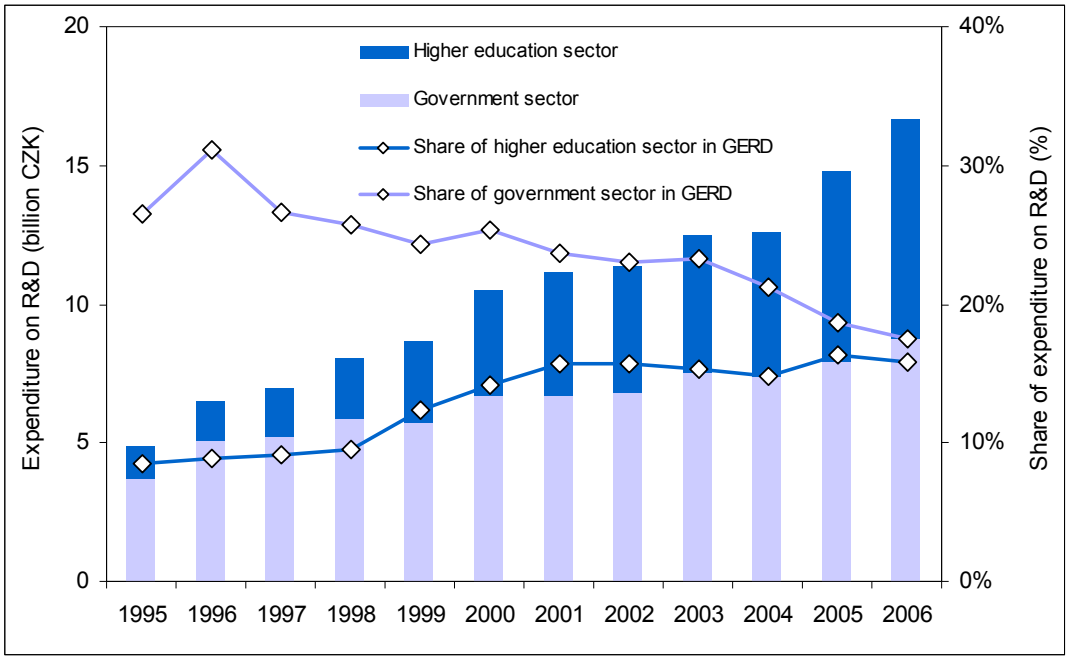
Source: CSO, Indicators research and development 2005

Analysis, comments and other information:

- **The Czech Republic is a country with the most globalization of R&D**. The share of foreign enterprises in the total expenditure on R&D in the business sector (BERD) is close to 60 % and only Ireland and Hungary have a higher share of foreign enterprises in research. The highest increase was recorded in the new EU member states Hungary and the Czech Republic. The increase in the share of business expenditure on R&D performed by foreign companies in the Czech Republic was delayed in comparison with Hungary due to the transformation strategy in Hungary which was based on attracting foreign investors. From more economically developed countries of the EU the share of expenditure of foreign enterprises in R&D increased the fastest in the United Kingdom and Sweden. The share of foreign enterprises in advanced countries generally increases very slowly however.
- **The share of foreign enterprises in the expenditure on R&D and the number of researchers in the business sector in the Czech Republic is constantly increasing**. The share of foreign businesses in the expenditure on R&D exceeds the share in the number of researchers, which shows the constant building of new and modernization of the existing R&D capacity.
- In the sectoral structure of business expenditure on R&D and the number of researchers in foreign companies **manufacturing of motor vehicles** prevails in the Czech Republic, with approx. 51 % of expenditure and 33 % of researchers of foreign enterprises in 2005, whereas other branches are represented significantly less. The second most significant sector is **computers and related activity**, which contributes approx. 9% and 23% to the expenditure on R&D and number of researchers of foreign enterprises, respectively
- **The share and significance of the R&D activity of foreign enterprises markedly differs among individual branches**. The greatest share was obtained by foreign enterprises in the manufacture of motor vehicles which contributed 96 % to the total number of researchers and 98 % to the total expenditure on R&D. Foreign enterprises not only focused on technologically advanced branches but also expanded their R&D activity in traditional industrial branches – food (66 % of researchers and 64 % of expenditure on R&D) and metallurgical industry (47 % of researchers and 46 % of expenditure on R&D). The higher share in the expenditure on R&D than the number of researchers in the manufacture of radios, televisions and communication equipment and apparatus, manufacture of rubber and plastic products and in the chemical industry indicates that new R&D capacity is being built or existing capacity is being modernized in these branches and at the same time highlights the high employment and lower investment activity of domestic businesses.

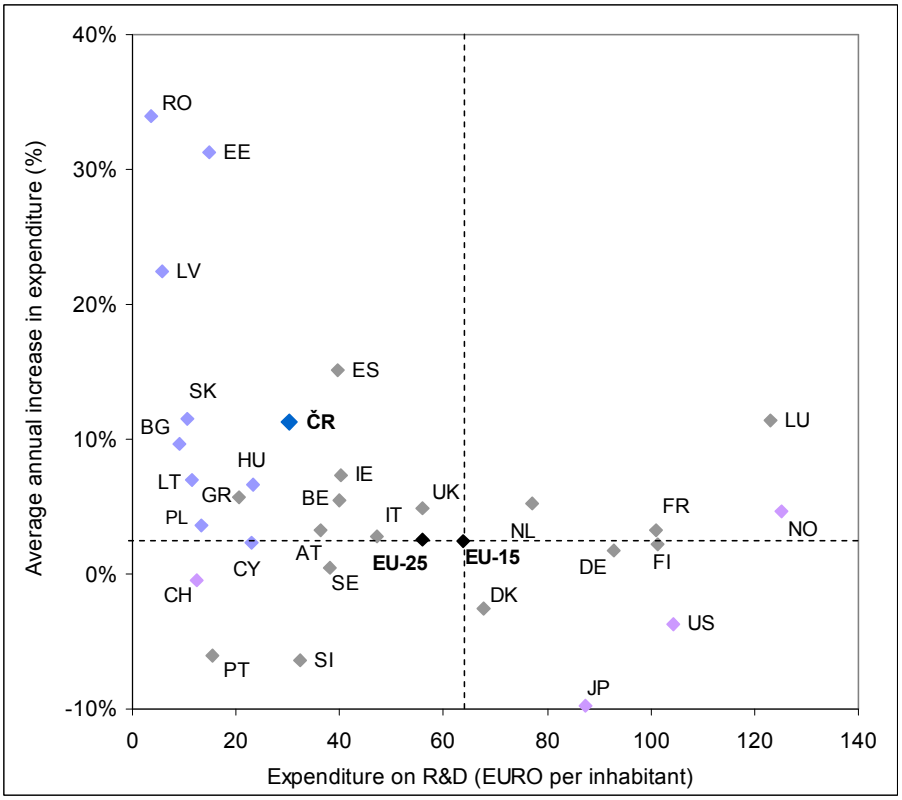
3.3.2.9 Expenditure on research and development in the government sector and higher education sector

Expenditure on R&D in the government sector and in the higher education sector between 1995 and 2006



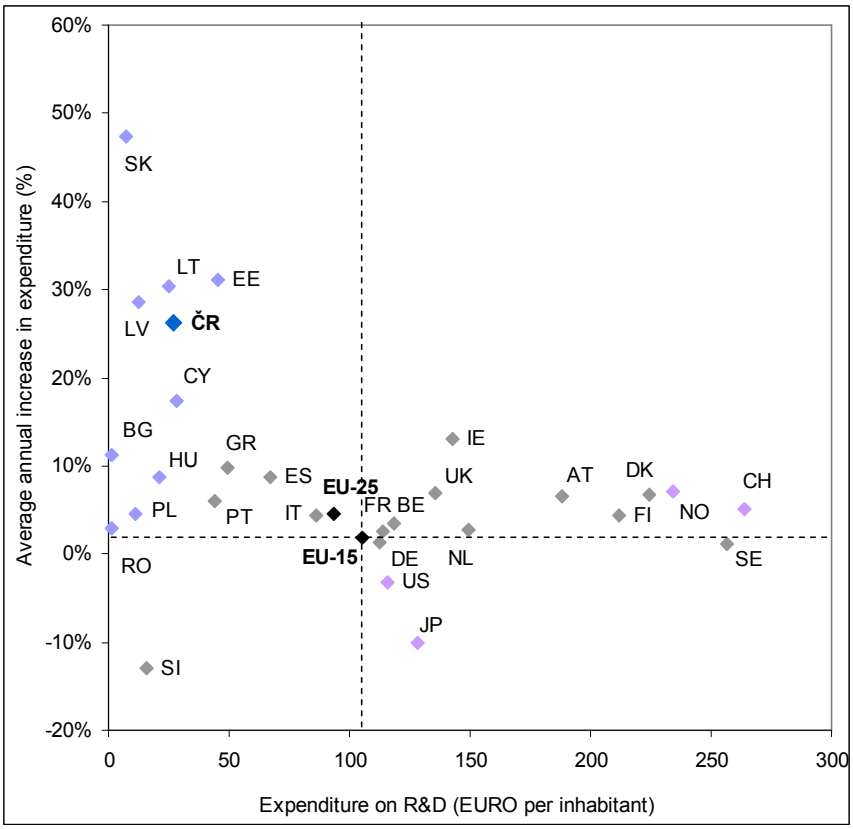
Source: Eurostat, CSO

Expenditure on R&D in the government sector in EUR per inhabitant in 2005 and its trend between 2001 and 2005



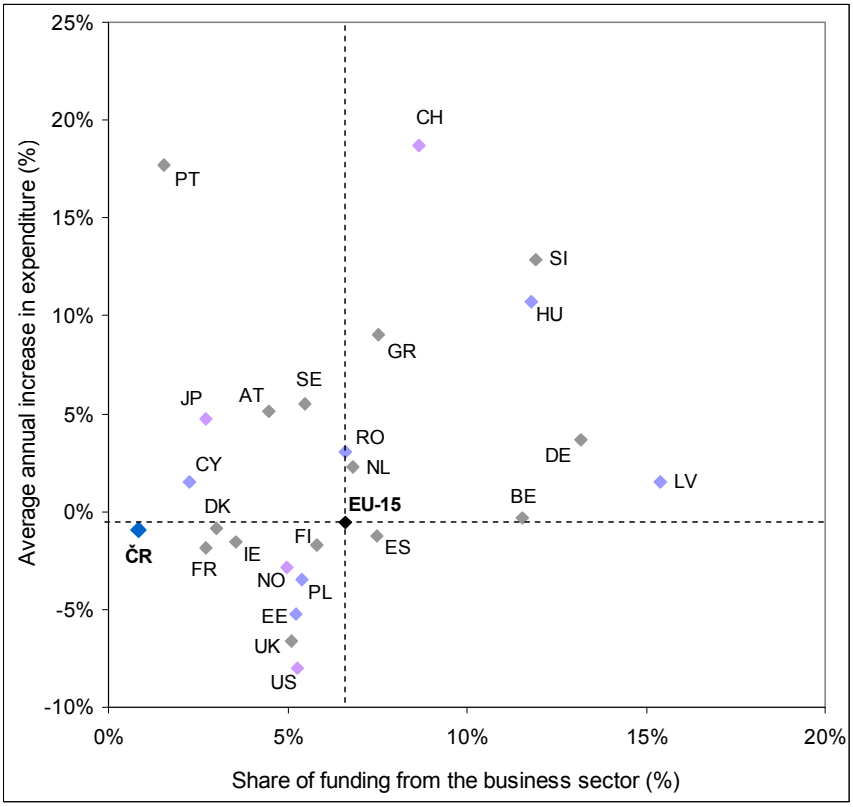
Source: Eurostat

Expenditure on R&D in the higher education sector in EUR per inhabitant in 2005 and its trend between 2001 and 2005



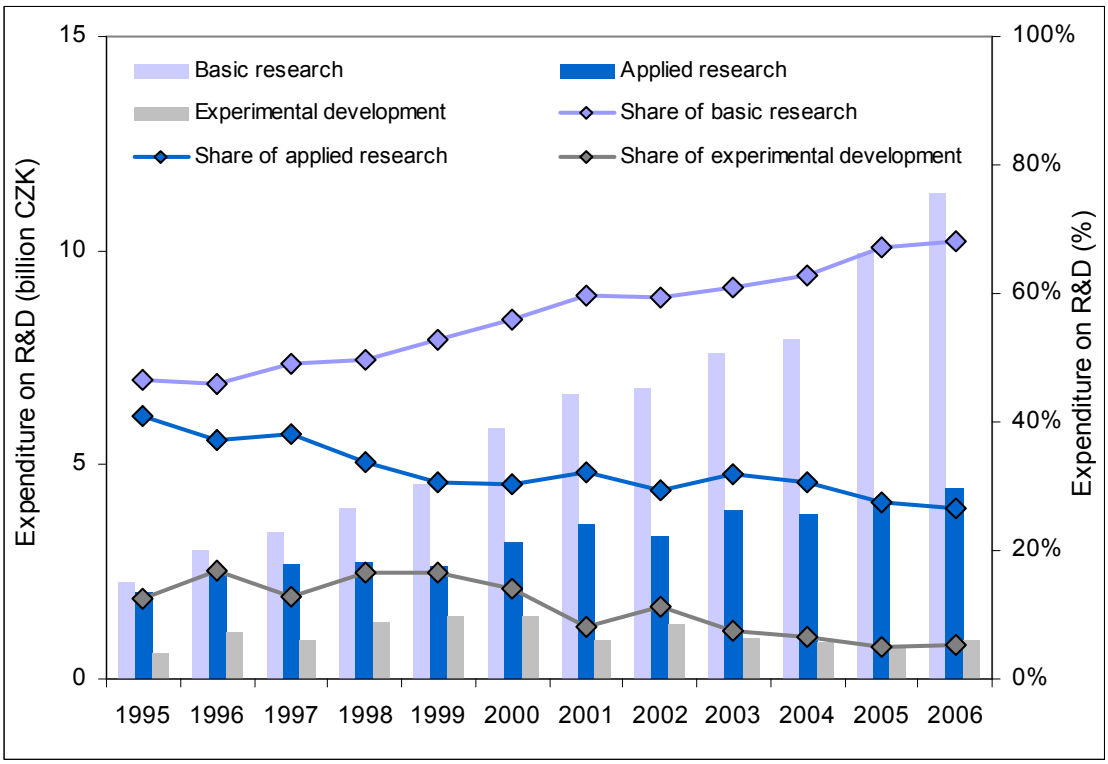
Source: Eurostat

Share of financial resources from the business sector in research performed in the higher education sector in 2005 and its trend between 2001 and 2005



Source: Eurostat

Share of basic research, applied research and experimental development in the expenditure on R&D in the government sector and higher education sector between 1995 and 2006



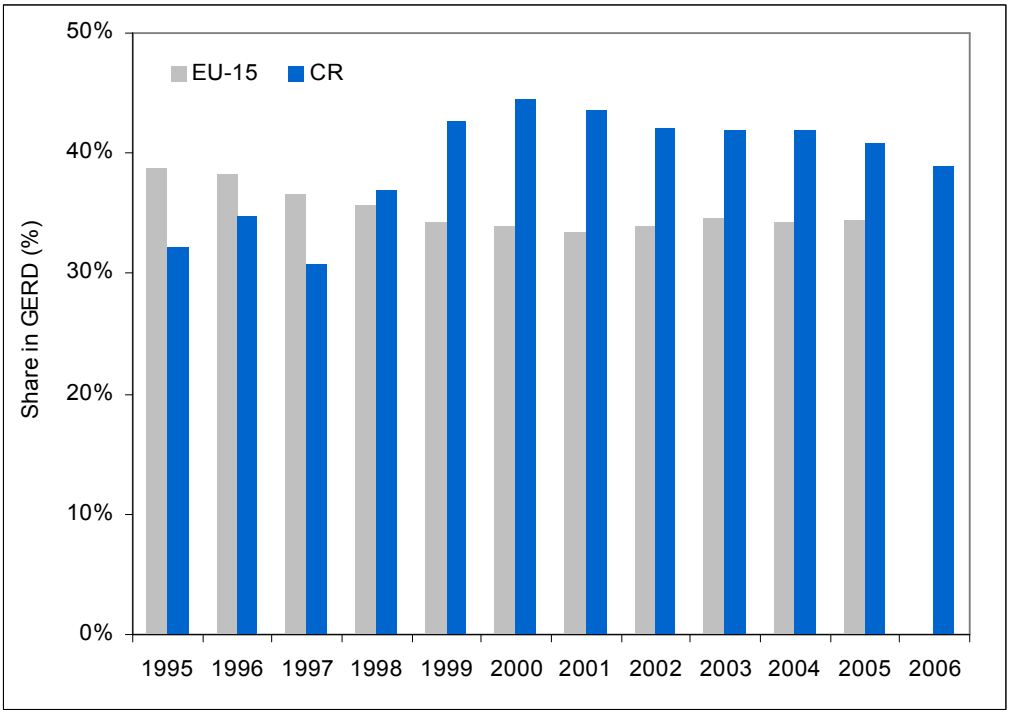
Source: Eurostat

Analysis, comments and other information:

- From the point of view of public research the **government sector** is currently the stronger sector in the Czech Republic (represented in particular by AS CR) and in contrast to the EU-15 performs more research than the higher education sector. Even though the expenditure on R&D increased in all sectors of activity, the government sector's share in the total expenditure of the Czech Republic on R&D (GERD) has consistently decreased since 1996 and in 2006 made up 17 % of the total expenditure on R&D (in 2005 it was almost 19 %). The share of expenditure on R&D of the **higher education sector** in the total expenditure of the Czech Republic on R&D (GERD) is approx. 16 %.
- Even though **expenditure on R&D in higher education and government sectors** increased by approx. 11 % and 15 %, respectively between 2005 and 2006, it is still **lower than in developed EU-15 countries**. There is a huge difference in the higher education sector, where expenditure on R&D recalculated into EUR per inhabitant is 20 % to 25 % of the average of EU-15 countries (e.g. Germany, France or Belgium) and only 10 % of the expenditure on R&D in this sector in Sweden, Finland, Denmark or Austria.
- In expenditure on R&D in the government and higher education sectors **expenditure on basic research prevails**. Expenditure on basic research in these sectors is continuously increasing as is the share of basic research in the expenditure on R&D (68 % in 2006). Expenditure on applied research is increasing less and therefore the share of applied research in the expenditure of these sectors on R&D is decreasing (in 2006 the share of applied research decreased to 27 %).
- There is a **low share of private funding** in the expenditure of the government and particularly higher education sector compared with most European countries. In 2006, only 1 % of funding for R&D in the higher education sector was from the business sector, whereas the EU-15 average for private resources is more than 6 % of the total funding for R&D and in several EU-15 countries the share of private resources is even higher (e.g. in Germany, Belgium, Slovenia and Hungary the share of funding from the business sector exceeds 10 %).
- The low share of private funding in public research can be a result of a lack of interest of the private sector in the research performed at universities (or public research institutes). The low and decreasing share of applied research in the public sector can also be reflected in the insufficient amount of knowledge utilized in industrial and commercial sectors.

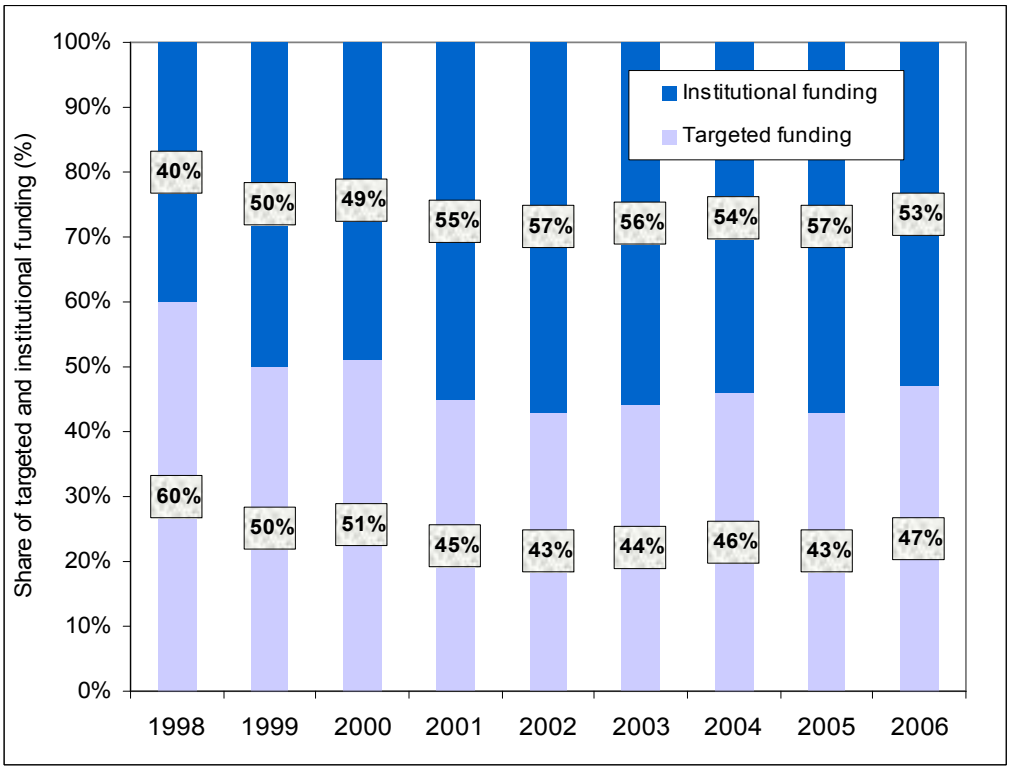
3.3.2.10 Support of R&D from public sources

Share of public resources in the total expenditure on R&D in the Czech Republic and EU-15 between 1995 and 2006



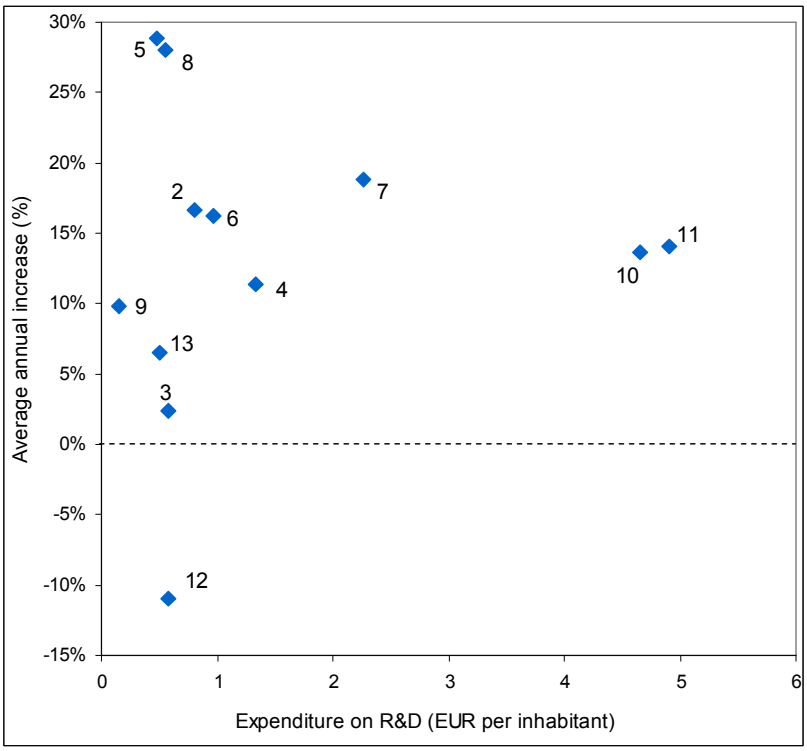
Source: Eurostat, CSO

Targeted and institutional funding of research and development in the Czech Republic between 1995 and 2006



Source: Analysis of the state of R&D in the Czech Republic and its comparison with abroad in 2006

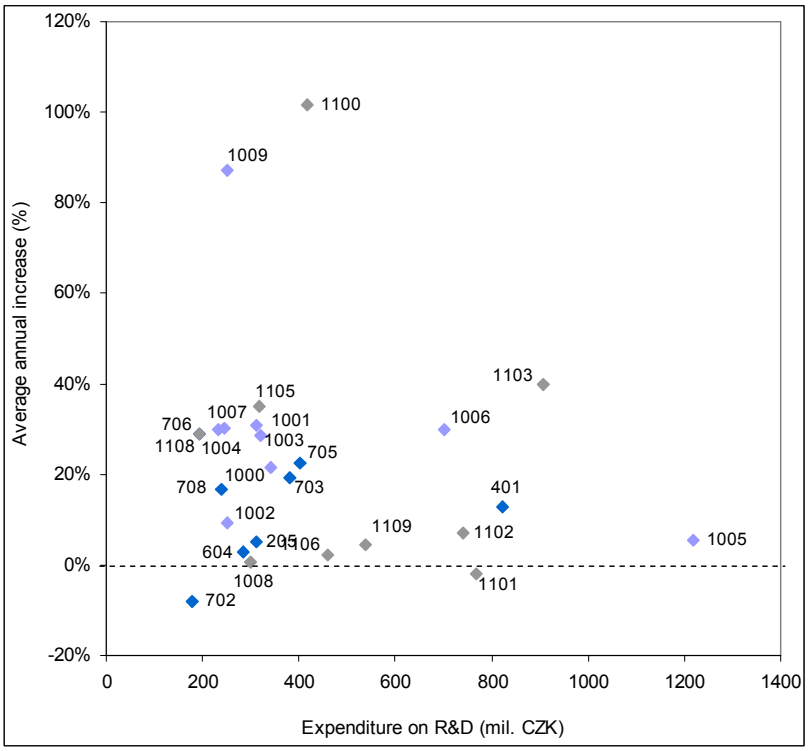
Public expenditure on R&D by the main socioeconomic objectives (NABS) – expenditure on R&D in 2006 and its average annual increase between 2002 and 2006.



1. Exploration and exploitation of the earth
2. Infrastructure and general planning of land-use
3. Protection of the environment
4. Protection and improvement of human health
5. Production, distribution and rational utilisation of energy
6. Agricultural production and technology
7. Industrial production and technology
8. Social structures and relationships
9. Exploration and exploitation of space
10. Research financed from general university funds (GUF)
11. Non-oriented research
12. Other civil research
13. Defence

Source: Eurostat

Public expenditure on R&D by detailed socioeconomic objectives (NABS) – expenditure on R&D in 2006 and its average annual increase between 2002 and 2006 (only significant objectives where more than 1 % of total public expenditure on R&D was allocated)

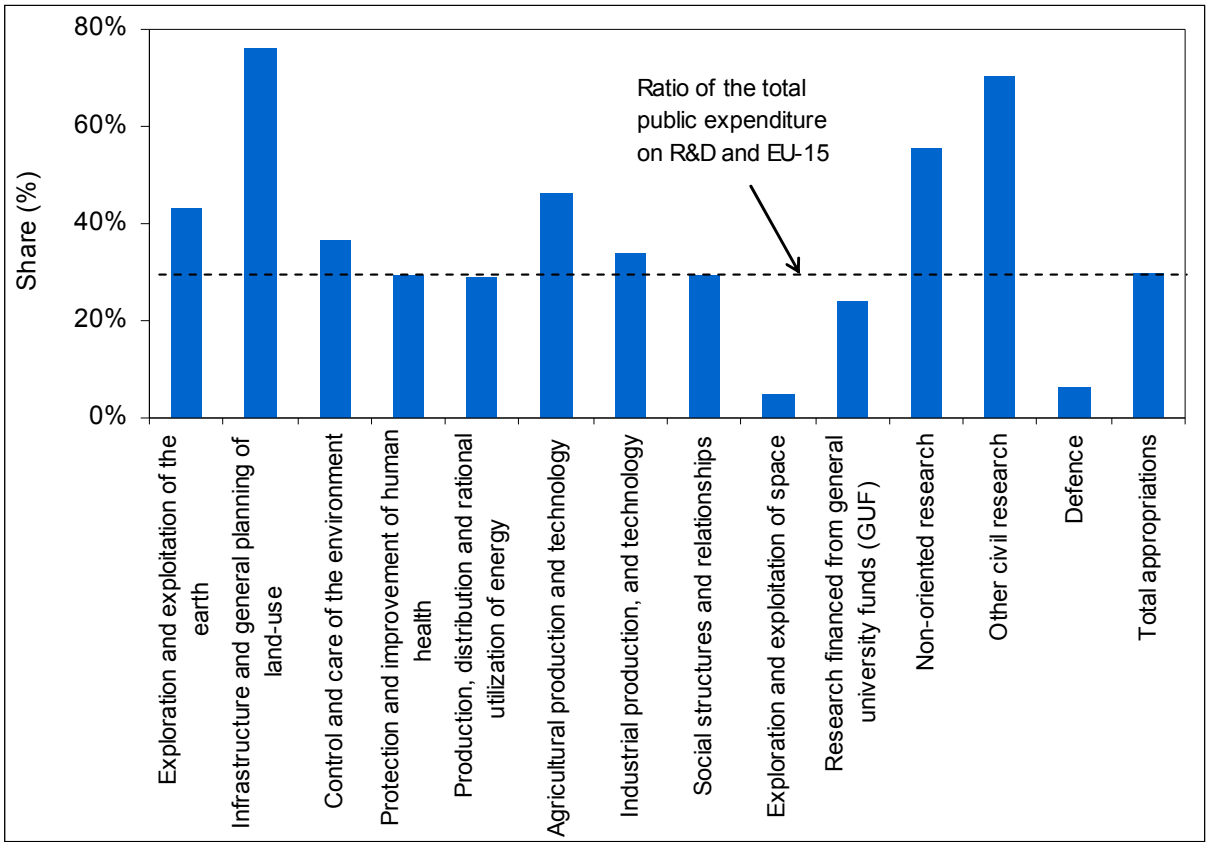


1005 University, Engineering sciences
1103 NOR, Biological sciences
401 Medical research, hospital treatment, surgery
1101 NOR, Physical sciences
1102 NOR, Chemical sciences
1006 GUF, Medical sciences
1109 NOR, Humanities
1106 NOR, Medical sciences
1100 NOR, Mathematics and computer sciences
705 Manufacturing of motor vehicles and other means of transport
703 Extractions and processing of non-energy mineral and derived products
1000 GUF, Mathematics and computer sciences
1003 GUF, Biological sciences
1105 NOR, Engineering sciences
205 Telecommunication systems
1001 GUF, physical sciences
1008 GUF, social sciences
604 Crops
1002 GUF, Chemical sciences
1009 GUF, Humanities
1007 GUF, Agricultural science
708 Manufacture of non-electronic and non-electrical machinery
1004 GUF, Earth and related sciences
706 Electronic and related industries
1108 NOR, social sciences
702 Manufacturing and processing techniques

(GUF – research financed from general university funds, NOR – non-oriented research)

Source: Eurostat

Comparison of distribution of expenditure on R&D in the Czech Republic and EU-15 in 2006



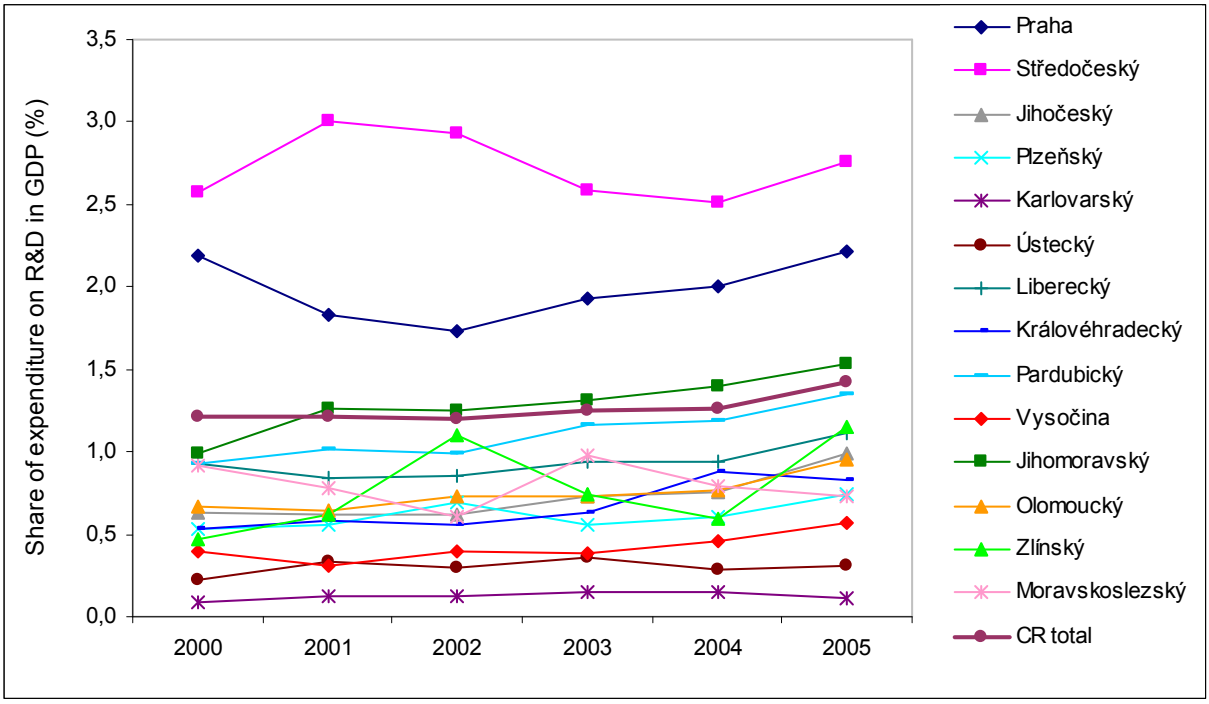
Source: CSO, Eurostat

Analysis, comments and other information:

- **The share of public funding** in the total expenditure on R&D in the Czech Republic in 2006 was approx. 40 %. The share of public funding for R&D has decreased since 2000 although it still exceeds the average share of public funding in the total expenditure on R&D in the EU-15 (34 % GERD in 2005). If we recalculate the expenditure on R&D from public resources per inhabitant, however, the Czech Republic is only at a level of 30 % of the EU-15 average (in 2006 the level was approx. 60 EUR per inhabitant whereas in the EU-15 the average public expenditure on R&D in 2005 was more than 200 EUR per inhabitant).
- In public expenditure on R&D in the Czech Republic **institutional funding prevails**, making up approx. 53 % of all public expenditure on R&D and its share has remained practically unchanged for the past few years.
- In classification based on the main socio-economic objectives (NABS) the highest share of public expenditure on R&D was in objectives 11. Non-oriented research and 10. Research financed from general university funds, which corresponds to the prevalence of basic research in the expenditure on R&D in the government sector and higher education sector. The highest increase in public expenditure on R&D was recorded in the socio-economic objectives 5. Production, distribution and rational utilisation of energy and 8. Social structures and relationships. A relatively high amount of expenditure on R&D with a marked year-on-year increase is also seen in the main socio-economic objective 7. Industrial production and technology.
- Even though the total public expenditure on R&D in EUR per inhabitant is at the level of approx. 30 % of the average public expenditure in the EU-15, in several disciplines the position of the Czech Republic is better. The best position of the Czech Republic is in the main socio-economic objectives 2. Infrastructure and general planning of land use (more than 70 % of the EU-15 average), 12. Other civil research (also more than 70 % of the EU-15 average) and 11. Non-oriented research (more than 50 % of the EU-15 average).
- In comparison with the EU-15 average, the lowest expenditure in the Czech Republic is in the main socio-economic objectives 9. Exploration and exploitation of space, 13. Defence and 10. Research financed from general university funds, which corresponds to the low share of R&D performed in the higher education sector in the Czech Republic.

3.3.2.11 Expenditure on R&D in regions

Share of expenditure on research and development in the GDP of Czech regions between 2000 and 2005



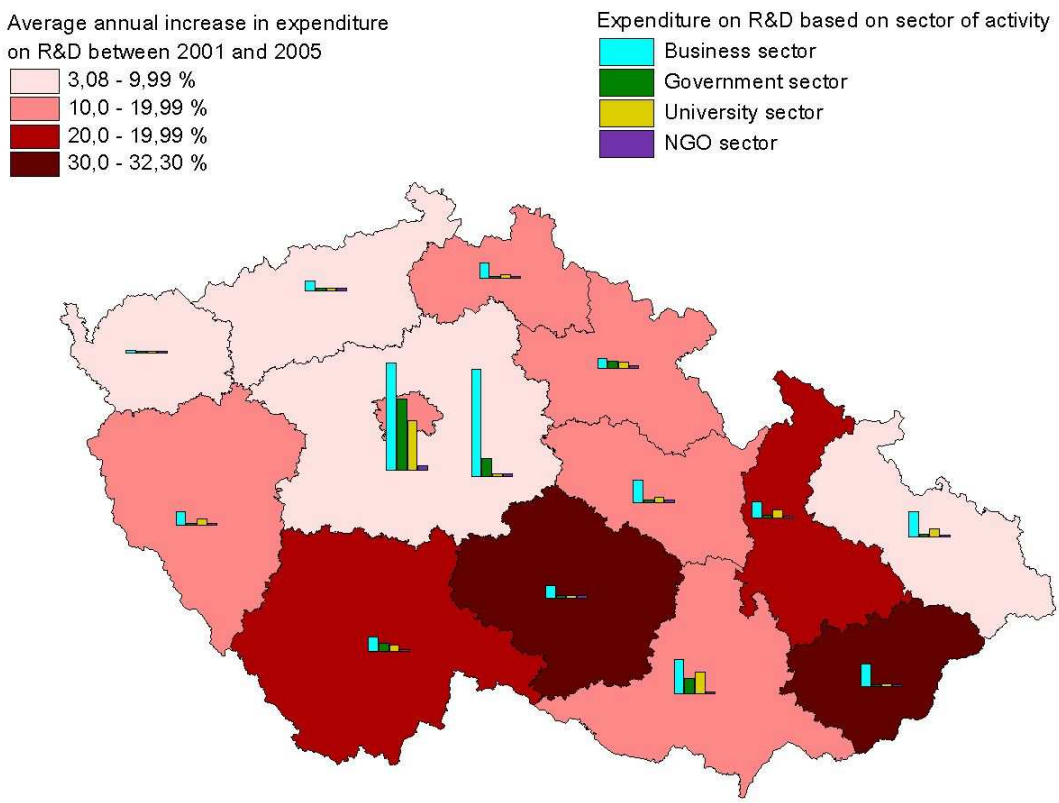
Source: CSO, our own calculations

Expenditure on R&D in Czech regions (in mil. CZK), its average annual increase and share in the total expenditure on R&D in the Czech Republic between 2001-2005

Region	Expenditure on R&D (in mil. CZK)					Average annual increase 2001-2005	Share in the Czech Republic				
	2001	2002	2003	2004	2005		2001	2002	2003	2004	2005
Praha	10 119	10 190	11 854	13 300	15 835	14,1	35,7	34,5	36,8	37,9	37,5
Středočeský	7 216	7 614	6 960	7 238	8 561	4,7	25,5	25,8	21,6	20,6	20,3
JIhočeský	807	848	1 027	1 146	1 610	24,9	2,8	2,9	3,2	3,3	3,8
Plzeňský	652	829	712	836	1 130	18,3	2,3	2,8	2,2	2,4	2,7
Karlovarský	68	77	92	96	76	3,1	0,2	0,3	0,3	0,3	0,2
Ústecký	500	458	605	510	589	4,4	1,8	1,5	1,9	1,5	1,4
Liberecký	728	766	817	868	1 110	13,1	2,6	2,6	2,5	2,5	2,6
Královéhradecký	685	662	784	1 177	1 169	17,7	2,4	2,2	2,4	3,4	2,8
Pardubický	993	1 018	1 264	1 364	1 632	16,1	3,5	3,4	3,9	3,9	3,9
Vysočina	319	424	428	529	707	30,4	1,1	1,4	1,3	1,5	1,7
Jihomoravský	3 061	3 144	3 473	3 964	4 654	13,0	10,8	10,6	10,8	11,3	11,0
Olomoucký	742	877	909	1 054	1 372	21,3	2,6	3,0	2,8	3,0	3,3
Zlínský	685	1 236	905	787	1 571	32,3	2,4	4,2	2,8	2,2	3,7
Moravskoslezský	1 761	1 410	2 416	2 212	2 182	6,0	6,2	4,8	7,5	6,3	5,2
CR total	**28 337**	**29 552**	**32 247**	**35 083**	**42 198**	**12,2**	**100,0**	**100,0**	**100,0**	**100,0**	**100,0**

Source: CSO, our own calculations

Expenditure on R&D by sector of performance and its annual increase between 2001 and 2005 in Czech regions



Source: CSO, our own calculations

Expenditure on R&D by sector of performance and regions in 2005 (in thous. CZK)

	Business sector	Government sector	Higher education sector	Private non-profit sector	Total
Praha	7 433 364	4 897 381	3 349 051	155 346	**15 835 142**
Středočeský	7 437 557	1 119 859	0	3 505	**8 560 920**
Jihočeský	867 280	451 262	282 976	8 912	**1 610 430**
Plzeňský	811 834	10 054	302 002	5 702	**1 129 593**
Karlovarský	72 031	4 147	0	0	**76 178**
Ústecký	531 991	8 970	48 423	0	**589 384**
Liberecký	949 489	11 718	147 048	1 353	**1 109 608**
Královehradecký	557 157	330 507	280 561	1 102	**1 169 327**
Pardubický	1 445 108	0	184 991	2 055	**1 632 154**
Vysočina	691 231	15 462	0	149	**706 842**
Jihomoravský	2 289 407	960 429	1 398 484	5 373	**4 653 693**
Olomoucký	966 253	8 182	392 901	4 829	**1 372 165**
Zlínský	1 473 082	840	97 150	0	**1 571 072**
Moravskoslezský	1 682 857	69 991	423 880	5 187	**2 181 915**
CR total	27 208 641	7 888 802	6 907 467	193 514	42 198 423

Source: CSO

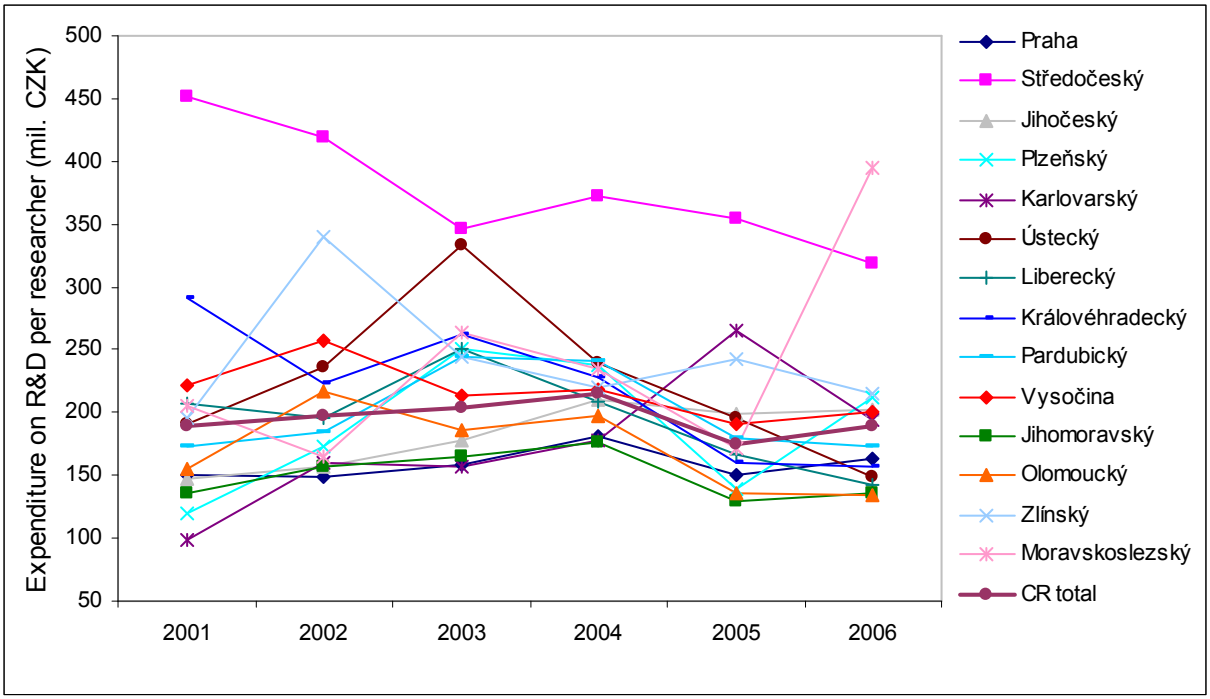
Share of expenditure on R&D invested in individual Czech regions (2005) by sector of performance

R&D sector	Region													
	AB	SČ	JČ	PL	KV	UL	LI	HK	PA	VY	JM	OL	ZL	MS
Business	27.3	27.3	3.2	3.0	0.3	2.0	3.5	2.0	5.3	2.5	8.4	3.6	5.4	6.2
Government	62.1	14.2	5.7	0.1	0.1	0.1	0.1	4.2	0.0	0.2	12.2	0.1	0.0	0.9
Higher education	48.5	0.0	4.1	4.4	0.0	0.7	2.1	4.1	2.7	0.0	20.2	5.7	1.4	6.1
Private non-profit	80.3	1.8	4.6	2.9	0.0	0.0	0.7	0.6	1.1	0.1	2.8	2.5	0.0	2.7

Legend: AB = Praha, SČ = Středočeský region, JČ = Jihočeský region, PL = Plzeňský region, KV = Karlovarský region, UL = Ústecký region, LI = Liberecký region, HK = Královéhradecký region, PA = Pardubický region, VY = Vysočina, JM = Jihomoravský region, OL = Olomoucký region, ZL = Zlínský region, MS = Moravskoslezský region

Source: CSO, our own calculations

Average expenditure on R&D per researcher (FTE) in Czech regions between 2001 and 2006



Source: CSO, our own calculations

Analysis, comments and other information:

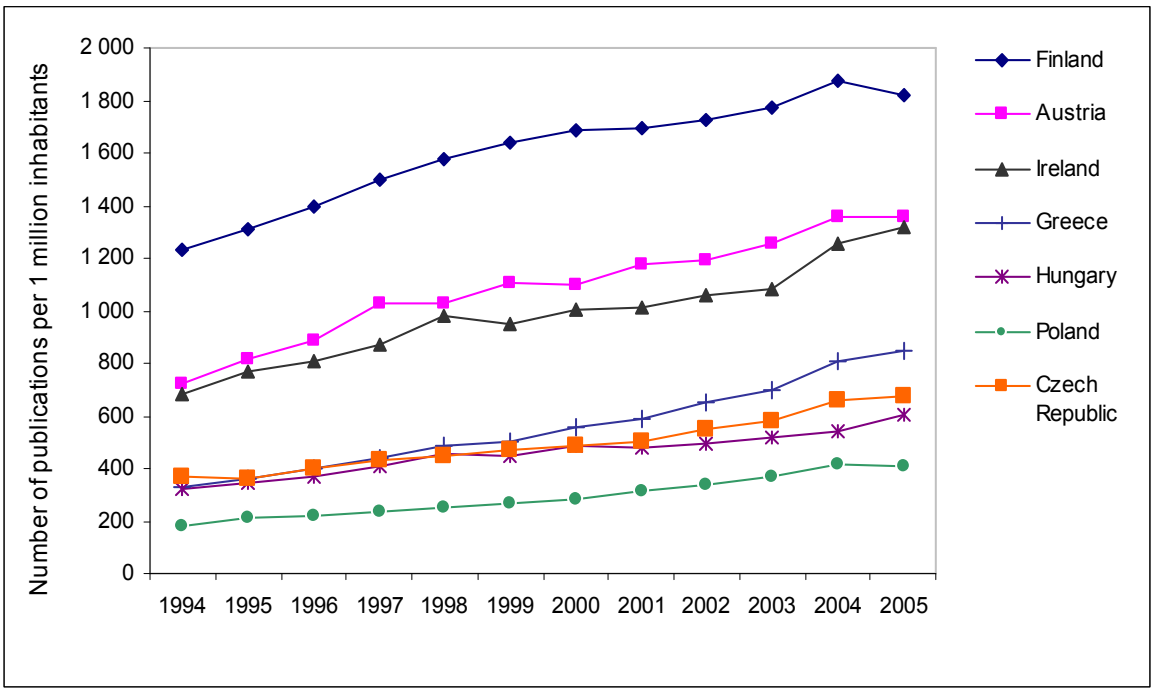
- **Intensity of research and development** (share of total expenditure on research and development in the total GDP) in all of the regions the Czech Republic is under the level of 3 % GDP, which was established as one of the main objectives of the Lisbon strategy to be met by 2010. Despite the fact that there has been an increase since 2000 in almost all regions in the intensity of R&D and Středočeský region (2.76 % GDP) together with the region of Praha (2.22 % GDP) came very close to meeting this objective in 2005, most regions range very much below the average of the Czech Republic and the EU-25. The amount of total expenditure on R&D is unsatisfactory in particular in the case of Karlovarský (0.11 % GDP) and Ústecký (0.30 % GDP) regions where despite very low values there was a slight increase in expenditure on R&D and its share of GDP during the monitored period (2000-2005).
- **Total internal expenditure on research and development** is strongly concentrated into a few regions. Praha, Středočeský and Jihomoravský regions saw 69 % of all expenditure on R&D in the Czech Republic in 2005. Four years earlier this share was 72 %, so we can suggest that there has been a slow deconcentration of funding of R&D in the Czech Republic. Apart from the position of Praha, the uneven distribution of funding can also be due to the high concentration in Středočeský region – the share of expenditure on R&D in this region in the total expenditure on R&D in the Czech Republic was almost twice the region's share in R&D personnel in the Czech Republic in 2005. However, the increase in total expenditure on R&D was one of the lowest between 2001 and 2005 in Středočeský region together with structurally afflicted regions – Karlovarský, Ústecký and Moravskoslezský. The highest (2x or higher) increase in total expenditure on R&D was recorded in the regions of Zlínský, Vysočina and Jihočeský.
- **The share of Praha and Středočeský region in the business expenditure on R&D** in 2005 was almost 55 %. In 2001 the share in Středočeský was 39 % (share in the region of Praha was 19 %). The strong position of the region is to a certain extent influenced by the presence of the automobile manufacturer Škoda in Mladá Boleslav, the main driver of the Czech economy and research in the business sector. The region's share in the total expenditure in the business sector on R&D in the Czech Republic (27 %) markedly exceeds the region's share in the total human resources in this sector (16 %).
- **The concentration of expenditure on R&D is highest in the government sector**, where Praha, Středočeský and Jihomoravský regions make up almost 90 % of all expenditure in this sector, similar to the number of R&D personnel.
- **Funding in the higher education sector** is significantly concentrated in the regions of Praha and Jihomoravský, where almost 70 % of the expenditure on R&D in this sector was spent in the Czech Republic in 2005. In the **non-profit sector** the concentration of funding is even higher – 80 % of all expenditure in this sector in the Czech Republic was invested in the capital city in 2005.
- **The level of expenditure on R&D recalculated for one researcher (in FTE)** is mainly influenced by the volume of expenditure on R&D in the business sector in the individual regions. With the exception of 2006, when Moravskoslezský region came to the forefront (several significant investments into technological centres – Siemens, Elcom etc.), the region of Středočeský with a strong commercial R&D basis has been in a leading position since 2000. In the case of Praha and Jihomoravský region the lower volume of expenditure per researcher is caused in particular by the prevalence of public sector R&D over commercial R&D.

3.4 OUTPUTS OF R&D AND INNOVATION

3.4.1 Results of R&D between 1994 and 2005

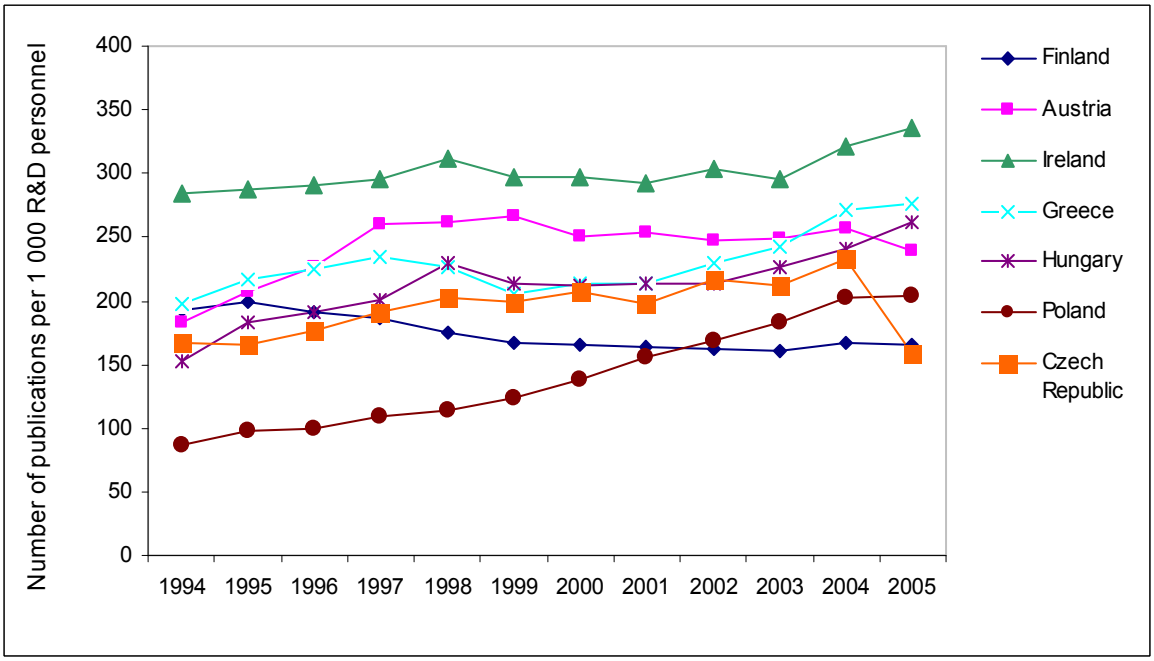
3.4.1.1 Publication activity – number publications

Comparison of the dynamism of growth in the number of scientific publications of authors from several EU countries



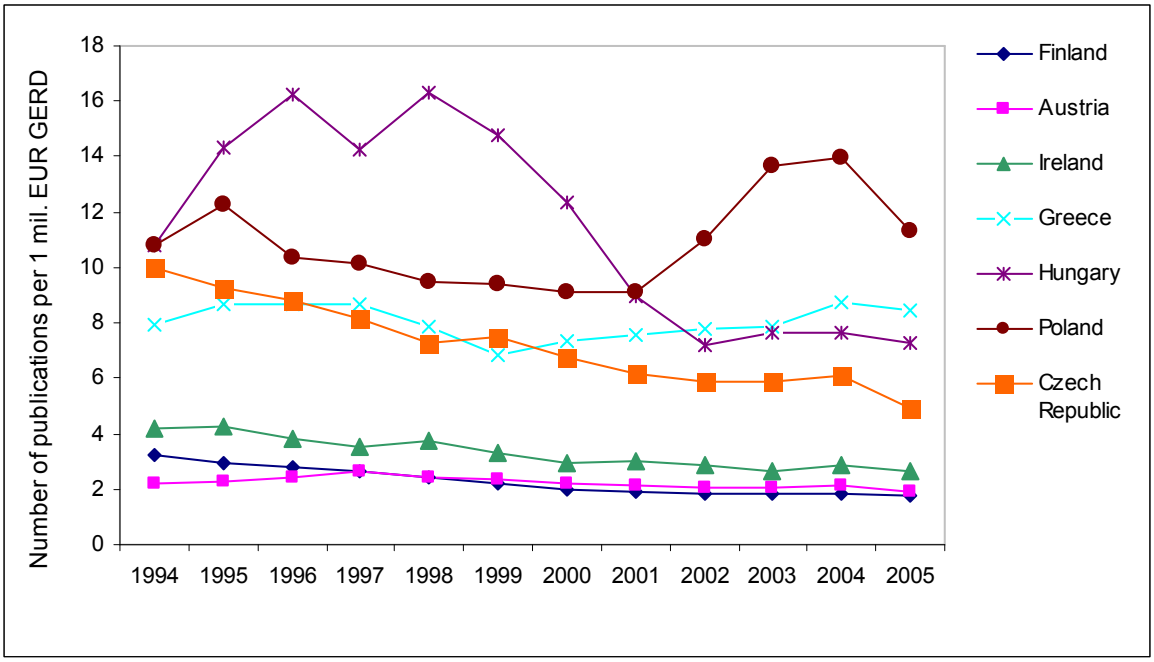
Source: ISI Web of Knowledge (Thomson Scientific)

Dynamism of growth in the number of scientific publications of several EU countries after recalculating into the number of R&D personnel



Source: ISI Web of Knowledge (Thomson Scientific)

Dynamism of growth in the number of scientific publications of several EU countries after recalculating into total expenditure on R&D (GERD)



Source: ISI Web of Knowledge (Thomson Scientific)

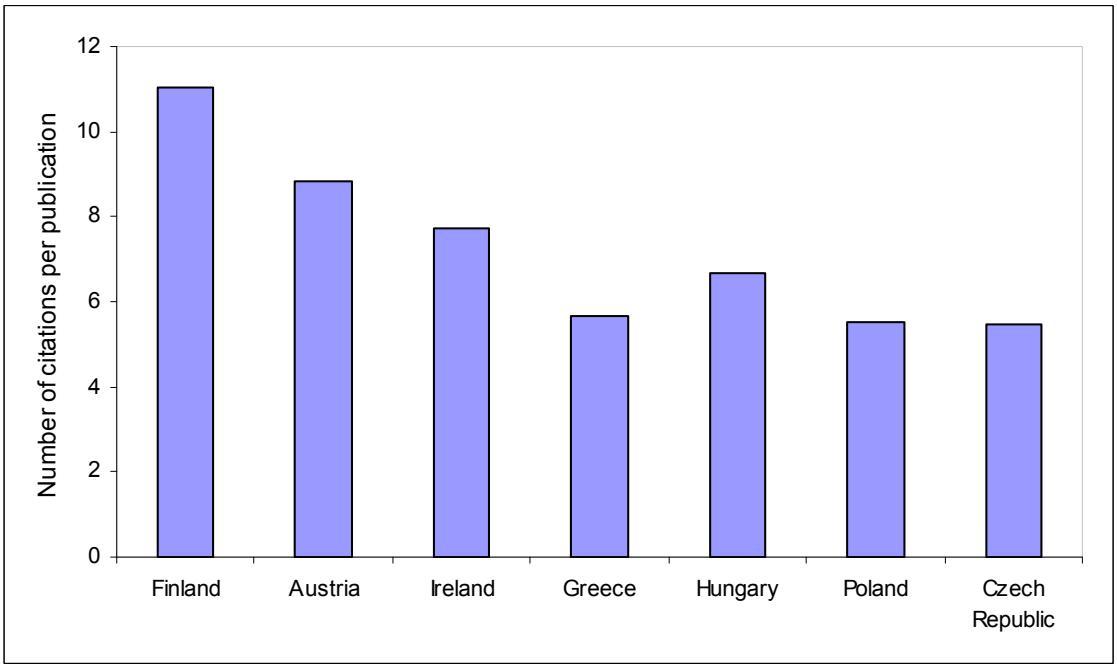
Analysis, comments and other information:

- **The number of scientific publications of Czech authors published** in scientific journals monitored by the ISI Web of Science (e.g. in impact journals) between 1994 and 2005 was 60 910. In the number scientific publications per inhabitant among seven selected EU countries[4] the Czech Republic is close to last (with only Poland and Hungary being worse).
- **The number of Czech publications increased annually** and during the 12 years monitored increased by more than 50 %. The number of publications has also increased in other countries and it is clear that the Czech Republic is not only failing to catch up on other EU countries but the gap is rather widening.
- **In the number of publications per number of R&D personnel** the Czech Republic was comparable to the EU average in the production of publications with only Ireland being significantly better.
- **After recalculating into the total expenditure on R&D (GERD)** the Czech Republic is ahead of advanced EU countries but behind Hungary, Poland and Greece. It is clear however, that the cheap production of publications in new EU member states is caused by the lower price levels and mainly the low pay of R&D personnel (Ref. analysis of expenditure on R&D).
- **From these findings it follows that the production of publications is to a certain extent corresponding to the number of R&D personnel**. In the Czech Republic, R&D personnel on average produce the same number of publications as in other EU countries. The Czech Republic's lag in the number publications recalculated per inhabitant is clearly caused by the low number of R&D personnel. The Czech Republic produces cheaper publications than most comparable EU countries, nevertheless from a comparison of trends it is clear that the price of publications in the Czech Republic during the monitored period has gradually increased and more rapidly than in advanced EU countries.

[4] Seven countries were selected for an international comparison of publication and patent activity– CR, Hungary, Poland, Austria, Finland, Ireland and Greece. The selection of these countries is described in more detail in the chapter Methodology chapter in the conclusion of the analytical part of the Green Paper.

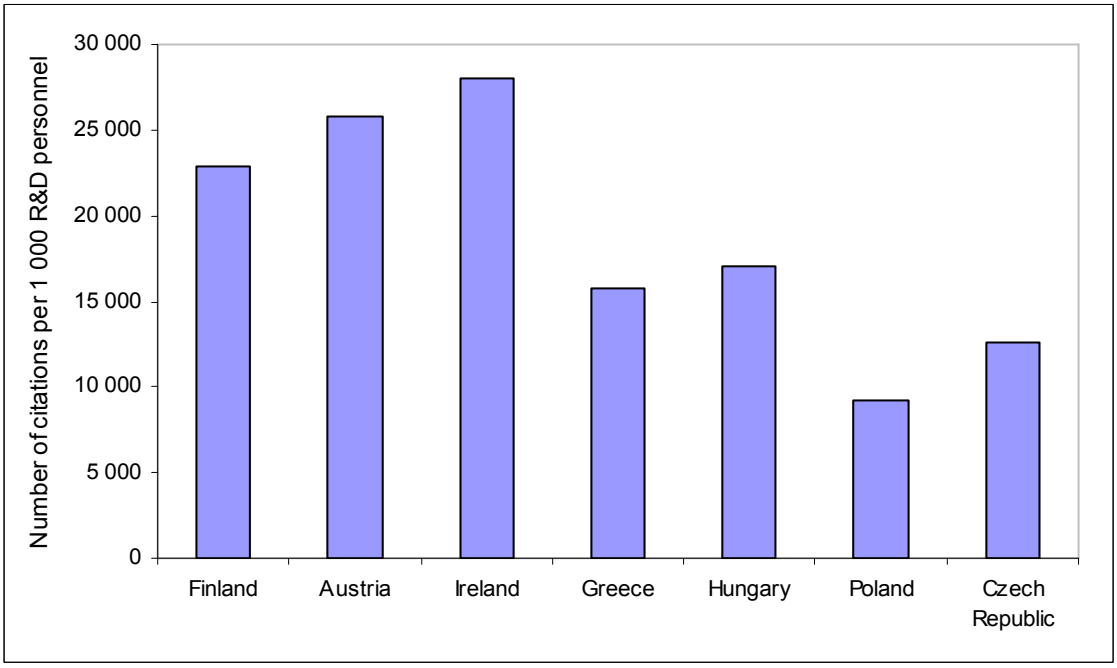
3.4.1.2 Publication activity - citation rate of publications

Average citation rate of scientific publications from several EU countries



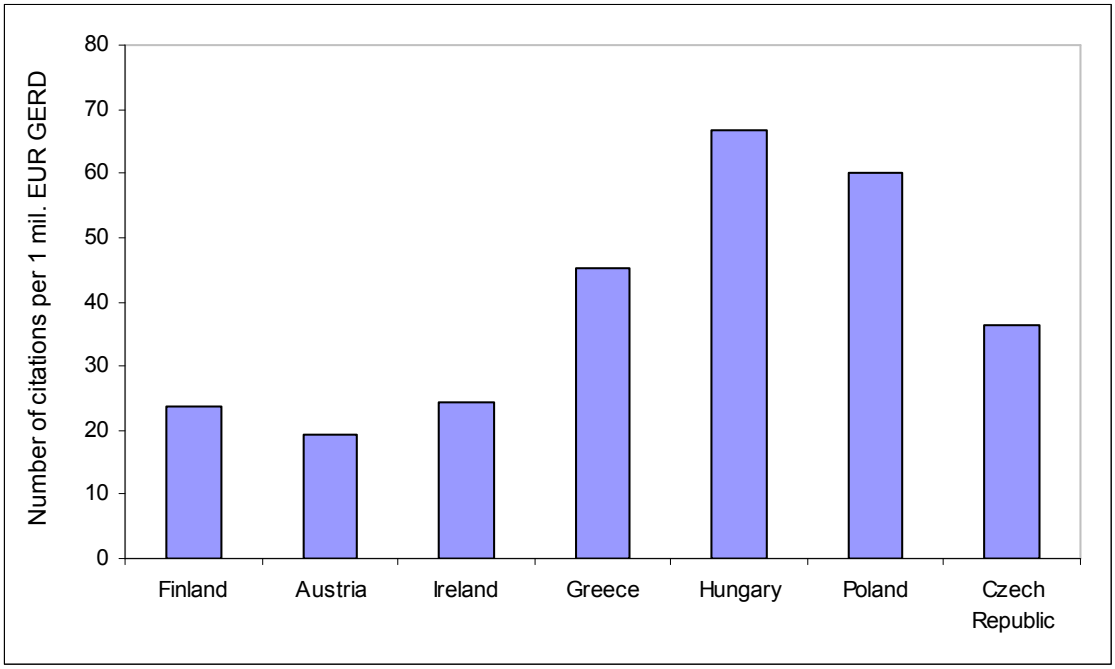
Source: ISI Web of Knowledge (Thomson Scientific)

Average citation rate of scientific publications from several EU countries after recalculating into number of R&D personnel



Source: ISI Web of Knowledge (Thomson Scientific)

Average citation rate of scientific publications from various EU countries after recalculating into total expenditure on R&D (GERD)



Source: ISI Web of Knowledge (Thomson Scientific)

Analysis, comments and other information:

- **For an evaluation of the quality of publications** a comparison of their citation rate is important. Czech work was citied on average 5.45 times during the monitored period and the average citation rate of publications was the lowest from the EU countries compared. The Czech Republic also had the second lowest **number of citations per R&D personnel**.
- **The citation rate of Czech publications has gradually increased**. The Czech Republic's relative citation index value, which was half of the value of the standard world database in 1994, increased in 2005 to a value of 0.9. The impact of Czech publications has slowly improved.
- **After recalculating into total expenditure on R&D (GERD)** the Czech Republic is ahead of Finland, Austria and Ireland but remains behind Hungary, Poland and Greece. We can summarize that a single R&D worker in the Czech Republic produces the same number of publications per year as their colleague in Finland or Austria, but these publications are less cited – by about 1/3. The causes of this situation may include the lower level of support of R&D in the Czech Republic, which may result in worse equipment (low investment) and/or lower quality of personnel possibly due to low remuneration (Ref. analysis of expenditure on R&D).
- **Publications originating through cooperation between Czech and foreign authors** with foreign authors being the corresponding have significantly higher citation rate than the Papers of purely Czech authors. Publications with corresponding authors from the USA, England, Portugal, Scotland or Ireland have an average citation rate three times higher in comparison with Czech corresponding authors. It is clear that Czech researchers are able to generate highly cited publications, if they cooperate with foreign workplaces. From the mentioned data it is not possible to derive whether higher citation rates are due to better ideas and test layouts, better laboratory equipment and more conclusive results or better presentation of the results. It is possible that higher citation rates can be due to the more rigorous selection criteria of data for publication in Anglo-Saxon workplaces. Czech authors sometimes publish less groundbreaking work which would probably be shelved in foreign countries. The fact that the highest citation rates have Papers of corresponding authors from English speaking countries (with the exception of Portugal), indicates that good presentation in English language plays an important role. We also cannot exclude the possibility that Anglo-Saxon workplaces prefer to cite each other than citing unknown workplaces in Central Europe.

3.4.1.3 Publication activity in science disciplines

Publication number of selected EU countries in 20 science disciplines per 1 mil. inhabitants

Discipline	Finland	Austria	Ireland	Hungary	Greece	Poland	Czech Rep.	Rank of Czech Rep.
Chemistry	1673	1354	945	805	1136	892	1208	3
Agricultural science	501	199	553	224	195	74	256	3
Physics	1883	1579	1034	901	826	928	1028	4
Microbiology	696	398	529	179	138	66	260	4
Plant and animal science	1183	648	609	293	360	218	447	4
Material science	756	601	462	293	206	286	426	4
Mathematics	391	412	310	258	350	157	264	5
Space science	324	141	137	118	67	79	96	5
Earth science	514	363	248	234	96	66	192	5
Ecology and the environment	989	310	230	270	110	92	176	5
Biology and biochemistry	1731	1007	765	407	502	190	491	5
Molecular biology and genetics	1742	1118	795	384	569	264	463	5
Immunology	639	453	299	160	114	64	137	5
Neuroscience and behavioral science	1172	695	442	183	339	111	225	5
Psychology and psychiatry	793	390	599	138	92	33	95	5
Computer science	544	348	260	351	159	115	132	6
Engineering	1141	612	700	700	307	232	279	6
Pharmacology and pharmacy	796	445	375	215	245	116	149	6
Clinical medicine	5567	4236	3443	2015	835	419	700	6
Multidisciplinary	92	94	94	25	34	12	16	6

Source: ISI Web of Knowledge (Thomson Scientific)

Average citation rate of publications in 20 science disciplines

Comparison of the Czech Republic with selected EU countries. Classification of science disciplines comes from the nomenclature used by Thomson Scientific (Ref. description of table 1).

Discipline	Finland	Austria	Ireland	Hungary	Greece	Poland	Czech Rep.	Rank of Czech Rep.
Mathematics	3.9	3.7	2.9	2.7	2.5	2.5	3.1	3
Ecology and the environment	10.0	7.7	6.2	5.3	6.2	5.2	6.3	3
Engineering	4.5	4.5	3.5	3.3	3.8	3.4	3.8	3
Molecular biology and genetics	17.8	17.0	17.3	9.1	9.3	7.8	9.4	4
Computer science	5.0	4.0	2.6	2.9	4.1	2.5	3.3	4
Chemistry	8.5	8.5	8.7	7.3	6.1	5.5	6.7	5
Pharmacology and pharmacy	10.0	8.7	9.3	5.4	6.7	5.9	6.5	5
Clinical medicine	13.0	8.0	7.9	5.3	6.0	5.3	5.4	5
Earth science	8.0	6.5	8.8	5.8	6.3	4.6	4.9	6
Biology and biochemistry	13.8	10.7	7.7	6.4	6.3	5.4	6.3	6
Microbiology	13.6	13.2	13.2	7.4	8.7	6.7	6.9	6
Immunology	13.0	14.2	15.7	8.2	8.0	5.6	7.0	6
Plant and animal science	7.7	6.5	5.6	4.9	5.1	3.3	4.8	6
Material science	5.9	6.2	5.4	4.3	4.4	3.2	4.1	6
Multidisciplinary	77.2	46.5	49.4	45.4	30.6	23.6	26.2	6
Physics	9.8	10.0	7.3	7.3	8.3	6.9	6.4	7
Space science	9.8	8.8	12.3	7.1	16.1	12.3	6.8	7

Agricultural science	7.7	5.6	7.5	4.8	2.8	3.5	2.1	7
Neuroscience and behavioral science	12.9	11.2	10.4	4.9	10.5	5.9	4.4	7
Psychology and psychiatry	7.3	5.5	5.6	3.1	5.4	3.8	2.6	7

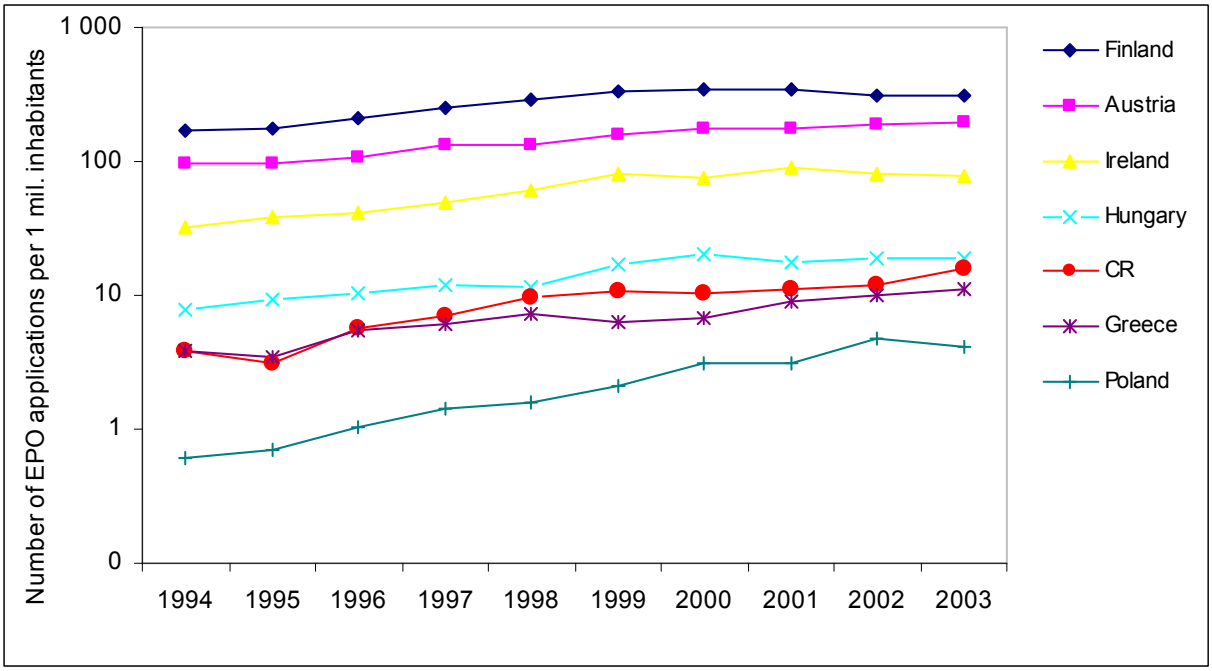
Source: ISI Web of Knowledge (Thomson Scientific)

Analysis, comments and other information:

- **For an evaluation of the quality of research in various disciplines** we compared the number of Czech publications and their citation rate with publications of the six other EU countries in 20 science disciplines. In comparison with the number of publications per inhabitant the Czech Republic is best placed in chemistry and agricultural science, where it finished in third place after Finland and Austria or Ireland and in material science, microbiology, physics and plant and animal science, where it finished in fourth place after Austria, Ireland and Finland.
- **In a comparison of citation rates the Czech Republic finished relatively high** in engineering, in ecological sciences and in mathematics, where Czech publications were the third most cited of all the monitored countries. The average citation rate of Czech publications from computer science and molecular biology was the fourth highest from the countries in the comparison. In pharmacology/pharmacy, chemistry and clinical medicine the Czech Republic finished in fifth place; in other disciplines it was either sixth or last.

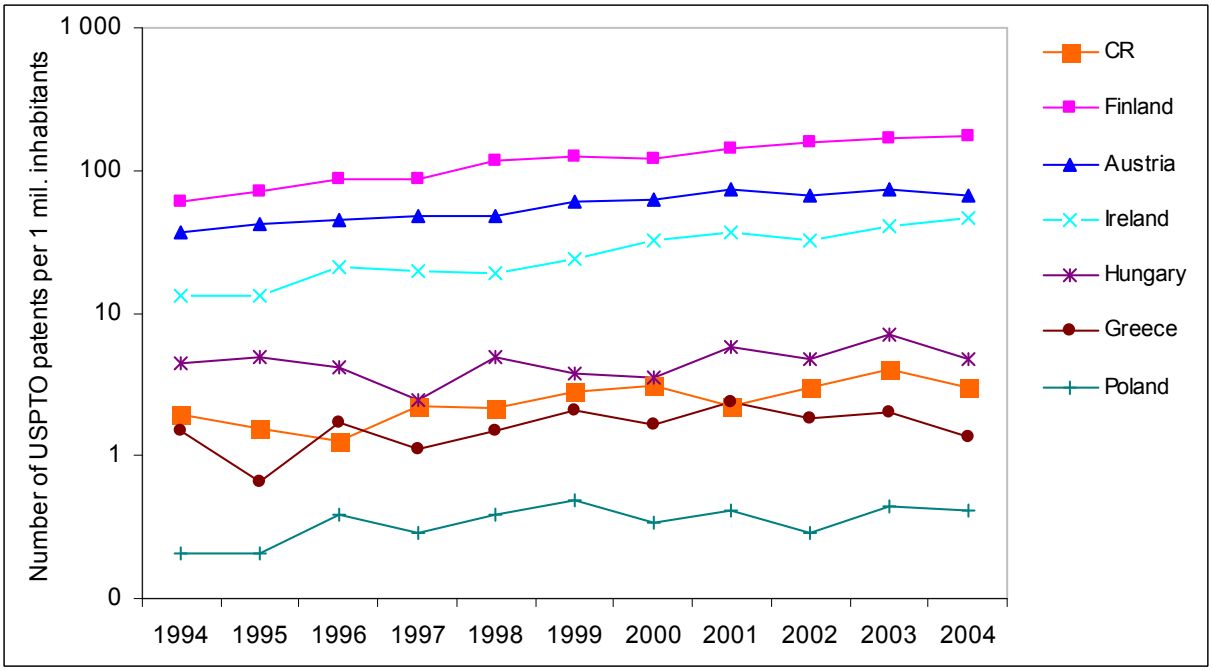
3.4.1.4 Patent activity – summary comparison

Dynamism in the growth of the number of patent applications at EPO from selected EU countries between 1994 and 2003



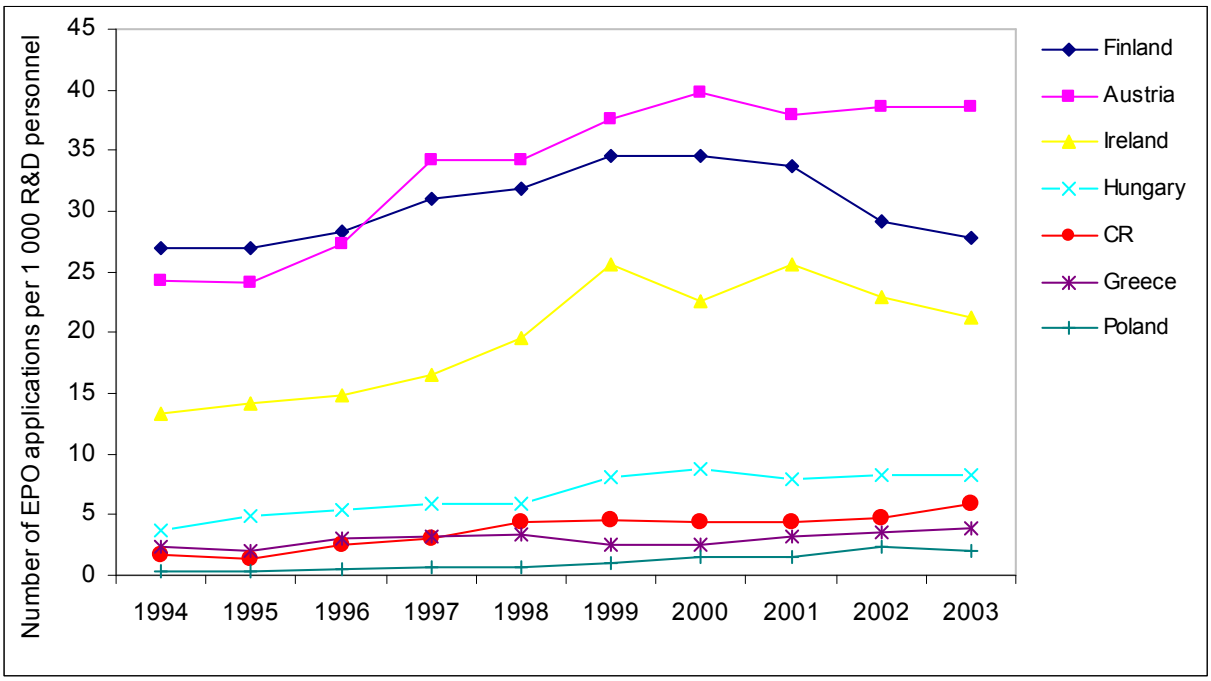
Source: Eurostat

Dynamism in the growth of the number of patents registered at USPTO from selected EU countries between 1994 and 2004



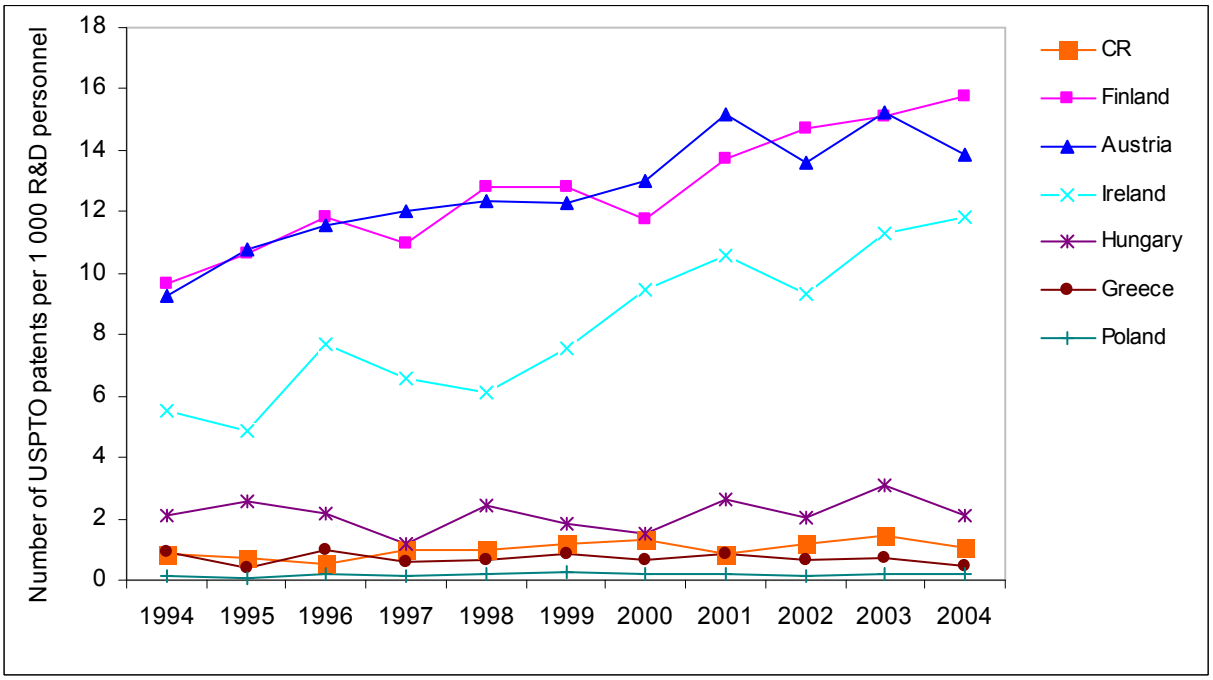
Source: USPTO

Number of patent applications to EPO from various EU countries between 1994 and 2003 after recalculating into R&D personnel



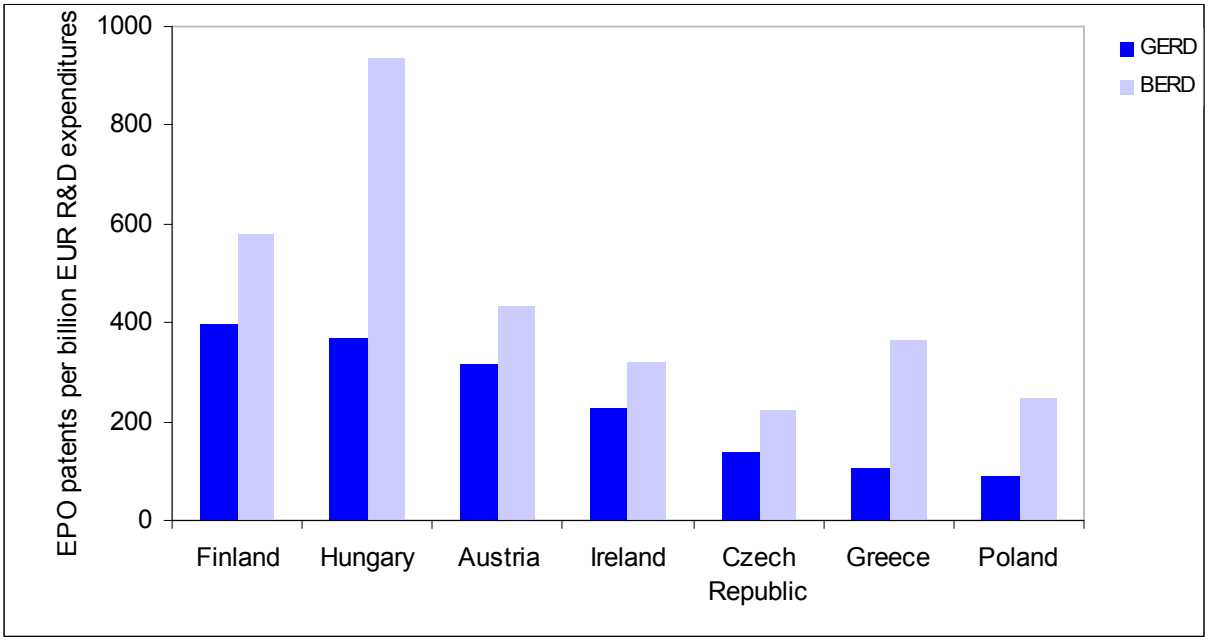
Source: Eurostat

Number of patents of selected EU countries registered by USPTO between 1994 and 2004 after recalculating into R&D personnel



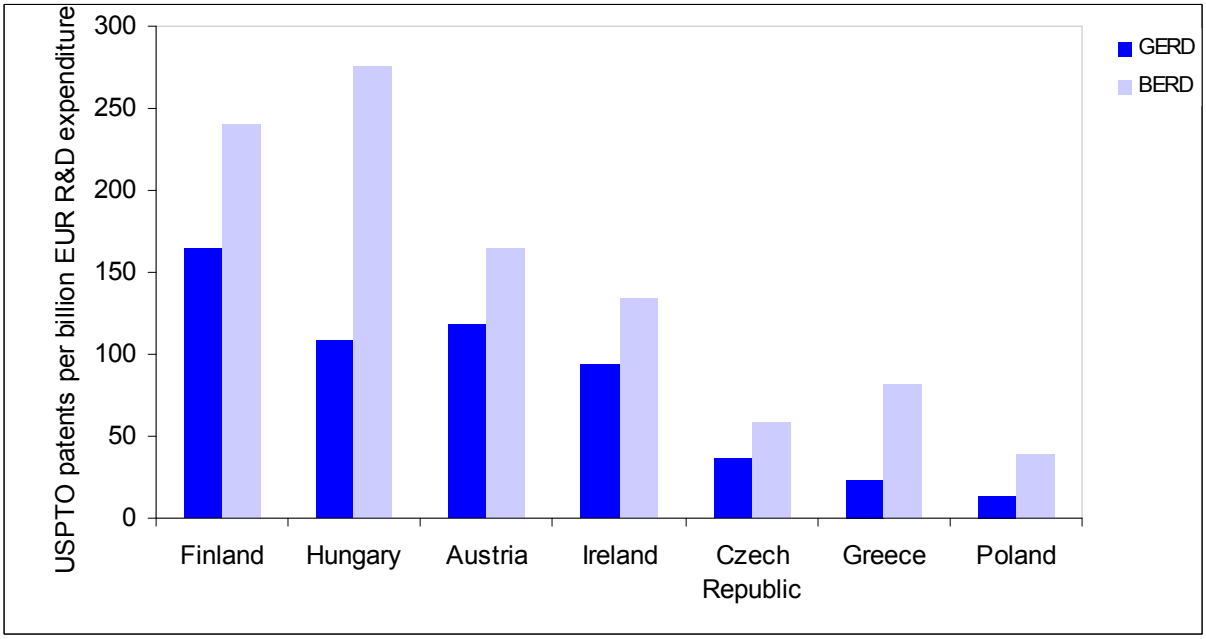
Source: USPTO

Number of EPO patents per 1 000 billion EUR of total support for R&D (GERD) and support from sources in the private sector (BERD) between 1994 and 2003



Source: EPO

Number of USPTO patents per billion EUR total support for R&D (GERD) and support from sources in the private sector (BERD) between 1994 and 2005.



Source: USPTO

Analysis, comments and other information:

- **The industrial property office (IPO) of the Czech Republic awarded a total of 3 913 patents between 1994 and 2005** to authors from the Czech Republic. IPO patents provide protection only on the less significant Czech market and therefore major patents are registered at the European Patent Office (EPO) or the United States Patent and Trademark Office (USPTO) or even the Japanese Patent Office.
- **Based on Eurostat data, 829 applications for patents from Czech authors were registered at EPO in the period between 1994 and 2003.** In the number of EPO applications per 1 million inhabitants, the Czech Republic was placed third from last among the 9 evaluated European countries, way behind Germany, Austria, Finland, Ireland and Belgium. The Czech Republic fell behind Hungary and only Greece and Poland registered less patent applications than the Czech Republic. Although the number of Czech patents has slowly increased, the rate of increase in other countries has been higher and therefore the Czech Republic is still lagging behind.
- **USPTO awarded a total of 222 patents to authors from the Czech Republic between 1994 and 2005** and another 84 patents to authors from Czechoslovakia. Czechoslovak patents were either awarded prior to the break up of the republic in 1993 or represent errors in the name of the country when filling in or preparing applications. When proportional part of these Czechoslovak patents (i.e. 2/3) is taken into account, USPTO awarded a total of 278 patents to authors from the Czech Republic. In the number of USPTO patents per 1 million inhabitants, the Czech Republic was placed seventh from the nine evaluated European countries ahead of Greece and Poland but behind Hungary, Ireland, Austria, Belgium, Germany and Finland.
- **The Czech Republic has a significantly lower number of R&D personnel in comparison with advanced EU countries**. The Czech Republic's position among the nine EU countries does not improve even per 1 000 R&D personnel. The Czech Republic was once again placed seventh, way behind Germany, Austria, Finland, Belgium and Ireland.
- **The poor results of Czech R&D in the area of patents are even more evident after recalculating into the amount of funding allocated**. The Czech Republic has the third lowest number of EPO and USPTO patents per 1 billion EUR in the total expenditure on R&D (GERD) after Greece and Poland.
- **From the OECD study (Compendium of Patent Statistics 2006) it follows that 89 % of all patents registered at EPO are from private businesses**. After recalculating the number of patents in business expenditure on R&D (BERD), the Czech Republic finished last in EPO patents and second to last in USPTO patents. If true that most patents are registered by businesses where their impetus and (at least partially) their funding originate, our findings indicate that the business sector in the Czech Republic has little interest in patents, does not allocate its funding to the generation of patents, and does not sufficiently motivate its R&D personnel to generate patents.

3.4.1.5 Patent activity in sectors

Percentage representation of applicants for EPO patents (1994-2004) based on sector of activity

	Private businesses	Government sector	University	Non-profit	Hospital	Other
Finland	90.7	0.1	0.3	1.4	0.0	7.6
Austria	78.7	0.1	0.3	0.3	0.0	20.6
Ireland	73.7	0.8	5.3	0.2	0.0	20.1
Czech Rep.	56.8	0.5	1.7	1.0	0.0	40.0
Hungary	49.6	0.3	0.8	0.9	0.1	48.3
Poland	36.3	0.7	4.2	5.6	0.2	53.0
Greece	35.0	1.5	1.7	2.5	0.2	58.9

Source Eurostat

Percentage representation of applicants for USPTO patents (1994-2002) based on sector of activity

	Private businesses	Government sector	University	Non-profit	Hospital	Other
Finland	92.0	0.1	0.5	0.9	0.0	6.4
Austria	81.7	2.6	0.2	0.5	0.0	14.9
Ireland	80.2	1.1	3.3	0.1	0.1	15.1
Czech Rep.	70.4	1.0	4.5	2.1	0.4	21.7
Hungary	68.1	0.8	2.2	1.0	0.0	27.8
Poland	48.7	3.6	14.8	5.2	1.5	26.2
Greece	48.1	3.7	1.9	4.8	0.0	41.5

Source Eurostat

Number of USPTO patents awarded to Czech authors classified based on applicant sector

Only major applicants that applied for at least 5 patents during the monitored period are included. For the period from 1971 to 1992 the values for the Czech Republic were calculated from data for Czechoslovakia, and also for the period after 1992 most Czechoslovak patents were recalculated for the Czech Republic. From the number of patents attributed to Czechoslovakia only 2/3 of patents registered by the Academy of Sciences and individual owners were recalculated for the Czech Republic and all Slovak businesses, departmental research institutes and universities were discarded.

	1971-75	1976-80	1981-85	1986-90	1991-95	1996-00	2001-05
Businesses	188	88	54	40	10	22	26
Departmental research institutes	125	75	41	10	1	0	0
AS CR	84	78	22	41	15	3	0
University	4	14	12	8	1	0	0
Atomic commission	0	4	1	0	0	0	0
Individual ownership	20	8	2	3	12	21	22
Major owners total	**421**	**267**	**132**	**102**	**39**	**46**	**48**

Source USPTO

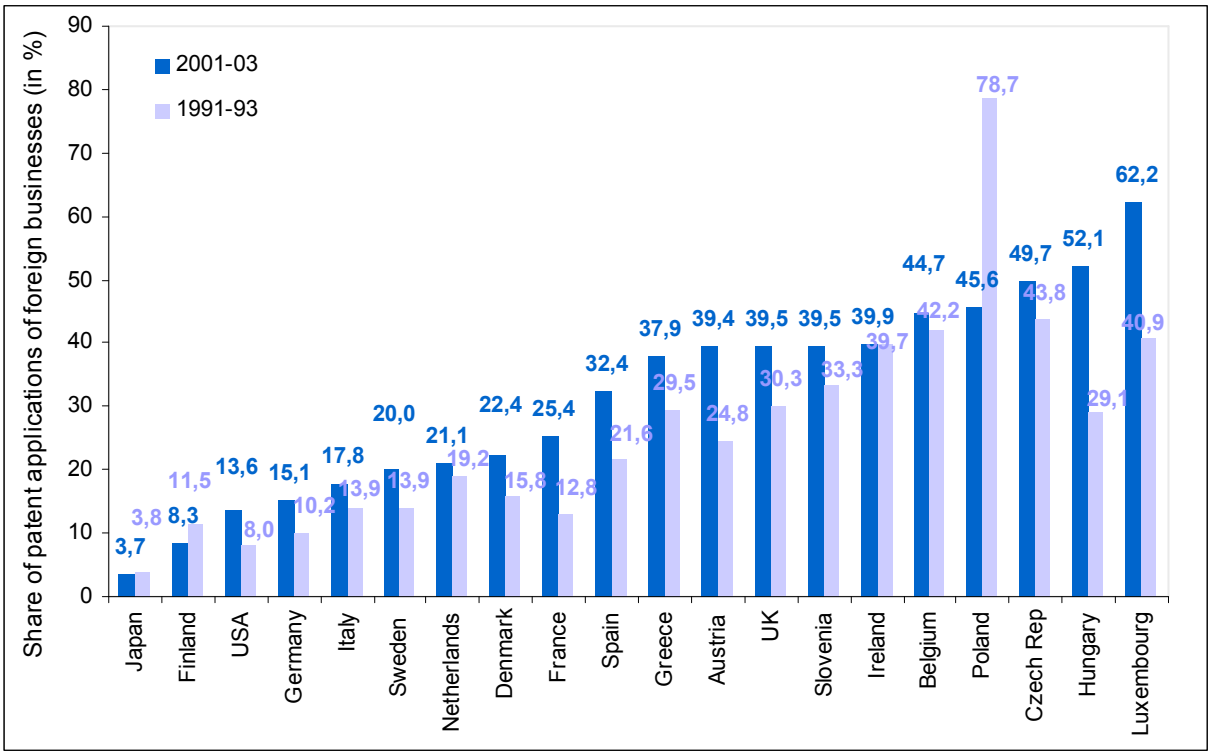
Foreign ownership of domestic patents and domestic ownership of foreign patents in selected EU countries between 1994 and 2003

Data is included as a percentage of all patents of domestic authors for the same period.

Country	Foreign ownership of domestic patents	Domestic ownership of foreign patents
Finland	9.4	20.9
Greece	33.5	8.8
Austria	35.5	24.5
Hungary	35.8	10.2
Ireland	39.2	43.7
Czech Rep.	41.9	14.1
Poland	43.3	15.6

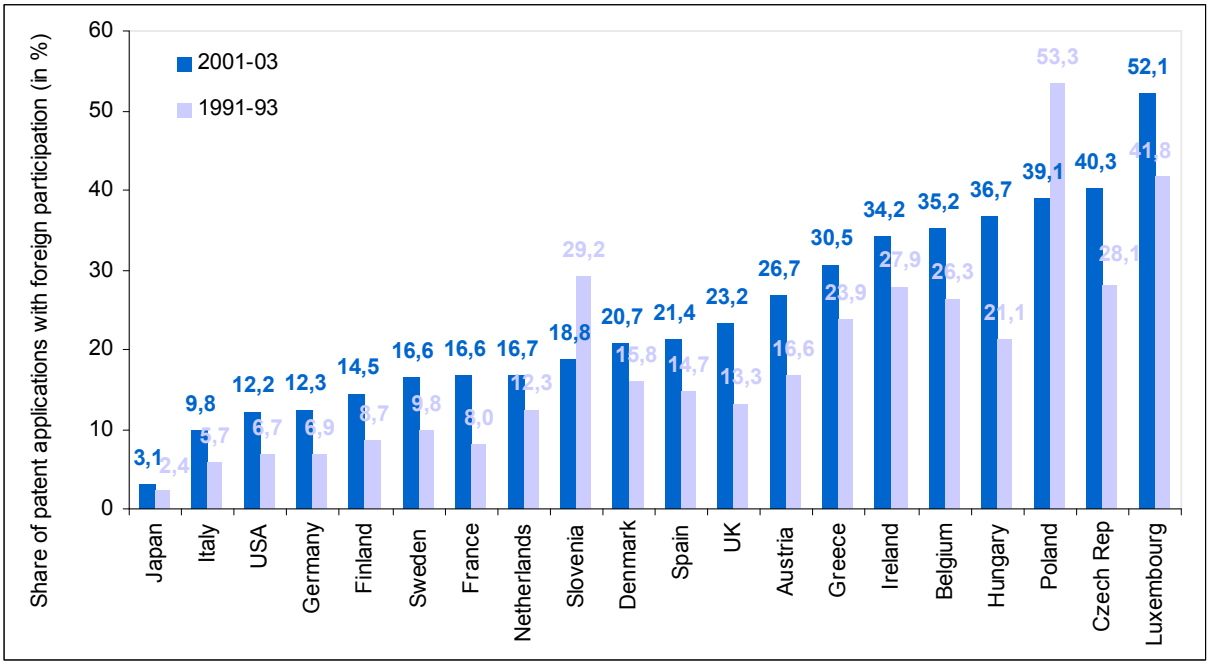
Source: Eurostat

Share of patent applications at the European Patent Office submitted by foreign businesses in the total number of patents in the given country



Source: OECD Science, Technology and Industry Scoreboard 2007

Share of patent applications at EPO, on which coauthors participated from abroad



Source: OECD Science, Technology and Industry Scoreboard 2007

Analysis, comments and other information:

- **Only 56 % of all Czech patent applications at EPO are registered (and owned) by private businesses**, which is significantly less than in advanced EU countries. In addition, the percentage of owners of USPTO patents in the Czech Republic represented by private businesses is less than in advanced EU countries. For Czech patents the percentage of owner being in the "other" category is more at both patent offices. Despite the fact that Eurostat does not include other details which would uncover what is hidden under the "other" category, it is probable that these are patents registered and owned by their authors. USPTO also includes the number of registered "individual patent owners" in the database of applicants in addition to the patents registered by individual businesses and this number corresponds with the numbers that Eurostat mentions in the group "other". The finding that Czech businesses own a relatively low share of Czech patents and on the contrary the relatively high share in the ownership of individual inventers clearly shows the lack of interest of Czech businesses in patents. In addition, a relatively high share of patents from Czech inventers is owned by foreign businesses. Belgium and Ireland have a relatively high share of patents from domestic inventors in the ownership of foreign businesses but local businesses own more than twice the share of foreign patents than in the Czech Republic. In general, Czech businesses show little interest in patents originating in the Czech Republic or aboard.
- **A closer look at the table of significant applicants of patents at USPTO shows several reasons for the drop in the number of Czech patents**. After 1990, patents registered by departmental institutes disappeared as these institutes were either cancelled or sold off. Patents registered by AS CR disappeared after 1995, which corresponds with the disestablishment of several academic institutes and the changes in the system of evaluation of workplaces when the main emphasis was placed on publications in impact journals. After 1990 the number of patents registered by businesses and universities decreased. Only the number of patents registered by individual owners (e.g. authors of the patents) increased. It should be taken into consideration that the number of patents registered by all significant owners (with the exception of individual owners) has decreased continuously since 1975 although this decrease heightened after 1990. This finding correlates with the overall decrease in the number of USPTO patents from authors from the Czech Republic.
- The importance of branches of foreign businesses in commercial R&D in the Czech Republic is clear from the share of patent applications at EPO submitted by branches of foreign businesses in the total number of patents (49.7 % between 2001 and 2003). **The Czech Republic together with Hungary (52.1 %) and Luxemburg (62.2 %) has the highest share of foreign businesses in the number of patents.** The lowest share of patent applications submitted by foreign businesses is in countries with strong domestic businesses active in the area of R&D – in Japan (3.7 %) and USA (13.6 %).
- During the 1990s the share of patent applications at EPO on which co-authors from abroad contributed increased in almost all of the monitored countries. The highest share was recorded in countries in which foreign businesses invested the most commercial R&D and were awarded the most patents. This shows that patents in which co-authors from abroad have contributed were awarded to foreign businesses active in the given country. The leaders of research teams in these businesses are often personnel from branches of businesses from other country.

3.4.1.6 Patent activity in science disciplines

Number of applications at EPO per 1 million inhabitants in seven EU countries based on science discipline. Data includes applications from 1994 and 2003.

Discipline	Rank of Czech Republic	Czech Republic	Poland	Greece	Hungary	Ireland	Austria	Finland
Ecology and the environment	4	2.5	0.5	1.8	2.3	4.9	18	20.5
Material science	4	11.8	1.8	5.8	6.1	34.4	191.6	271.4
Physics	5	3.6	1.1	2.2	4.5	32.4	59.2	128.7
Chemistry	5	5.7	1.6	3.5	12.4	21.7	77.9	188.6
Earth science	5	0.2	0.1	0.1	0.6	1	5.8	10.8
Molecular biology and genetics	5	2.4	0.6	1.5	6.3	14.1	23.6	28.8
Engineering	5	44.5	11.3	29.3	53.3	237.7	794.8	857.1
Pharmacology and pharmacy	5	6.1	1.5	5.6	18.6	58.7	58.6	72.2
Microbiology	5	1.1	0.3	1.1	1.9	10.2	15.9	20.1
Agricultural science	6	2	0.8	3.5	4.9	19.7	23.4	49
Clinical medicine	6	3.9	0.9	5	9.8	51	43.1	55.4
Computer science	6	4	1.4	7.1	19.1	115.2	115.9	997.2
Plant and animal science	6	1.3	0.4	2.2	3.9	19.5	17.7	27.8

Source: Eurostat

Number of patents awarded by the USPTO per 1 million inhabitants in seven EU countries based on science discipline. Data includes applications from 1994 and 2002.

Discipline	Rank of Czech Republic	Czech Republic	Poland	Greece	Hungary	Ireland	Austria	Finland
Ecology and the environment	4	0.3	0	0.3	0.2	1.7	2.2	6.2
Material science	4	2.4	0.2	1.6	1.5	13.9	76.9	110.3
Physics	5	1.4	0.3	0.4	1.5	18.9	22.3	61.7
Chemistry	5	1.4	0.3	0.7	3.1	6.8	25.5	71.3
Molecular biology and genetics	5	0.6	0.1	0.3	1.8	2.8	7.5	9.4
Microbiology	5	0.3	0	0.2	0.8	1.7	4.6	6
Engineering	5	10.2	1.5	5.1	12.9	113.7	253.4	352.3
Pharmacology and pharmacy	5	2.1	0.5	1.6	5.8	18.5	21	33.7
Computer science	5	1.9	0.2	1	2.6	50	33.2	308.9
Plant and animal science	5	0.5	0.2	0.4	1.2	7	6.2	10.3
Agricultural science	6	0.2	0.1	0.3	0.5	7.3	6.6	14
Clinical medicine	6	1.4	0.3	1.5	3.6	16.3	16.1	26.6
Earth science	6	0	0.1	0	0.1	0.2	1.9	3.2

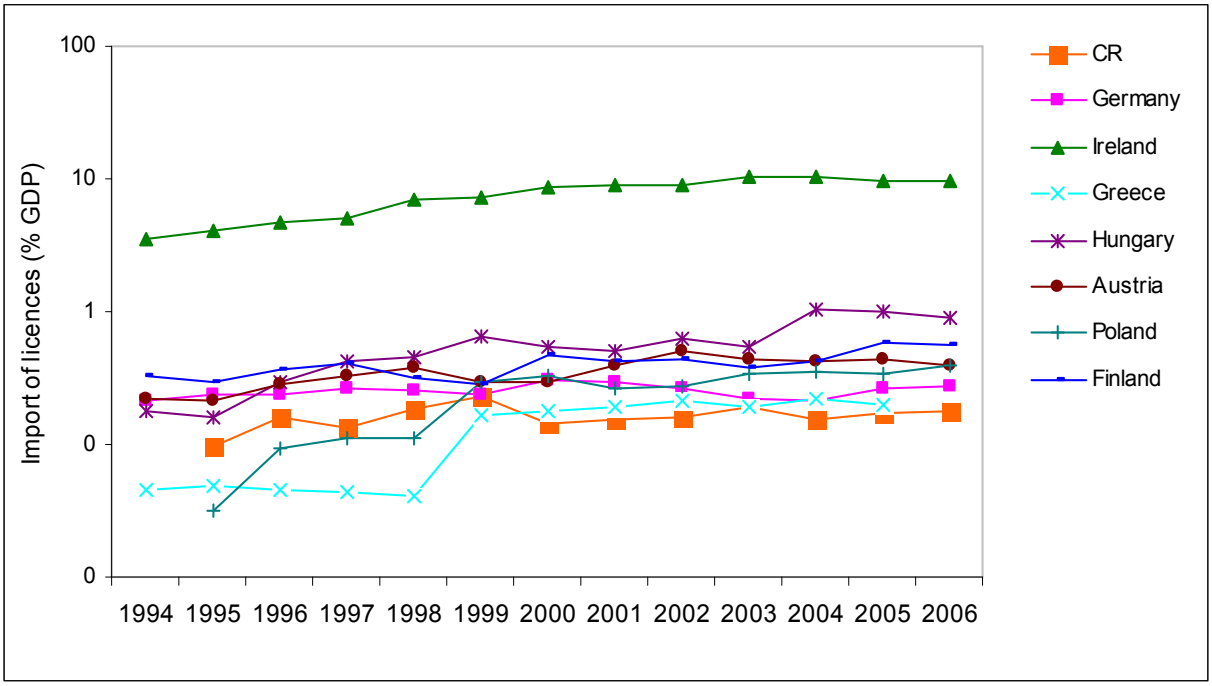
Source: Eurostat

Analysis, comments and other information:

- **After a detailed analysis of the number of patent applications at EPO in the main sections of international patent classification** (IPC), the Czech Republic finished third from last in four sections and last but one in two sections. The Czech Republic was placed fourth ahead of Hungary, Greece and Poland in section B (performing operations, transport) and in section D (textiles, Paper) the Czech Republic overtook even Ireland to end up in third place.
- **In order to compare the contribution of various scientific subjects for practical utilization**, we attempted to classify the patents based on the main subject fields from which the authors of the patents have taken their knowledge and inspiration. In cases where in our opinion knowledge was used from more than one scientific subject, we have only taken into account the proportionate part of all of these subjects. The highest number of Czech patents at both patent offices was in engineering, material science, pharmaceutical subjects and chemistry, and also computer science in the case of USPTO. Other countries also have the highest number patents in most of these subjects.
- **Comparing the number of Czech patent applications at EPO with selected European countries**, in most of these subjects the Czech Republic was placed either in fifth or last but one sixth position. The Czech Republic was placed in fourth place from the seven countries only in patents from environmental subjects and material sciences. The Czech Republic overtook Poland, Greece and Hungary in these subjects at both patent offices (EPO and USPTO). The number of Czech patents in these subjects, however, was significantly lower than Austrian, Finish or Irish patents. Nevertheless, it is clear that knowledge of research in these two subjects is used in the Czech Republic more often and more effectively in practice than in other subject.

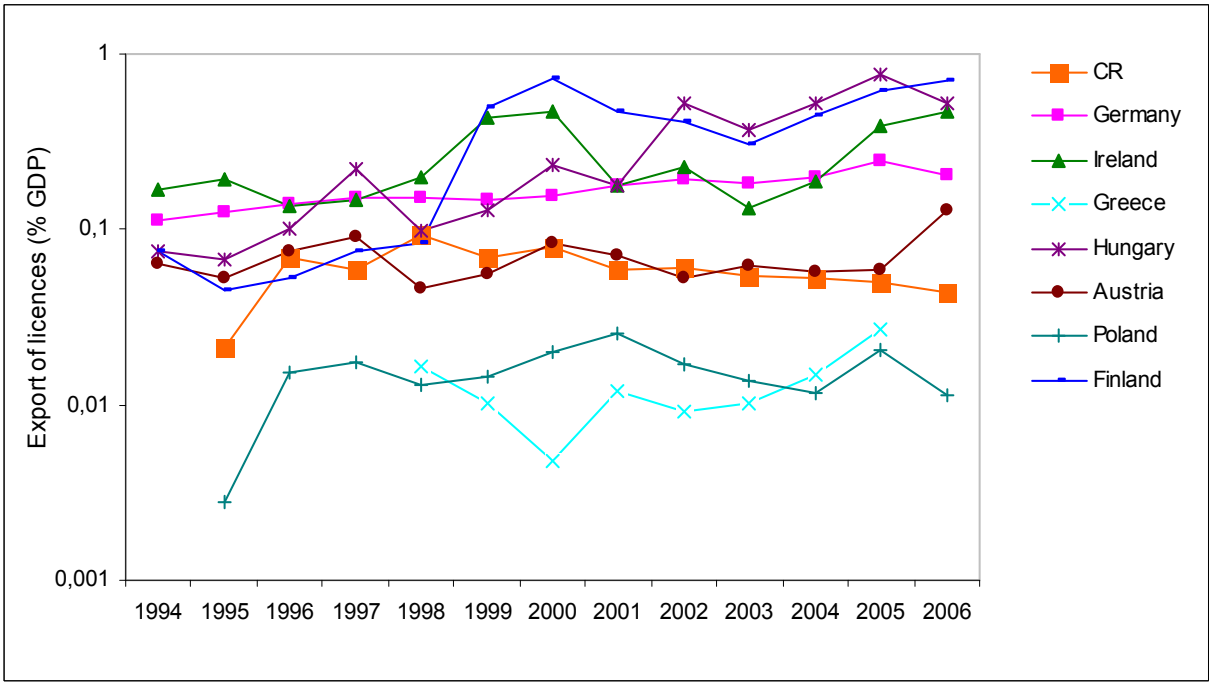
3.4.1.7 Utilization of the results of R&D

Payment for the purchase of licenses from abroad in selected EU countries between 1994 and 2006



Source: Eurostat

Payment for the sale of licenses abroad for selected EU countries between 1994 and 2006



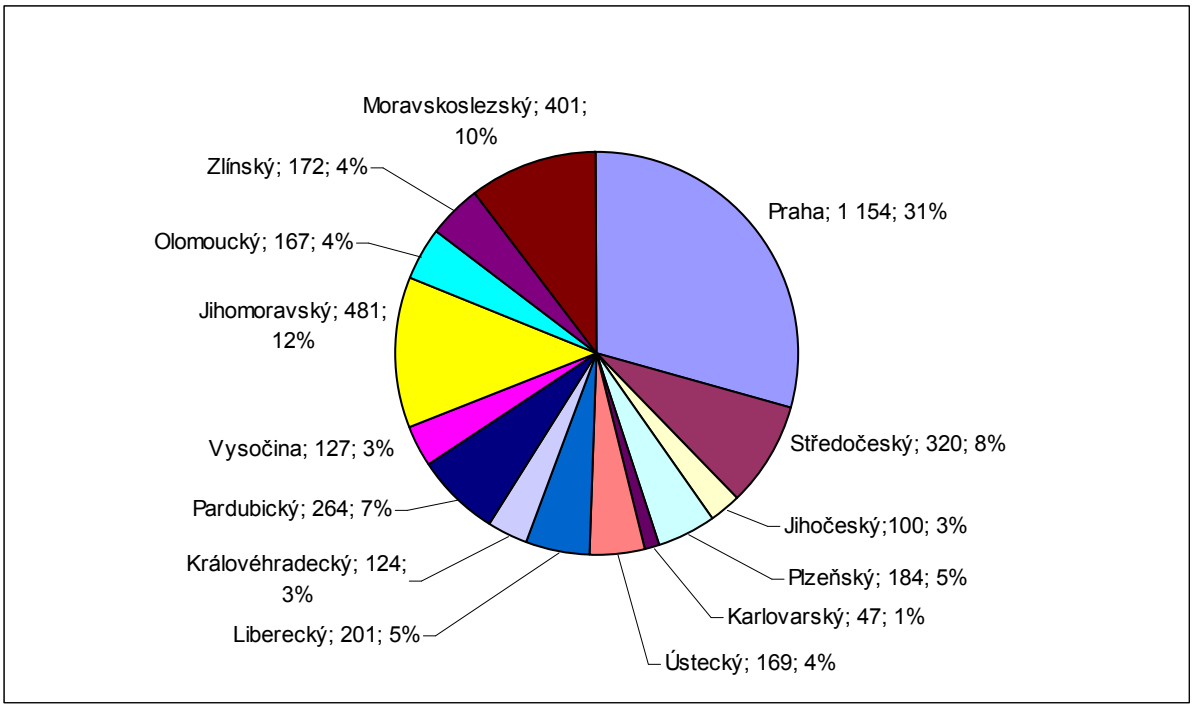
Source: Eurostat

Analysis, comments and other information:

- **Payments of Czech subjects for the purchase of licenses and trademarks** from abroad have increased year-on-year and since 1996 payments in EUR have nearly doubled. Expressed as a percentage of GDP the value of purchased licenses has been unchanged since 1996 and has stagnated at approx. 0.16 % GDP. Revenue from the export of licenses has also stagnated since 1996 at around 0.055 % GDP. Payments abroad for licenses purchased exceeded the revenue for the sale of licenses abroad by more than 2.5 times. Czech businesses purchase the results of R&D for their innovation from abroad (e.g. license for patents, trademarks and know-how) because they cannot be obtained from domestic R&D.
- **The import of licenses by Czech businesses** in comparison with the other eight EU countries was the second lowest after Greece. There is a huge difference not only in comparison with Ireland, which did not fit the scale of the graph and also neighbouring Hungary. Czech businesses clearly have no need for the results of either foreign or domestic R&D.
- **In the sale of licenses** the Czech Republic is placed seventh among the nine selected EU countries, way behind Finland, Belgium, Germany, Hungary and Ireland, with only Poland and Greece being in a worse position. This is further proof of the low performance of Czech R&D in the area of protecting the results of intellectual property.
- **These findings show that Czech businesses have little interest in patents**. It is possible that development of a patent until to final product represents too large a risk for financially weak Czech businesses, or that after the disappearance of departmental research workplaces they do not have sufficient knowledge for this process. The expenditure of the private sector on R&D has increased over the past few years in the Czech Republic, in the light of the previous analysis it is not clear which outputs this expenditure is focused on.

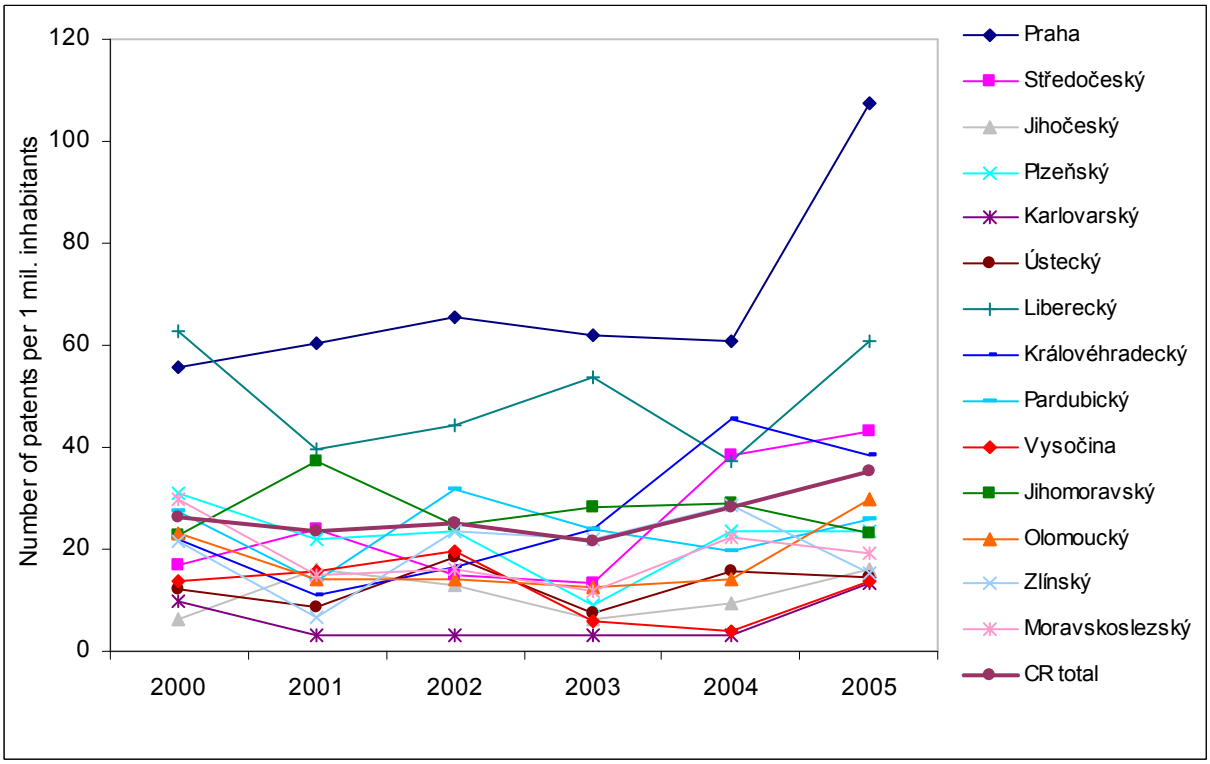
3.4.1.8 Outputs of R&D in regions

Number of patents awarded by the IPO between 1994 and 2005 based on Czech regions



Source: CSO, our own calculations

Number of patents awarded by the IPO per 1 million inhabitants in Czech regions between 2000 and 2005



Source: CSO, our own calculations

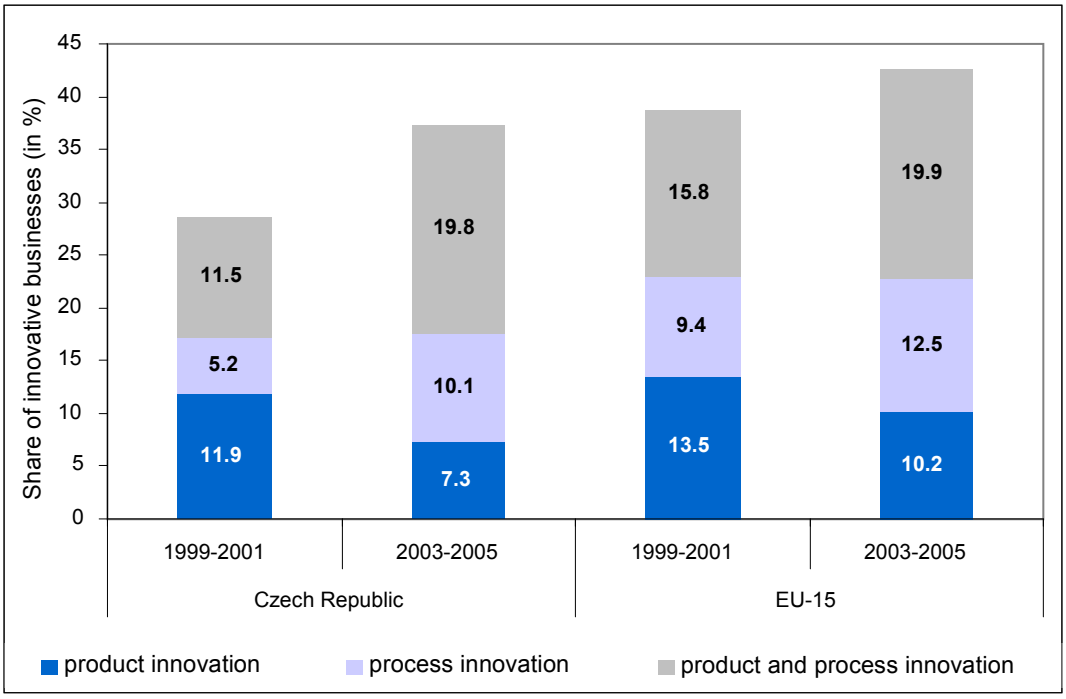
Analysis, comments and other information:

- The region of Praha has the highest **share in the total number patents from applicants from the Czech Republic awarded by the Industrial Property Office (IPO)** between 1994 and 2005, followed by Jihomoravský and Středočeský regions, (they have a large share in R&D capacity in the Czech Republic due to their population and economic significance), and the Moravskoslezský region where the size and strong industrial basis of the region contribute more to the high number of patents than the size if its research capacity. More than 60 % of all patents awarded by the IPO were awarded in the four mentioned regions.
- From the point of view of the **number of patents awarded per 1 million inhabitants,** Praha has a marked head start on the other regions, from which the second placed Liberecký region also maintains its distance – mainly due to the high number of patents awarded in Section B (performing operations, transport). The lowest number patents awarded per million inhabitants between 2000 and 2005 were in regions with a weak research basis (low number of R&D personnel and low expenditure on R&D) – Karlovarský, Ústecký and Vysočina, and also region of Jihočeský, in which are located two departments of AS CR (this is understandably due to their specialization in biological science and weak linkage to industry).

3.4.2 Innovation in businesses

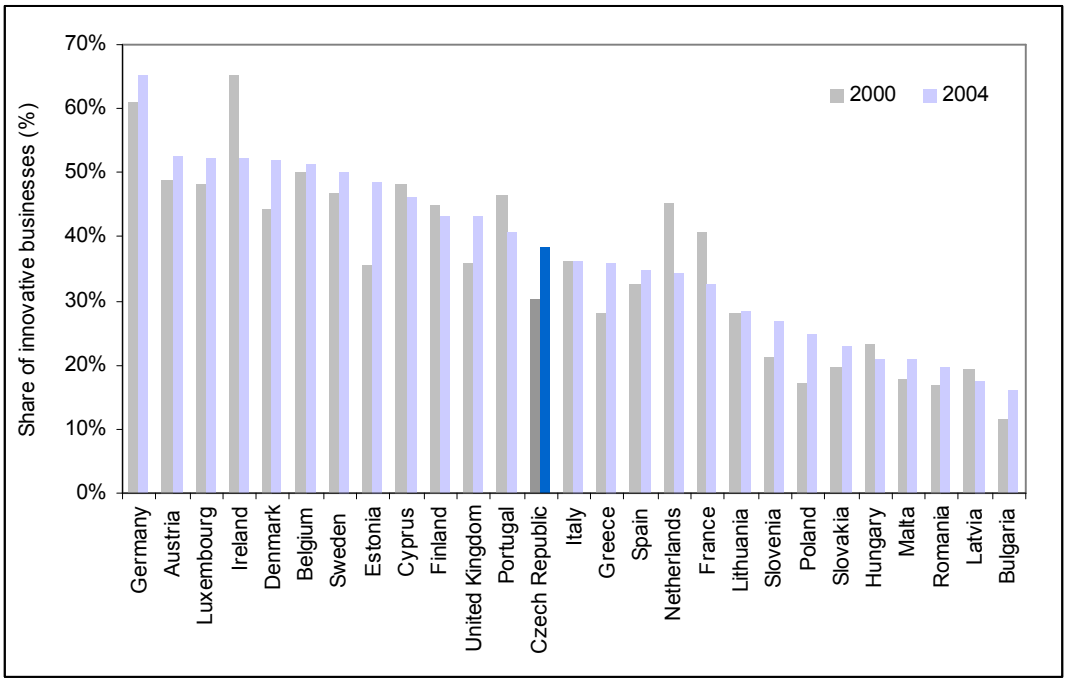
3.4.2.1 Innovative and non-innovative businesses

Share of businesses with product and/or process innovation



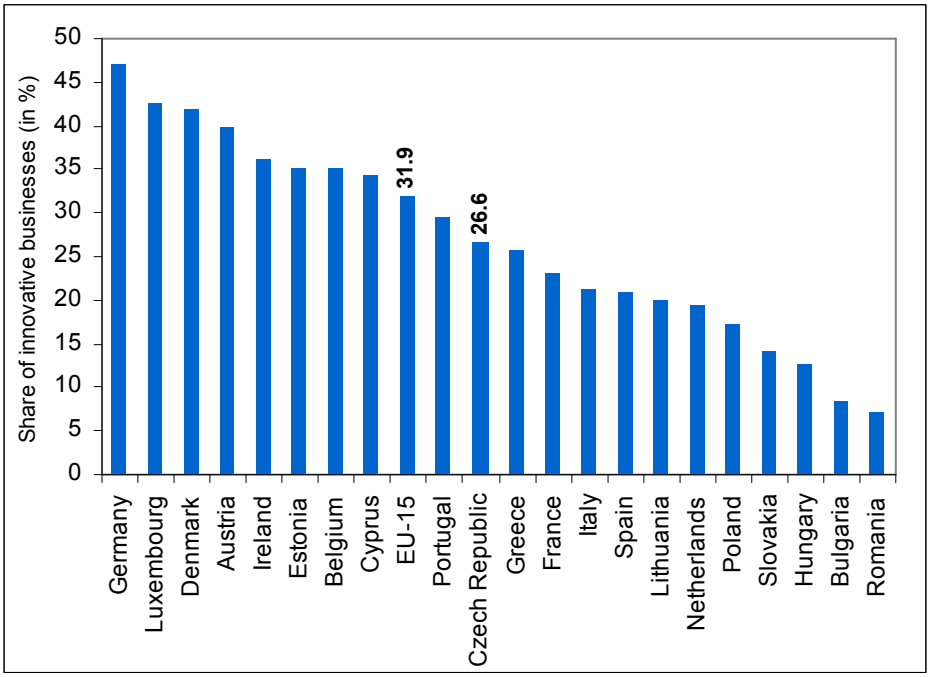
Source: Eurostat – CIS 4

Share of innovative businesses in the total number of businesses in European countries in 2000 and 2004



Source: Eurostat, - CIS 3 and CIS 4

Share of businesses with organizational and/or marketing innovation between 2003 and 2005



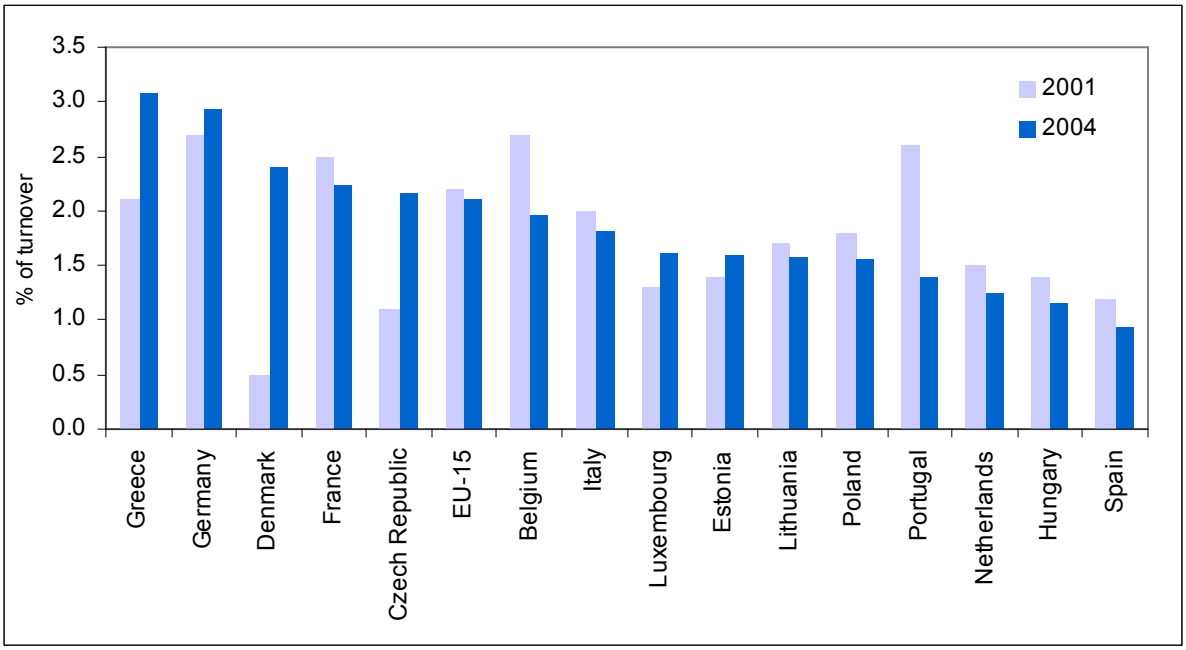
Source: Eurostat – CIS 4

Analysis, comments and other information:

- Even if the **share of innovative businesses** in the Czech Republic is increasing, it is still under the EU-15 average. From the point of view of share of technically innovative businesses, i.e. businesses that implement innovative products or processes, the relative position of the Czech Republic is worse than in the case of businesses implementing organizational or marketing innovation. Between 2003 and 2005 the share of technically innovative businesses in the Czech Republic was 37.2 %, whereas in EU-15 this share was 43.6 %. Compared with other EU-27 countries, the Czech Republic finished in 13th place which from the new member states is ahead of Estonia and Cyprus.
- **The development in the share of technically innovative businesses** in the Czech Republic shows that innovation in Czech businesses has begun to play a more important role. In contrast to the period between 1999 and 2001, when the share of technically innovative businesses was 28.5 %, there has been an increase of almost 9 percentage points. A significant impact on this development can be seen in the inflow of foreign direct investment to manufacturing industry, through which there was a diffusion of new technology and an innovative approach of businesses in the Czech Republic. This is reflected in the significant increase in technically innovative businesses in manufacturing industry, where this share increased from 29.9 % between 1999 and 2001 to 40.9 % between 2003 and 2005.
- In businesses with innovative products or processes it is possible to see a shift in the structure of innovation activities. Whereas the share of businesses with innovative products (11.9 %) prevailed between 1999 and 2001, between 2003 and 2005 the share of businesses implementing innovative products together with innovative processes (19.8 %) prevailed. In addition, there was a general increase in the significance of **implementing innovative processes in businesses**. The change of the structure of innovative businesses based on type of innovation implemented can be seen both in manufacturing industry and in the service sector.
- Between 2003 and 2005 **innovation in the fields of organization or marketing** was implemented in 26.6 % of all businesses, which was approx. 5% less than in the EU-15. From the point of view of this "non-technical" innovation, businesses that implemented organizational innovation (24.1 %) prevailed above businesses that implemented marketing innovation (14.9 %). This structure corresponds to the European average. More emphasis on marketing innovation was recorded in the service sector which corresponds to the nature of the services and their narrower orientation towards the end customer. The increase in the significance of organizational and marketing innovation reflects the increase in quality of statistical data on this type of innovation activity.

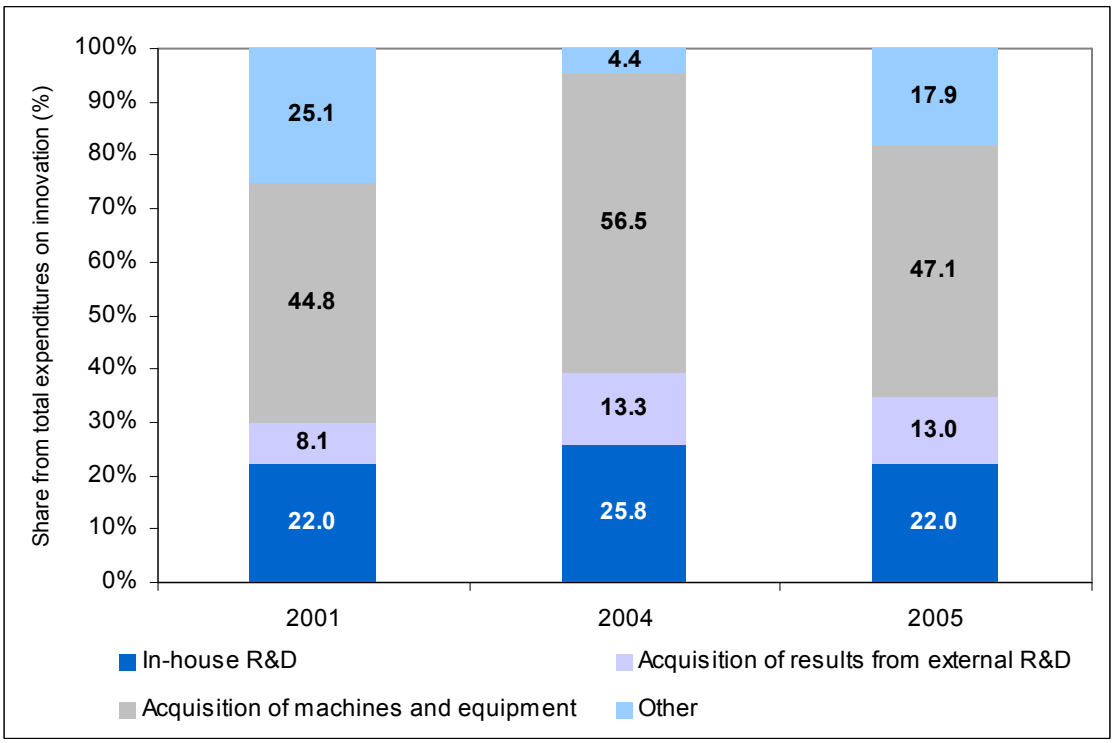
3.4.2.2 Expenditures on innovation

Intensity of innovation (share of expenditures on innovation on the total turnover of innovative businesses)



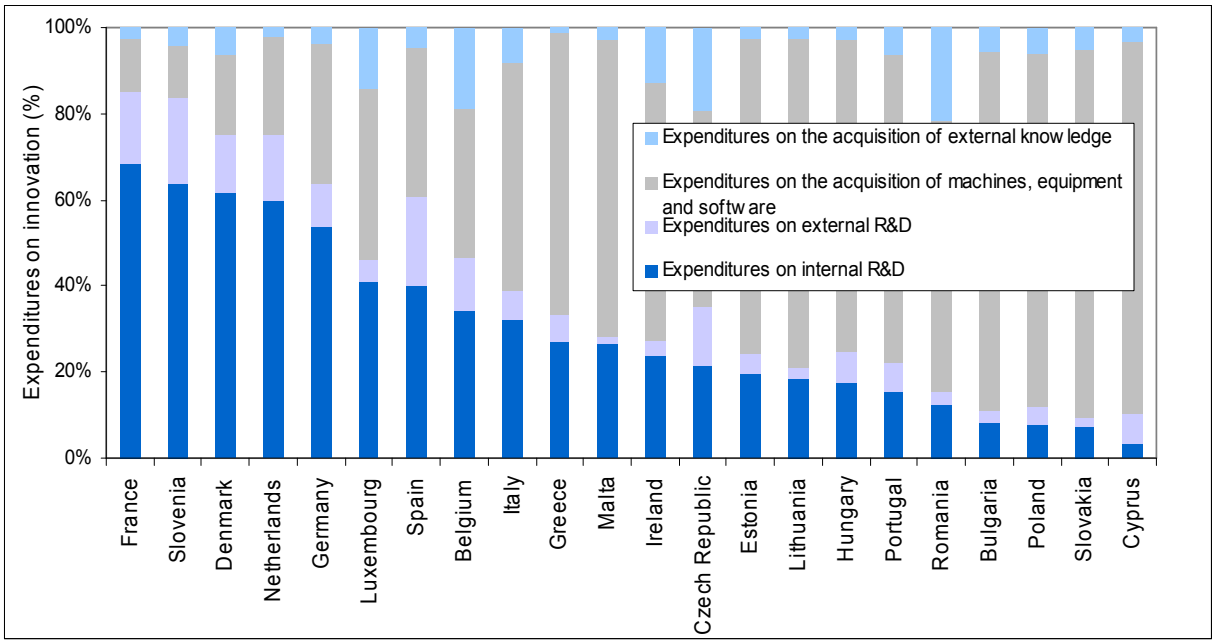
Source: Eurostat – CIS 4

Structure of expenditures on innovation in the Czech Republic between 2001, 2004 and 2005



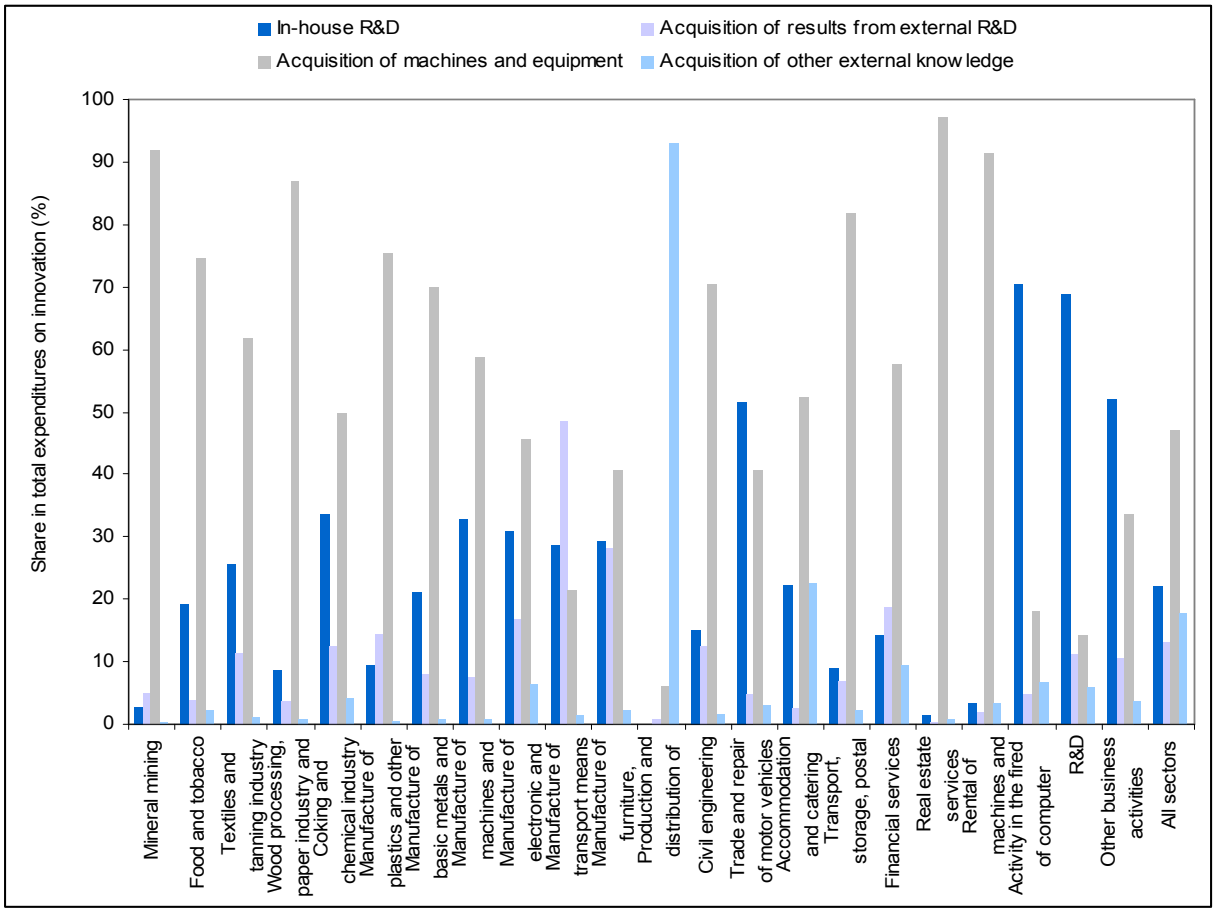
Source: CSO – Technical innovation in the Czech Republic 1999 – 2001, Innovation in the Czech Republic 2005

Expenditures on innovation in selected European countries in 2004 – distribution based on type of expenditures



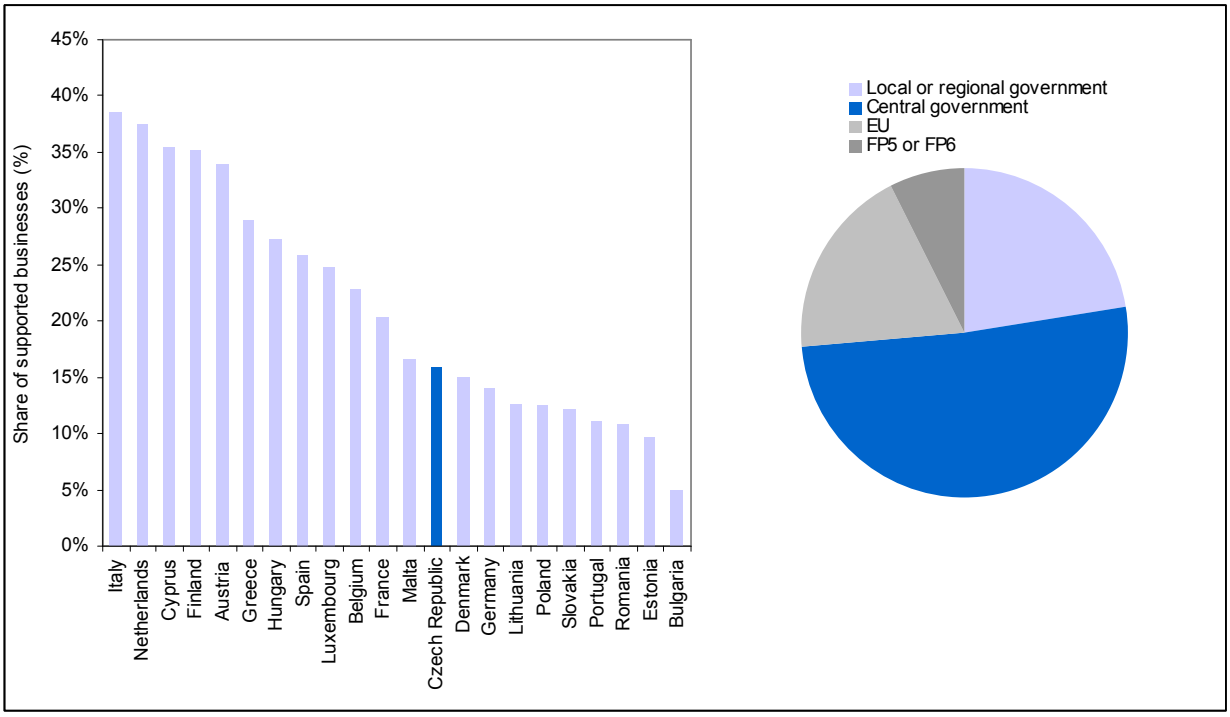
Source: Eurostat - CIS 4

Distribution of expenditures on innovation based on sectors in 2005 (share of expenditures on individual innovation activities)



Source: CSO, Research CIS 4

Share of businesses with innovation activity which in 2004 obtained public support in individual European countries and distribution of support based on their sources in the Czech Republic



Source: Eurostat - CIS 4

Analysis, comments and other information:

- The significance of innovation activity in businesses to a certain degree corresponds to **the amount of expenditures on innovation**, and the pattern innovation activity can be assessed by the **structure of this expenditures**. From the point of view of the share of total expenditures on innovation in the turnover of innovative businesses (intensity of innovation) the Czech Republic is above the EU-15 average. The intensity of innovation in the Czech Republic has significantly increased since 2001, when it reached 1.1 %, and in 2004 it was as high as 2.2 %. The latest information from 2005 shows that the intensity of innovation in the Czech Republic is increasing by more than 3 %.
- **An increase in the intensity of innovation** shows that Czech businesses have begun to appreciate the significance of innovation for maintaining competitiveness and have increased the volume of investment into innovation activity. A significant influence can also be attributed to foreign investment made in the Czech Republic, which creates the conditions for the investment of Czech businesses into innovation.
- **In manufacturing industry** businesses invested more than 60 billion CZK into innovation in 2005, which corresponds to an average of 11.9 mil. CZK per innovative business. On the other hand, **in the service sector** businesses invested nearly 33 billion CZK into innovation activity, i.e. an average of 7.3 mil. CZK per innovative business. We can assume from this that innovation activity in the service sector is on average less costly than innovation activity in manufacturing industry. This fact is supported when comparing the intensity of innovation in the service sector (2.4%) and in manufacturing industry (3.4%) in the Czech Republic in 2005.
- A look at the structure of expenditures on innovation shows that the main share of expenditures is placed on the **purchase of machines and equipment** (47.1 % in 2005). In contrast, 22 % of total expenditures on innovation were invested into in-house R&D activity in the same year. The structure indicates that the innovation process of the Czech businesses is generally characterized by the transfer of knowledge through the purchase of machines and equipment. In relation to the inflow of foreign investment we can conclude that the transfer takes place in a line from the foreign mother companies to subsidiary (or daughter) companies located in the Czech Republic. The innovation process of Czech businesses has the character of taking-over advanced technologies, processes and other methods connected with production.
- From the point of view of **development in the structure of expenditures on innovation** there were no dramatic changes between 2001 and 2005. Despite the stagnation in the share of expenditures on in-house R&D it is possible to see an increase in share of expenditures on the acquirement of results of external R&D (connected to the increased significance of the transfer of technology in the innovation process of Czech businesses) and an increase in the share of expenditures on the purchase of machines and equipment.
- In 2004, approx. 16 % of innovative businesses obtained public support. This is significantly less than in several EU-15 countries and new member states (e.g. almost 27 % of innovative businesses were supported in Hungary). If we take into consideration that the share of innovative businesses in the Czech Republic is lower

than in advanced innovative countries, the public support of the innovation activity of Czech businesses is still insufficient. Most businesses obtained support from government or regional resources and on the contrary businesses were least involved in framework programmes of the EU. From the statistical data it follows that both high-tech businesses and businesses active in medium-tech and low-tech sectors were supported.

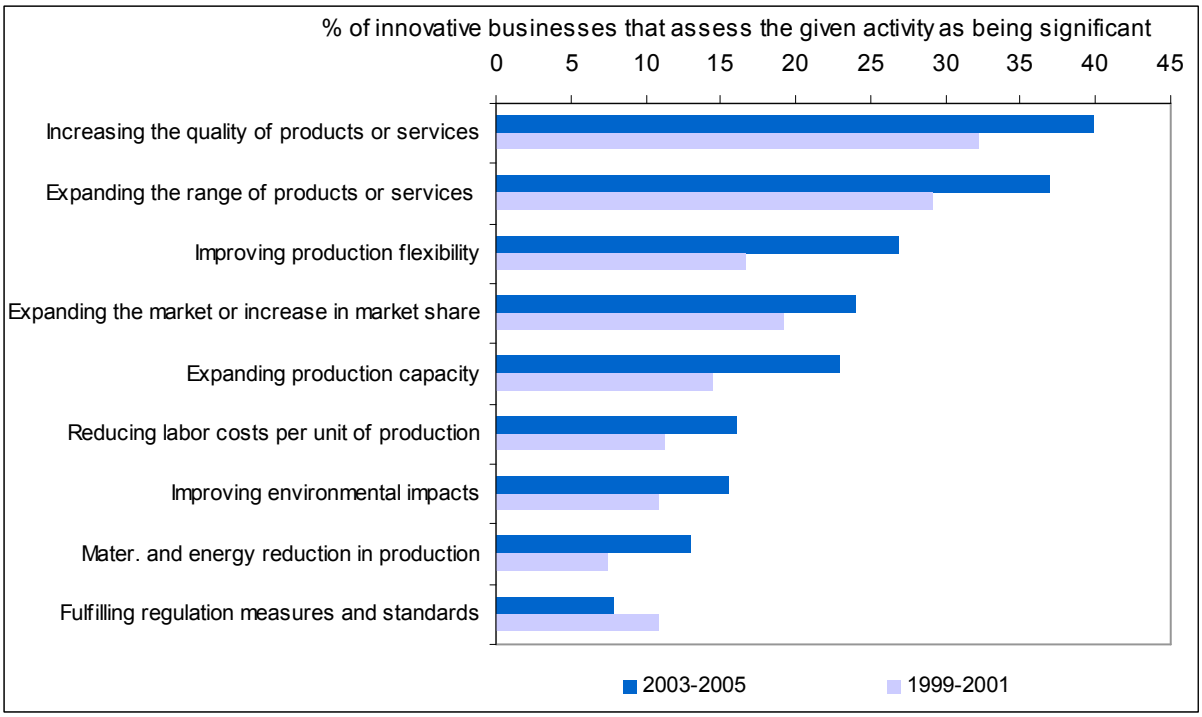
3.4.2.3 Outputs of innovation activities

Share of turnover from innovation new to the market and new to businesses

	Share of turnover from innovation new to the market		Share of turnover from innovation new to businesses	
	2001	**2004**	**2001**	**2004**
EU-15	5.9	5.9	17.1	6.5
Belgium	5.1	4.8	13.9	8.2
Bulgaria	–	8.5	–	4.1
CR	**7.2**	**7.7**	**7.3**	**7.8**
Denmark	6.6	5.2	13.5	5.8
Estonia	4.5	4.4	5.4	7.6
Finland	14.5	9.7	17.5	5.1
France	5.7	6.2	11.7	5.6
Ireland	–	5.6	–	4.5
Italy	9.5	6.3	16.1	5.6
Cyprus	–	1.9	–	3.7
Lithuania	4.3	4.4	10.6	5.3
Latvia	–	3.5	–	1.6
Luxemburg	2.1	6.4	7.3	9.1
Hungary	1.4	4.2	4.9	2.5
Malta	–	13.6	–	8.7
Germany	6.2	7.5	23.4	10.0
Netherlands	5.6	4.0	12.1	4.3
Poland	–	8.1	–	5.4
Portugal	10.8	4.4	15.1	5.6
Austria	4.6	5.2	13.2	5.4
Romania	–	7.1	–	9.5
Greece	2.9	4.8	8.9	6.2
Slovakia	6.6	12.8	6.2	6.4
Slovenia	5.3	7.4	4.9	6.9
Spain	8.3	3.8	17.0	10.0
Sweden	–	8.3	–	5.1
United Kingdom	1.9	6.4	15.1	7.6

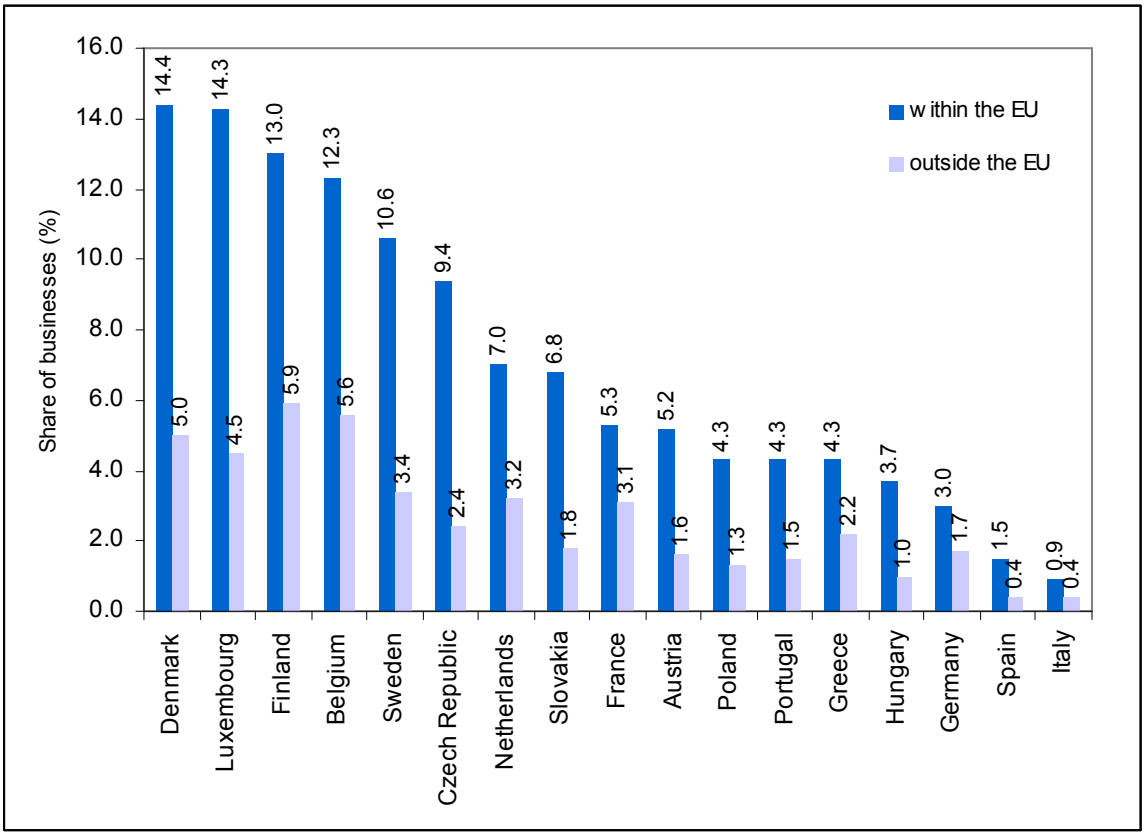
Source: Eurostat – CIS 4, our own calculations

Significance of the outputs of innovation activities in technical innovative businesses in the Czech Republic



Source: CSO – Technical innovation in the Czech Republic 1999 – 2001, Innovation in the Czech Republic 2005

Share of businesses involved in international cooperation in the area of innovation in 2005



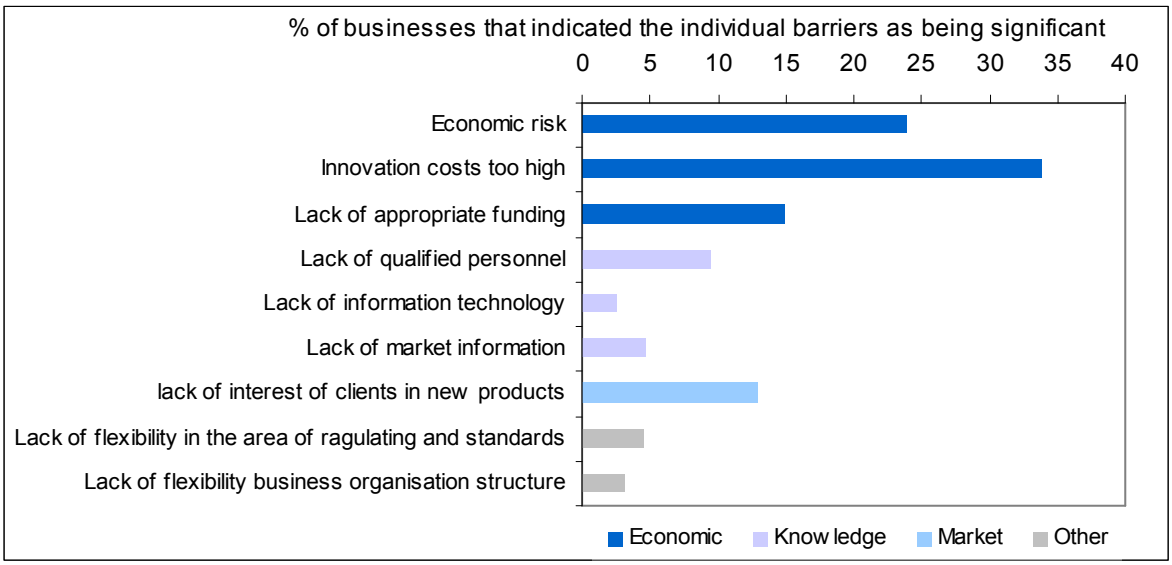
Source: OECD Science, Technology and Industry Scoreboard 2007

Analysis, comments and other information:

- Information on the share of the turnover from innovation in the total turnover of innovative businesses can reflect the significance of innovation for businesses from the point of view of the results of innovation activity. Between 2001 and 2004 there was an increase in the **share of turnover from innovative products** in the total turnover of innovative businesses in the Czech Republic, which provides proof of the growth in the significance of innovation in the business sector in the Czech Republic.
- From the point of view of structure of the total **turnover from innovative products,** the share of the **turnover from innovation new to business** (7.8 % in 2004) is almost the same as the share from **innovation new to the market** (7.7 % in 2004).
- In an **international comparison,** the Czech Republic had a higher share of turnover from innovative products than the EU-15 average. These results were attained however in most new member states of the EU-27 because this indicator does not take into account the differences in the absolute volume of turnover from innovation. From the table on international comparison it is clear that in many countries the share of turnover from innovative products has significantly decreased (the Czech Republic is an exception here).
- **Improvement of the quality of products and services** and **expansion of the range of products and services** are examples of the results of innovation activity which innovation businesses consider as being most significant. These two objectives of innovation activity were mentioned by innovative businesses as being significant both between 1999 and 2001 and between 2003 and 2005.
- A comparison of the significance of the objectives of innovation activity between the individual studies indicates that in the later study (2003 – 2005) all of the results (with the exception of the objective of fulfilling regulation measures) were assessed as being more significant than between 1999 and 2001. This fact indicates that businesses generally have a greater awareness of the significance of innovation for their commercial activity and for the maintenance or even increase of their competitive advantages.
- Businesses from small countries with relatively advanced local R&D are more involved in **international cooperation in the field of innovation**. In contrast, businesses from large EU countries are less involved in international cooperation. The most international cooperation was made among businesses from Denmark (14.4 % of businesses cooperate with businesses in the EU) and Luxemburg (14.3 %). Less cooperation was among businesses from large countries – Italy (0.9 %) and Spain (1.5 %).
- International cooperation of businesses in the field of innovation is very much based on mutual distance. The most intensive cooperation takes place between businesses in neighbouring countries. Therefore businesses cooperate with businesses from EU countries. Cooperation with businesses located outside of the EU is significantly weaker.
- The share of businesses involved in international cooperation in the field of innovation in the Czech Republic (9.4%) is at an above-average level in the framework of the EU countries and is higher than the innovation activity of countries like Hungary (7 %) or France (5.3 %).

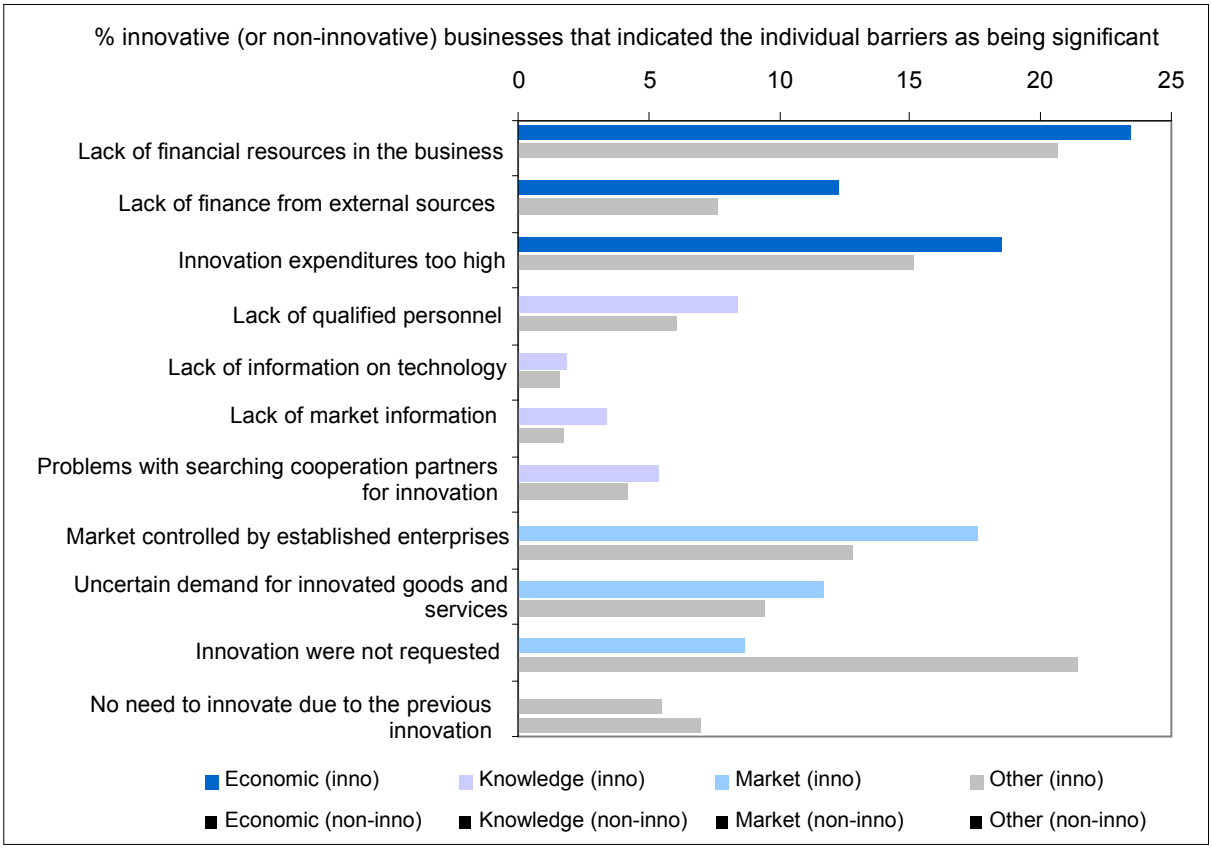
3.4.2.4 Barriers to innovation activities

Barriers to innovation activities indicated by businesses as being significant between 1999 and 2001



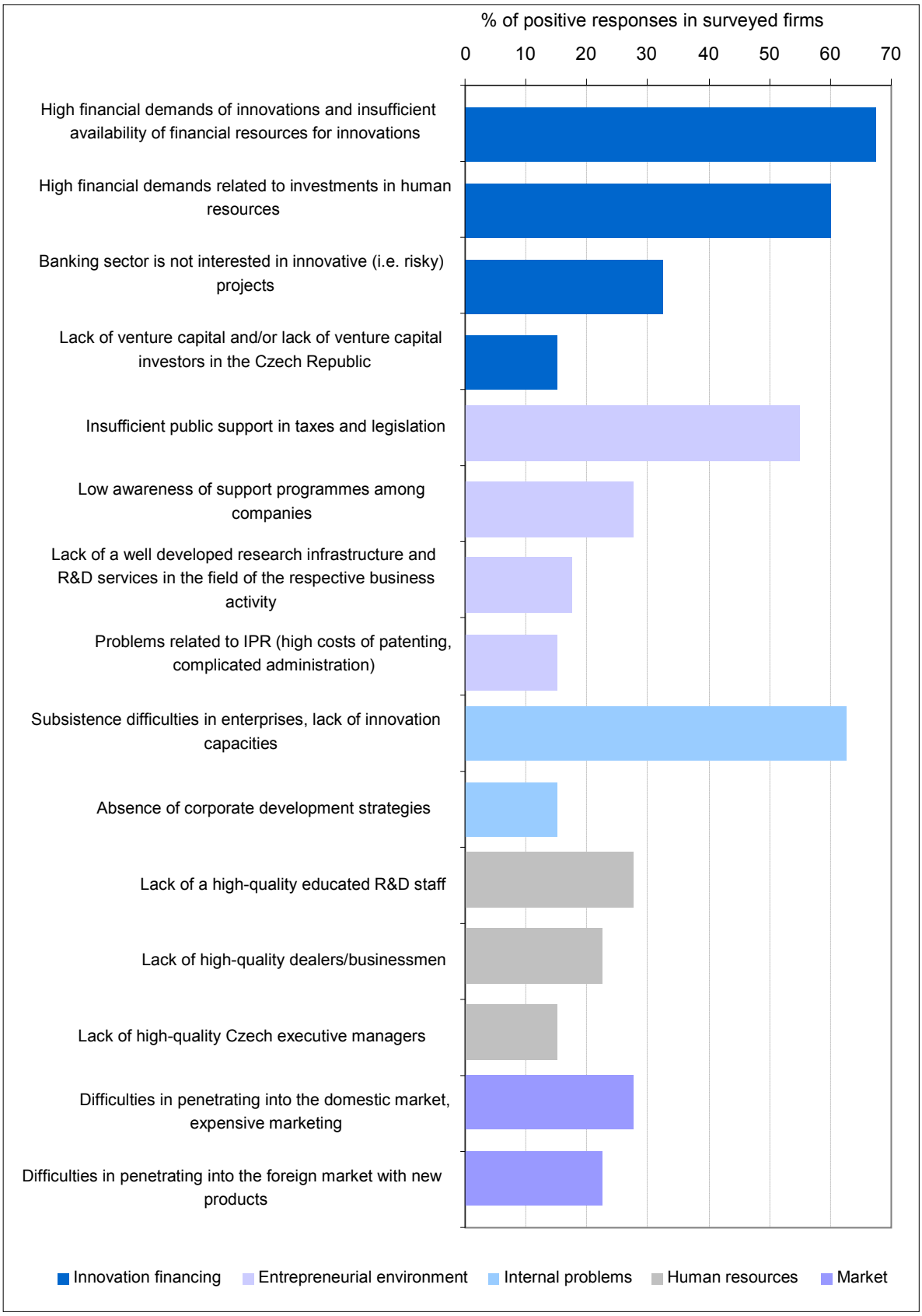
Source: CSO – Technical innovation in the Czech Republic 1999 – 2001

Barriers to innovation activities indicated by businesses as being significant between 2003 and 2005



Source: CSO – Innovation in the Czech Republic 2005

Main barriers to the growth of competitiveness determined in the study among innovative businesses (2004)



Source: Barriers to the growth of competitiveness in the Czech Republic

Analysis, comments and other information:

- The analysis of barriers to innovation activity performed by CSO and the Technology Centre of the AS shows that as the most significant businesses perceive **economic barriers** mainly in the form of economic risk, high cost of innovation and the lack of appropriate financial resources for innovation. A major barrier (related to economic barriers) is the necessity to solve the surviving problems of businesses which can be considered as a result of the delayed effect of the restructuralization of the Czech economy.
- The results of the above-mentioned studies also show that businesses (in particular innovative) intensively recognize barriers in the form of **a lack of qualified personnel** for the innovation activity.
- Innovative and non-innovative businesses also complain about the **control of markets by established businesses, the uncertain demand for innovation** and in particular in the case if non-innovative businesses the lack of demand for innovative products. The existence of these market barriers to the innovative activity of businesses also confirm the results of research performed among innovation businesses in the framework of the project Barriers to the growth of competitiveness in the Czech Republic[5].

[5] Study of the barriers to growth of competitiveness in the Czech Republic. Final report 4/04 Evaluation of Framework Community Support, Prague, Prague (2005) (http://www.tc.cz/dokums_novinka/Zprava_Bariery_final_pdf_1523.zip)

4. Methodology and classification

4.1 METHODOLOGY

Macroeconomic framework

Index of inward foreign direct investment (FDI Performance Index) – comparison of the volume of inward FDI in relation to the size of the country. It is the ratio of a country's share in global FDI inflows to its share in global GDP:

$$INDi = \frac{FDIi / FDIw}{GDPi / GDPw}$$

Where,
INDi = The Inward FDI Performance Index of the ith country
FDIi = The FDI inflows in the ith country
FDIw = World FDI inflows
GDPi = GDP in the ith country
GDPw = World GDP

Index of the potential for inward foreign direct investment (FDI Potential Index) – is an average of the normalized values of 12 variables that determine the future development of inward FDI. The variables are normalized to yield a score between zero, for the lowest scoring country, to one, for the highest scoring country. The index is made up of the following 12 variables:

- GDP per capita
- The rate of GDP growth over the previous 10 years
- The share of exports in GDP
- The average number of telephone lines per 1,000 inhabitants and mobile telephones per 1,000 inhabitants
- Commercial energy use per capita
- The share of R&D spending in GDP
- The share of tertiary students in the population
- Country risk, a composite indicator capturing some macroeconomic and other factors
- The world market share in exports of natural resources
- The world market share of imports of parts and components for automobiles and electronic products
- The world market share of exports of services
- The share of world FDI inward stock

Summary innovation index (SII) – is an average of normalized values of 25 indicators of innovation performance. The variables are normalized to yield a score between zero, for the lowest scoring country from the EU-25, to one, for the highest scoring country from the EU-25. The SII is made up of the following 25 indicators in five basic areas:

INNOVATION DRIVERS

- S&E graduates per 1000 population aged 20-29
- Population with tertiary education per 100 population aged 25-64
- Broadband penetration rate (number of broadband lines per 100 population)
- Participation in life-long learning per 100 population aged 25-64
- Youth education attainment level (% of population aged 20-24 having completed at least upper secondary education)

CREATION OF KNOWLEDGE

- Public R&D expenditures (% of GDP)
- Business R&D expenditures (% of GDP)
- Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures)
- Share of enterprises receiving public funding for innovation

INNOVATION AND ENTRENEURSHIP

- SMEs innovating in-house (% of all SMEs)
- Innovative SMEs co-operating with others (% of all SMEs)
- Innovation expenditures (% of total turnover)

- Early-stage venture capital (% of GDP)
- ICT expenditures (% of GDP)
- SMEs using organizational innovation (% of all SMEs)

APPLICATION OF KNOWLEDGE

- Employment in high-tech services (% of total workforce)
- Exports of high technology products as a share of total exports
- Sales of new-to-market products (% of total turnover)
- Sales of new-to-firm products (% of total turnover)
- Employment in medium-high and high-tech manufacturing (% of total workforce)

INTELLECTUAL PROPERTY

- EPO patents per million population
- USPTO patents per million population
- Triad patents per million population
- New community trademarks per million population
- New community designs per million population

Country abbreviations:

BE	Belgium
CZ	Czech Republic
DK	Denmark
EE	Estonia
FI	Finland
FR	France
IE	Ireland
IT	Italy
CY	Cyprus
LT	Lithuania
LV	Latvia
LU	Luxemburg
HU	Hungary
MT	Malta
DE	Germany
NL	Hungary
PL	Poland
PT	Portugal
AT	Austria
EL	Greece
SK	Slovakia
SI	Slovenia
ES	Spain
SE	Sweden
UK	United Kingdom

Inputs for research, development and innovation

Human resources for R&D and innovation

R&D personnel - research personnel who directly perform research and development, and also auxiliary, technician, administrative and other personnel working in research and development workplaces (R&D managers, administrative clerks, secretaries etc.). Everyone 15 years or over in paid employment based on employment, works agreement or service contract.

Researchers – personnel involved in the conception or creation of new knowledge, products, processes, methods and systems, or manage such projects.

Human resources in science and technology (HRST) – persons which have successfully completed a tertiary level of education (ISCED group 5A, 5B, 6) and persons not formally qualified as above, but employed in a S&T occupation (Ref. classification).

HC (headcount) - number of R&D personnel and researchers by 31st of December of the given year (e.g. total number of personnel in research and development regardless of length of time performing research and development).

FTE (full-time equivalent) - average number of personnel in full time employment performing research and development activities. For personnel who perform activities other than R&D, only the relevant period of their work capacity is taken into account. In addition, a calculation of hours worked by research and development personnel based on a works agreement or service contract was also included.

Important note:

In 2005 the CSO changed the way of specifying FTE, which caused a jump in the increase of number of researchers and R&D personnel in full time employment. For this reason it is not possible to compare the time series to 2004 with data from 2005 and the following.

- From 1995 to 2004 FTE was calculated by CSO from the register of intelligence units that divided personnel into intervals of 0-30% (x), 30-70% (y), 70-100% (z) of their work on research and development. The FTE calculation (a) is: a = (0.15*x) + (0.5*y) + (0.85*z).
- Since 2005, FTE has been calculated directly by intelligence units who calculate FTE based on examples included in the questionnaire which the intelligence units fill in themselves. In this case FTE was defined as one year of work (in full time employment) of personnel who only perform R&D activity.

The change in methodology was taken into account in the analytical part of the Green Paper and, therefore, for the Czech Republic the calculation of the percentage increase in R&D personnel and researchers was modified in graphs comparing the Czech Republic with other European countries (Ref. below).

Economically active population –all persons 15 years of age and older who can be classified as being either employed or unemployed (e.g. employed + unemployed)

The average increase in the number of personnel in R&D and research personnel was calculated from the values of indicators in the actual year and the average values of indicators in the previous three years with an annual interval (e.g. the increase up until 2005 was specified from 2005 values and average values from 2002 and 2004). This eliminated the possibility of accidental variations in the data[6]. If all the information was not available the calculation was modified so that time series variations were excluded from the resulting increase using the available data. As a result of the change in CSO methodology used for specifying the number of R&D personnel and research personnel in FTE in 2005 the increase for the Czech Republic was specified using data from 2006 and 2005.

Gross rate of internal migration (GF) – sum of immigrants and emigrants (migration turnover) in the number of inhabitants in the investigated territory. On a national level, the gross level of internal migration is calculated as half of the sum of the migration turnover in the individual region (E_R + I_R) and the total number of inhabitants in the region (P).

$$GF = \frac{1}{2}\left[\frac{\sum\left(E_R + I_R\right)}{\sum P}\right]$$

Net rate of internal migration (NF) – the difference between the number of immigrants and emigrants (migration balance) in the number of inhabitants in the investigated territory. On a national level this indicator is calculated as

[6] A similar method is used for comparing coutries in the European Innovation Scoreboard database.

half of the sum of absolute values of the differences in the numbers of emigrants and immigrants in the region (E_R – I_R) and the total number of inhabitants in the region (P).

$$NF = \frac{1}{2}\left[\frac{\sum |E_R - I_R|}{\sum P}\right]$$

Labour mobility – the share of the number of personnel that changed their employment in the monitored period in the total number of personnel (in specific sectors, branches, and qualifications).

Change in the number of employees in the region– Index change comparing the development in the number of employees in the regions over several time periods (X, Y). The share of the number of employees in two subsequent years is calculated (Y/X·100). If the indicators increase between the two time intervals the subsequent index of change will be higher than 100. If they decrease the index change will be lower than 100.

Region abbreviations:

AB –Region of Praha
SČ – Středočeský (Central Bohemia)
JČ – Jihočeský (Southern Bohemia)
PL – Plzeňský
KV – Karlovarský
UL – Ústecký
LB – Liberecký
HK – Královéhradecký
PU – Pardubický
VY – Vysočina
JM – Jihomoravský (Southern Moravia)
OL – Olomoucký
ZL – Zlínský
MS – Moravskoslezský

Financing R&D and innovation

GERD – Gross expenditure on R&D

BERD – Business expenditure on R&D

HERD – Higher-education expenditure on R&D

GOVERD – Government expenditure on R&D

GBAORD – Government budget appropriations or outlays for research and development

PPS (Purchasing Power Standard) – is an artificial currency unit used in an international comparison to express the volume of economic summary indicators. Data in PPS is obtained from values expressed in national currency units divided by the relevant PPP. A purchase power of 1 PPS corresponds to the average purchase power of 1 EURO in EU15 or EU25, based on which the information of individual countries was measured.

Gross salary –salary including payments made by the employer for social security and health insurance for the employee

Non-investment expenditure on R&D – salary costs and other non-investment costs:

- total volume of salaries of R&D personnel in registration numbers, whose amount corresponds to the share of work period performing R&D activity (including health insurance and social security paid for them by the employer) and remuneration for work based on works contracts or additional R&D activity.
- other non-investment expenditure – purchase of material, supplies and equipment for R&D support, expenditure on services leased or purchased for R&D

Investment expenditure on R&D – acquisition of long-term intangible and tangible assets for R&D (land, buildings, halls and constructions) and other long-term intangible and tangible assets, e.g. technical and other equipment essential for performing R&D (machines, apparatus and equipment including their programming).

The average increase in expenditure on R&D was calculated in the same way as in the case of human resources for R&D

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Selection of countries for publication and patent analysis

The Czech Republic was compared with the following six selected EU countries in the production of scientific publications and patents:

- Three countries from the Central European region - Austria, Hungary and Poland
- Three small or medium sized European countries– Finland, Ireland and Greece.

The number of inhabitants was the main criterion for selection of the countries so the countries had a comparable or smaller number of inhabitants than the Czech Republic. In comparison with large countries, smaller countries mainly do not choose a strategy of even development of all scientific fields but specialize only in a few of them for obvious reasons. It is also clear that geographic location, economic level, historical development and local habits all play a significant role in the specialization of R&D. Therefore countries with a similar recent history to the Czech Republic and advanced countries with research and development of a distinct type were included for an international comparison. Hungary, Austria and Greece have a similar number of inhabitants to the Czech Republic, although Finland and Ireland have a significantly lower population. One exception is Poland, with 38 million inhabitants, which was included in the comparison because it has a similar recent history to the Czech Republic.

Publication analysis

Publications issued from the start of 1994 to the end of 2005 in natural science and technical journals monitored in the Web of Science database were used for the analysis. All publications with at least one (co)author mentioned in a Czech workplace were considered as being Czech.

Patent analysis

Data on patents awarded by the EPO between 1994 and 2003 and data on patents awarded by the USPTO, classified based on the International Patent classification (IPC), was obtained from the Eurostat database (statistical information on patents awarded by the US patent and trademark office in the USPTO database is classified based on US classification which does not significantly differ from international classifications). The information on the total number of patents awarded by USPTO between 1994 and 2005 and their long-term trends were taken directly from the USPTO database, where this information is published with a much shorter delay than in the Eurostat database.

Apart from the classification of patents into sections based on IPC, patents were also ranked based on the predominant sources of knowledge into individual clusters scientific fields. If patents took knowledge from more than one scientific field only their proportionate part was used in the calculation. From the 170 scientific sub-sections defined by Thomson Scientific, 164 sub-sections were monitored, and 6 sub-sections which are not developed in the Czech Republic were discarded (e.g. marine engineering). These sub-sections were further grouped into twenty large clusters of fields (Ref. classification). All of the work published in the given journals is ranked to the same sub-sections and clusters of fields. More than one sub-section or field was ranked to about 20 % of the work, which by adding the number of publications in individual fields led to a higher total than the total number of publications in the given country.

4.2 CLASSIFICATION

Nomenclature of Territorial Units for Statistics (CZ-NUTS)

NUTS 2	NUTS 3
Prague	Capital City of Praha
Central Bohemia	Středočeský
Southwest	Jihočeský region Plzeňský region
Northwest	Karlovarský region Ústecký region
Northeast	Liberecký region Královéhradecký region Pardubický region
Southeast	Vysočina Jihomoravský region
Central Moravia	Olomoucký region Zlínský region
Moravskoslezsko	Moravskoslezský region

Sectoral classification of economic activity (NACE)

01 Agriculture, hunting and related activities
02 Forestry, logging and related activities
05 Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
10 Mining of coal and lignite; extraction of peat
11 Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
12 Mining of uranium and thorium ores
13 Mining of metal ores
14 Other mining and quarrying
15 Manufacture of food products and beverages
16 Manufacture of tobacco products
17 Manufacture of textiles
18 Manufacture of wearing apparel; dressing and dyeing of fur
19 Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21 Manufacture of pulp, Paper and Paper products
22 Publishing, printing and reproduction of recorded media
23 Manufacture of coke, refined petroleum products and nuclear fuel
24 Manufacture of chemicals and chemical products
25 Manufacture of rubber and plastic products
26 Manufacture of other non-metallic mineral products
27 Manufacture of basic metals
28 Manufacture of fabricated metal products, except machinery and equipment
29 Manufacture of machinery and equipment n.e.c.
30 Manufacture of office machinery and computers
31 Manufacture of electrical machinery and apparatus n.e.c.
32 Manufacture of radio, television and communication equipment and apparatus
33 Manufacture of medical, precision and optical instruments, watches and clocks
34 Manufacture of motor vehicles, trailers and semi-trailers
35 Manufacture of other transport equipment
36 Manufacture of furniture; manufacturing n.e.c.
37 Recycling
40 Electricity, gas, steam and hot water supply
41 Collection, purification and distribution of water
45 Construction
50 Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
51 Wholesale trade and commission trade, except of motor vehicles and motorcycles
52 Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
55 Hotels and restaurants
60 Land transport; transport via pipelines
61 Water transport
62 Air transport
63 Supporting and auxiliary transport activities; activities of travel agencies
64 Post and telecommunications
65 Financial intermediation, except insurance and pension funding
66 Insurance and pension funding, except compulsory social security
67 Activities auxiliary to financial intermediation
70 Real estate activities
71 Renting of machinery and equipment without operator and of personal and household goods
72 Computer and related activities
73 Research and development
74 Other business activities
75 Public administration and defence; compulsory social security
80 Education
85 Health and social work
90 Sewage and refuse disposal, sanitation and similar activities
91 Activities of membership organization n.e.c.
92 Recreational, cultural and sporting activities
93 Other service activities
95 Private households with employed persons
96 Undifferentiated goods producing activities of private households for own use
97 Undifferentiated services producing activities of private households for own use
99 Extra-territorial organizations and bodies

Delimitation of branches based on technological intensity

MANUFACTURING INDUSTRY (NACE 15 – 37)

High-tech branches
24.4 Manufacture of pharmaceuticals and medicinal chemicals
30 Manufacture of office machinery and computers
32 Manufacture of radio, television and communication equipment and apparatus
33 Manufacture of medical, precision and optical instruments, watches and clocks
35.3 Manufacture of aircraft and spacecraft

Medium high-tech branches
24 Manufacture of chemicals and chemical products (except for 24.4)
29 Manufacture of machinery and equipment n.e.c.
31 Manufacture of electrical machinery and apparatus n.e.c.
34 Manufacture of motor vehicles, trailers and semi-trailers
35 Manufacture of other transport equipment (except for 35.1 and 35.3)

Medium low-tech branches
23 Manufacture of coke, refined petroleum products and nuclear fuel
25 Manufacture of rubber and plastic products
26 Manufacture of other non-metallic mineral products
27 Manufacture of basic metals
28 Manufacture of fabricated metal products, except machinery and equipment
35.1. Building and repairing of ships and boats

Low-tech branches
15 Manufacture of food products and beverages
16 Manufacture of tobacco products
17 Manufacture of textiles
18 Manufacture of wearing apparel; dressing and dyeing of fur
19 Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20 Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21 Manufacture of pulp, Paper and Paper products
22 Publishing, printing and reproduction of recorded media
36 Manufacture of furniture; manufacturing n.e.c.
37 Recycling

SERVICES (NACE 50 – 99)

High-tech knowledge intensive services
64 Post and telecommunications
72 Computer and related activities
73 Research and development

Market knowledge intensive services
61 Water transport
62 Air and space transport
70 Real estate activities
71 Renting of machinery and equipment without operator and of personal and household goods
74 Other business activities

Financial knowledge intensive services
65 Financial intermediation, except insurance and pension funding
66 Insurance and pension funding, except compulsory social security
67 Activities auxiliary to financial intermediation

Other knowledge intensive services
80 Education
85 Health and social work and veterinary activities
92 Recreational, cultural and sporting activities

Market less knowledge intensive services
50 Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
51 Wholesale trade and commission trade, except of motor vehicles and motorcycles
52 Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods

55 Hotels and restaurants
60 Land transport; transport via pipelines
63 Supporting and auxiliary transport activities; activities of travel agencies

Other less knowledge intensive services
75 Public administration and defense; compulsory social security
90 Sewage and refuse disposal, sanitation and similar activities
91 Activities of membership organizations n.e.c.
93 Other activity
95 Private households with employed persons
96 Undifferentiated goods producing activities of private households for own use
97 Undifferentiated services producing activities of private households for own use
99 Extra-territorial organizations and bodies

International standard classification of education – ISCED

0 Pre-Primary Education
1 Primary Education or First Stage of Basic Education
2 Lower Secondary or Second Stage of Basic Education
    2A – group leading to higher education
    2B – preparatory group leading to the labour market
    2C – group with direct access to the labour market
3 (Upper) Secondary Education
    3A - group leading to higher education
    3B - preparatory group leading to the labour market
    3C - group with direct access to the labour market
4 Post-Secondary Non-Tertiary Education
    4A - group leading to higher education
    4B – practical oriented study
5 First Stage of Tertiary Education (Not leading directly to an advanced research qualification)
    5A - group leading to higher education
    5B – practical oriented study
6 Second Stage of Tertiary Education (Leading to an advanced research qualification)

S&E fields (e.g. natural science and technical)

Natural science subjects (science)
41 Biological science
44 Physical and chemical science
46 Mathematical science and statistics
48 Information and computer science

Technical subjects (engineering)
52 Technical science and technically oriented skills
54 Manufacturing and manufacturing industry
58 Architecture and civil engineering

Classification of science and technology fields

1. NATURAL SCIENCES
1.1 Mathematics
1.2 Computer science and information
1.3 Physical science
1.4 Chemical science
1.5 Earth and related environmental science
1.6 Biological science
1.7 Other natural science

2. ENGINEERING AND TECHNOLOGY
2.1 Civil engineering
2.2 Electrical engineering, electronic engineering, information engineering
2.3 Mechanical engineering
2.4 Chemical engineering
2.5 Material engineering
2.6 Medical engineering
2.7 Environmental engineering
2.8 Environmental biotechnology
2.9 Industrial biotechnology
2.10 Nanotechnology
2.11 Other technical science

3. MEDICAL AND HEALTH SCIENCES
3.1 Basic medicine
3.2 Clinical medicine
3.3 Health science
3.4 Medical biotechnology
3.5 Other medical science

4. AGRICULATURAL SCIENCES
4.1 Agriculture, forestry, fisheries
4.2 Animal and dairy science
4.3 Veterinary science
4.4 Agricultural biotechnology
4.5 Other agricultural science

5. SOCIAL SCIENCES
5.1 Psychology
5.2 Economics
5.3 Educational science
5.4 Sociology
5.5 Law
5.6 Political science
5.7 Social and economic geography
5.8 Media and communication
5.9 Other social science

6. HUMANITIES
6.1 History and archaeology
6.2 languages and literature
6.3 Philosophy, etiquette and religion
6.4 Art (art, history of art, acting, music)
6.5 Other humanities

Nomenclature for analysis and comparison of scientific programs and budgets (NABS)

NABS Classification rev. 1992 – socio-economic objectives based on 2 level classification

1. Exploration and exploitation of the earth
0100 General Research on the exploration and exploitation of the earth
0101 Mineral, oil and natural gas prospecting
0102 Exploration and exploitation of the sea-bed
0103 Earth's crust and mantle excluding sea-bed
0104 Hydrology
0105 Sea and oceans
0106 Atmosphere
0109 Other research on the exploration and exploitation of the earth

02 Infrastructure and general planning of land-use
0200 General research on the infrastructure and general planning of land-use
0201 General planning of land-use
0202 Construction and planning of buildings
0203 Civil engineering
0204 Transport systems
0205 Telecommunication systems
0206 Water supply
0209 Other research on the infrastructure and general planning of land-use

03 Control and care of the environment
0300 General research on the environment
0301 Protection of atmosphere and climate
0302 Protection of ambient air
0303 Solid waste
0304 Protection of ambient water
0305 Protection of soil and groundwater
0306 Abatement of noise and vibration
0307 Protection of species and habitats
0308 Protection against natural hazards
0309 Protection against radioactive radiation
0310 Other research on the environment

04 Protection and improvement of human health
0400 General research on protection and improvement of human health
0401 Medical research, hospital treatment, surgery
0402 Preventive medicine
0403 Biomedical engineering and medicines
0404 Occupational medicine
0405 Nutrition and food hygiene
0406 Drug abuse and addiction
0407 Social medicine
0408 Hospital structures and organization of medical care
0409 Other medical research

05 Production, distribution and rational utilization of energy
0500 General research on production, distribution and rational utilization of energy
0501 Fossil fuels and their derivatives
0502 Nuclear fission
0503 Radioactive waste management including decommissioning with regard to fuel/energy
0504 Nuclear fusion
0505 Renewable energy sources
0506 Rational utilization of energy
0509 Other research on production, distribution and rational utilization of energy

06 Agricultural production and technology
0600 General research on agricultural production and technology
0601 Animal Products
0602 Fishing and fish-farming
0603 Veterinary medicine
0604 Crops
0605 Forestry and timber production
0606 Food technology
0609 Other research on agricultural production and technology

07 Industrial production and technology
0700 General research on industrial production and technology
0701 Increasing economic efficiency and competitiveness
0702 Manufacturing and processing techniques
0703 Extractions and processing of non-energy mineral and derived products
0704 Products of the chemical industry
0705 Manufacture of motor vehicles and other means of transport
0707 Manufacture of electrical machinery and apparatus
0708 Manufacture of non-electronic and non-electrical machinery
0709 Manufacture of instruments
0710 Manufacture of food products and beverages
0711 Manufacture of textile, clothing and leather goods
0712 All other manufacturing products
0713 Recycling waste

08 Social structures and relationships
0800 General research with regards to society
0801 Education, training, recurrent education and retraining
0802 Cultural activities
0803 Management of businesses and institutions
0804 Improvement of working conditions
0805 Social security system
0806 Political structure of society
0807 Social change, social processes and social conflicts
0809 Other research with regard to society

09 Exploration and exploitation of space
0900 General research on the exploration and exploitation of space
0901 Scientific exploration of space
0902 Applied research programmes
0903 Launch systems
0904 Space laboratories and space travel
0909 Other research on the exploration and exploitation of space

10 Research financed from general university funds (GUF)
1000 Mathematics and computer sciences
1001 Physical sciences
1002 Chemical sciences
1003 Biological sciences
1004 Earth and related (environmental) sciences
1005 Engineering sciences
1006 Medical sciences
1007 Agricultural sciences
1008 Social sciences
1009 Humanities

11 Non-oriented research
1100 Mathematics and computer sciences
1101 Physical sciences
1102 Chemical sciences
1103 Biological sciences
1104 Earth and related (environmental) sciences
1105 Engineering sciences
1106 Medical sciences
1107 Agricultural sciences
1108 Social sciences
1109 Humanities

12 Other civil research

13 Defense

Classification of scientific fields used for analysis of publications and patents

The classification of scientific fields is derived from the nomenclature used by Thomson Scientific. All of the monitored journals are assigned to one or several of the 170 sub-sections which are further clustered into the following 20 scientific fields.

- Engineering fields
- Mathematical science
- Computer science
- Ecology and environmental science
- Molecular biology and genetics
- Chemical science
- Clinical medicine
- Pharmacology and pharmacy
- Biological and biochemical fields
- Earth science
- Immunological fields
- Material science
- Microbiological fields
- Science on plants and animals
- Agricultural science
- Multidisciplinary fields
- Neuroscience and behavioural science
- Physical science
- Psychology and psychiatry
- Space science

5. List of abbreviations

CIP	Competitiveness and Innovation Framework Programme
LPRD	Long-term Principle Research Directions
EEA	European Economic Area
EPO	European Patent Office
ERA	European Research Area
EC	European Commission
EU	European Union
ESFRI	European Strategic Forum on Research Infrastructures
EIT	European Institute of Innovation and Technology
EURAB	European Research Advisory Board
EVCA	European Private Equity and Venture Capital Association
GCI	Global Competitiveness Index
ICT	Information and Communication Technology
IMD Index	Competitiveness index used by the IMD
IPO	Initial Public Offering
KIS	Knowledge Intensive Services
MRD	Ministry for Regional Development
MIT	Ministry of Industry and Trade
SME	Small and Medium-sized Enterprises
MEYS	Ministry of Education, Youth and Sports
NIP	National Innovation Policy of the Czech Republic 2005 - 2010
NPR&D	National Research and Development Policy for 2004-2008
NACE	Industrial Classification of Economic Activity
OP EI	Operational program Enterprise and Innovation
OP RDI	Operational Program Research and Development for Innovation
EI	Enterprise incubator
PPP	Public Private Partnership
FDI	Foreign Direct Investment
SF	EU Structural Funds
STPA	Science and Technology Parks Association
IPO	Industrial Property Office of the Czech Republic
USPTO	US Patent and Trademark Office
R&D	Research and Development
R&DI	Research, Development and Innovation
LFSS	Labour Force Sample Survey
STP	Science and Technology Park
PRI	Public Research Institute
FP6	6th EU Framework Programme for Research and Technological Development and Demonstration Activities
FP7	7th EU Framework Programme for Research, Technological Development and Demonstration Activities

Abbreviations used in the chapter "Participation of the Czech Republic in ERA and international cooperation in R&D" in the analytical part of the Green Paper of research, development and innovation:

Life	1st thematic priority of FP6 "Life sciences, Genomics and Biotechnology for Health"
IST	2nd thematic priority of FP6 "Information Society Technologies"
NMP	3rd thematic priority of FP6 "Nanotechnologies and Nanosciences, Knowledge-based Multifunctional materials, New Production Processes and Devices"
A-S	4th thematic priority of FP6 "Aeronautics and Space"
Food	5th thematic priority of FP6 "Food Quality and Safety"
SD	6th thematic priority of FP6 "Sustainable Development, Global Change and Ecosystems"
CITI	7th thematic priority of FP6 "Citizens and Governance in a Knowledge-based Society"
EURATOM	Specific FP6 nuclear research program; European Atomic Energy Community
ERANET	FP6 program Supporting the Cooperation and Coordination of Research Activities carried out at National or Regional Level
CohDevPo	FP6 program "Coordination of Research and Development Policies"
SME	FP6 program "Research Activity of Small and Medium-sized Enterprises"
HRMMCA	FP6 program "Mobility (Marie Curie) "
INCO	FP6 program „Support of International Cooperation (INCO) "
NEST	FP6 program "New and Emerging Science and Technology (NEST) "
Polsup	FP6 program "Research for Policy Support"
ResInno	FP6 program "Research and Innovation"
RInfra	FP6 program "Research infrastructure"
SciSoc	FP6 program "Science and Society"
STREP	Specific Targeted Research Projects (FP6 instrument)
NoE	Networks of Excellence (FP6 instrument)
IP	Integrated Projects (FP6 instrument)
CRAFT	Cooperative Research Projects (FP6 instrument)
SSA	Specific Support Actions (FP6 instrument)
CA	Coordination Actions (FP6 instrument)
CLR	Collective Research Projects (FP6 instrument)
I3	Integrated Infrastructure Initiatives (FP6 instrument)

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GREEN PAPER

ON RESEARCH, DEVELOPMENT AND INNOVATION IN THE CZECH REPUBLIC

TEXT PART

Karel Klusáček (project manager), Zdeněk Kučera, Michal Pazour

TECHNOLOGY CENTRE AS CR

Technology Centre of the Academy of Sciences of the Czech Republic
Prague, 2008

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1. Introduction

1.1 Green Paper on Research, Development and Innovation and its main objectives

The policy of research, development and innovation in the Czech Republic is currently defined by the National Policy for Research and Development the Czech Republic for 2004 – 2008 (NPR&D), the National Innovation Policy of the Czech Republic for 2005 – 2010 (NIP), the Long-term Principle Research Directions (LPRD) and other general strategic documents, e.g. Strategy for Economic Growth or the National Reform Programme of the Czech Republic.

The Czech Republic has been advancing towards a knowledge based economy since 2004, when the basic conceptual documents were formed for the research and innovation policy of the Czech Republic (NPR&D and NIP). Resources from the EU Structural Funds for the period 2007 – 2013 provide an opportunity for a further shift in the transformation of the Czech Republic from a labour intensive to a knowledge intensive economy, which could further stimulate research and innovation activity in the Czech Republic. The changing conditions influence research, development and innovation policies which will form a mid-term strategic framework for the orientation of research, development and innovation in years to come.

Several minor background studies and analyses that tackle the issues of research, development and innovation have been worked out in the Czech Republic. So far, however, no broad analytical or conception work has been performed which would comprehensively assess the state of research, development and innovation in the Czech Republic and by involving wider professional public would lead to a document identifying necessary measures to be taken to increase competitiveness of the Czech Republic through intensive utilization of knowledge achieved by research and development.

The main objective of the Green Paper is to provide a comprehensive evaluation of the situation regarding research, development and innovation in the Czech Republic in an international context to initiate a wider national professional discussion in key thematic areas. For this discussion the Green Paper formulates a range of questions and themes which will lead to the preparation of a White Paper on Research, Development and Innovation in the Czech Republic. The White Paper will contain measures proposed to remove barriers to developing innovation based competitiveness of the Czech Republic and will form a resource for decision-makers and create a basis for strategic documents on research, development and innovation including the aforementioned policies.

1.2 How to read the Green Paper on Research, Development and Innovation

The Green Paper on Research, Development and Innovation in the Czech Republic is made up of two separate documents – the text of the Green Paper and the analytical resource document, whose objective is to assess the state of knowledge based economy in the Czech Republic in a wider context.

The text part of the Green Paper is divided into several chapters. For a greater clarity and better orientation the text in all of the chapters is written in two levels. The first level, made up of text blocks in italics on the left hand side of the page, can be used for a quick orientation in the text of the Green Paper. This synoptic level is meant as a guide and it can be read through separately. The more extensive blocks on the right hand side of the page elaborate the brief information written in italics on the left hand side of the page in more detail.

Subsequent chapters briefly describe the most important trends in research, development and innovation and principle directions of R&D and innovation policies in the EU. In chapter three there is a general summary of the current position of knowledge based economy in the Czech Republic identified in the analytical part of the Green Paper.

The fourth chapter contains a SWOT analysis of research, development and innovation in the Czech

Republic. Strengths, weaknesses, opportunities and threats identified in the analytical part of the Green Paper are divided according to two criteria – phases of the innovation process in which they occur (i.e. knowledge creation, knowledge transfer and knowledge utilization), and the area of knowledge based economy (human resources, financing, infrastructure and cooperation, environment and system).

The next chapter of the Green Paper outlines the vision of knowledge based economy in the Czech Republic and a strategy for realizing this vision. Concluding chapters contain topics that should be discussed with the wider professional public and which will be used in the preparation of the White Paper on Research, Development and Innovation in the Czech Republic.

Only selected documents are included in the text of the Green Paper. An overview of all of the information sources used during the preparation of the Green Paper is included in the concluding chapter. In the text of the Green Paper there is a range of indicators used to evaluate the Czech Republic in the international context. Exact definitions of these indicators together with used classifications are summarized in the appendixes of the analytical part of the Green Paper.

In the electronic version of the Green Paper the text is linked to the analytical part of the Green Paper using hypertext links.

2. Current trends in the field of R&D and innovation

New trends in research and development have been noticeable over the past few years...

… resulting from strengthening the ties between R&D and socioeconomic development.	Research and development and systematic utilization of their results are key factors in the present socioeconomic development. With the growth of global connectivity, which is one of the main effects of globalization, there is an increase in competition on the global market and therefore the application of new knowledge becomes the main priority for maintaining a competitive advantage. Research and development have therefore come to the forefront of social development and significantly contribute to the growth of the economic level and quality of life of society.
The impact of globalization is more and more evident in corporate research; ...	Advancing globalization of the world economy and increasing significance of multinational companies operating on several continents and establishing interconnected networks of suppliers and sellers is also reflected in the field of R&D. Research and development originally performed in the headquarters of a company are increasingly being moved to its branches in other countries and also links are being established not only between individual branches of multinational companies but also between other key players active in the given country or region.
... in public research the priority is to reach excellence and utilize knowledge in practice.	In public R&D the questions of utilizing R&D knowledge and ensuring effective links between individual phases of the innovation process, i.e. from the knowledge creation (research and development) through its application in innovation in the business sector, are increasingly coming to the forefront. Priority is also given to increasing excellence of public R&D and reaching the critical mass which is essential for ensuring progress on the frontier of a current knowledge. For this reason multinational research infrastructures are built in which research is performed (or will be performed) in order to obtain unique know-how which could advance knowledge and sustainable economic development. More attention is given to the evaluation of R&D and its results.

2.1 Internationalization of industrial R&D and innovation

Internationalization and globalization of corporate R&D and innovation ...

... can be seen in practically all advanced countries, countries in economic transition and developing countries.	The globalization of R&D can be seen not only in advanced countries but also in countries in economic transition and developing countries. The main movers and shakers are multinational corporations which with the development of their global activities establish various autonomous, specialized and mutually connected R&D centres in individual countries. The significance of multinational corporations in R&D has increased particularly in the new EU member states – in Hungary and the Czech Republic.
The presence of a strong multinational company performing R&D activities usually has a positive effect on the development of knowledge based economy of the region.	The presence of a strong multinational company performing research activities usually has a positive effect on the development of the region. Formation of links to public research and universities in the region is of particular importance as this leads not only to more intensive cooperation on specific research projects but also to wider and more long-term activities, consisting in e.g. conducting complex projects or cooperating in training human resources etc. It is also useful to establish links with local companies in the region acting as sub-contractors who will then be gradually incorporated into the R&D activities of multinational companies (so-called spill-over effect).

There is a whole range of factors that determine localization of R&D by multinational companies. Availability of a qualified labour force, advanced technology and a favourable environment are the general key factors.

There is a whole range of factors which influence a company's decision to locate their R&D activity in a given country. Supply factors which characterize the level of technology in the given country are especially important. Availability of a highly qualified labour force and the flexibility it offers, the existence of other innovation companies with their own advanced technologies and good quality local R&D count as other important factors. Some political factors are also important, like for example a quality innovation environment and appropriate policies for supporting R&D and innovation. The greatest share of multinational corporations with R&D activities is therefore usually in countries with an integrated development strategy, a stable innovation environment, excellent local R&D and qualified labour force.

In the EU the insufficient quality of the educational system and various problems within the business environment were identified as being the main weaknesses.

From a survey among managers of important multinational companies operating in the EU follows that the main weaknesses of the EU for localization and development of research activities of multinational companies include insufficient quality of the educational system, inadequately prepared graduates for employment and problems in cooperation between companies and universities. Other negative factors for the development of R&D activities of multinational companies are high taxation rate and frequent changes in the EU legislation. It was also highlighted that support to R&D is rather fragmented, which can hinder realization of more extensive R&D projects.

Internationalization affects the innovation process and recently there has been much talk about the so-called "open" innovation approach.

Over the past few years there has been a noticeable shift in the strategy of multinational companies from a "closed" innovation approach, where companies exclusively use their own knowledge and external knowledge is used to a minimum, to a so-called "open" innovation approach, which relies on a purposeful flow of information between individual companies leading to a fast and effective innovation process. Companies do not solely rely on their own research; they share their in-house and external know-how (e.g. patents of other companies), and not used know-how is sold in form of licences or it is utilized through establishing joint-ventures or spin-off companies. On the EU level a great deal of attention is therefore placed on supporting R&D in small and medium sized enterprises, which are the most significant elements in the whole system from the point of view of employment and act as major partners of multinational companies in the model of open innovation.

2.2 European policy on R&D and innovation

2.2.1 ERA and European trends in research

EU policy reacts to current trends in R&D.

The long-term priority is the formation of a European Research Area (ERA), which is still inhibited with a whole range of problems.

The formation of a European Research Area (ERA) was approved at the meeting of the European Council in Lisbon in 2000 and to-date a whole range of initiatives and support have been implemented. Nevertheless, many problems still remain unsolved. The main problem is the fragmentation of the basis of public research which prevents growth of the innovation potential of the EU and reduces the attractiveness of the EU for localization and development of R&D activities in the business sector. On the EU level the major problem often consists in a difficult international cooperation in research and the lack of coordination for the financing of research, which results in the scattering of resources. It is also clear that reforms implemented on the level of individual EU countries often lack a European perspective and multinational cohesion.

The European Commission therefore prepared a Green Paper, which specifies a vision for the ERA and proposes activities that should be performed in the EU countries.	The European Commission consequently began the compilation of a Green Paper entitled The European Research Area: New Perspectives[1]. Its objective is to initiate a discussion within the professional public on how to deepen and widen the European Research Area so that it fully contributes to the renewed Lisbon Strategy. This Green Paper deeply analyses problems that appear on the EU level and establishes a vision for the ERA, which should be fulfilled within 10 to 15 years. The Green Paper also proposes activities which individual EU member states should implement and it also raises questions for discussion within the professional public. On the basis of the results of the public discussion, dialogue between European institutions and the work of a variety of expert groups, specific initiatives and activities will be planned during 2008 which should lead to an improvement in the EU research. These results will also be a part of the basis for formulating the White Paper.
Emphasis is placed on the creation of a single market for researchers, ...	The key challenge for the EU consists in creating a single labour market for researchers which will allow effective mobility of researchers between EU countries, institutes and individual branches. It is also important to improve the education process and professional preparation of young researchers and to provide quality European PhD programmes which will fulfil the needs of universities, research institutes and the business sector.
...development of research infrastructure on a global scale, ...	Excellent research requires the construction of a research infrastructure which will be shared by the whole European research community. The establishment of the European Strategy Forum on Research Infrastructure (ESFRI) is a significant step. The objective of ESFRI is to create a pan-Europe research infrastructure including mobilization of public and private financial resources needed for its creation and setting-up a legal framework allowing its shared utilization.
... strengthening the role of research institutes, ...	Strengthening the role of public research institutes, which have to adjust to a more complex environment and strong competition in securing financing and talented professionals, is vital for the stimulation of investment from the private sector into R&D. A higher degree of specialization may play an important role in establishing European Centres of Excellence, which would be competitive on a worldwide scale. It is essential to integrate the allocation of public resources with evaluation of the results of research and create innovation partnerships between the public and private sector. Creation of virtual centres of excellence with the involvement of industry is another effort which would go beyond a project-based framework of cooperation.
... effective knowledge sharing, ...	Effective knowledge sharing and access to it on the European level is also essential. It is vital to improve the transfer of knowledge between public research and the business sector, including handling intellectual property rights and adoption of the Community patent.
... optimization of research programmes and priorities ...	Ensuring cohesion of national and regional research programmes and priorities is another basic objective of the ERA. Reciprocal opening of national programmes to participants from other member states, including their joint coordination and creation of European and national research programmes and priorities should be among the important steps.
... and international cooperation in sci-	It is also important to open the ERA to the surrounding world and to utilize international cooperation in science for the stability and prosperity in the world.

[1] Green Paper The European Research Area: New perspectives, COM (2007) 161

ence and technology.	The objectives therefore consist in ensuring a greater coordination between the EU and member states and extending the ERA towards the EU neighbour countries (e.g. through coordination of research programmes, shared infrastructure and mobility), including cooperation with development countries, e.g. in the framework of global initiatives.
An important tool of the EU research policy is the 7th Framework Programme.	The 7th Framework Programme for Research and Technological Development (FP7) is an important tool of the EU research policy. With a budget of 50.5 billion EUR the FP7 represents an essential tool for financing European research projects between 2007 and 2013. The FP7 reacts to the needs of Europe in the areas of employment and competitiveness and supports research in selected priority areas.

2.2.2 Knowledge transfer from research to practice

Effective utilization of R&D results, which is key for the development of a knowledge based economy, ...	
... represents one of the most serious shortcomings of the European environment ...	Insufficient utilization of knowledge coming from public research is one of the most serious problems of the EU. Knowledge transfer between universities (public research institutes) and companies is hindered by a range of factors, for example cultural differences between both communities, a lack of suitable incentives, legal obstacles, in particular in the area of intellectual property, and fragmentation of knowledge and technology markets.
... and therefore improvement of cooperation between (public) research and companies remains one of the priorities of the EU.	Therefore the improvement of cooperation between universities (public research institutes) and companies is one of the main priorities[2] of the EU, in particular in the context of the renewed Lisbon strategy. Therefore the European Commission established the improvement of knowledge transfer between public research institutes and third parties, including industrial enterprises, as one of the key areas in its newly adopted innovation strategy[3] (this strategy is discussed in detail later). Simultaneously, guidelines for universities and other research institutes have been prepared,[4] how to improve their links with industry.
Knowledge sharing between research institutes and industry is essential.	Effective knowledge sharing between universities, public research institutes and the business sector is essential for the development of a knowledge based economy. Even if companies begin to apply an open innovation approach to R&D, combining internal and external R&D resources, and start to perceive public research as a strategic partner, public research institutes and universities must play a much more active role in this relationship (the third role of universities is described later in the text).
It is therefore necessary to create conditions for a successful knowledge transfer, ...	Not only establishing centres for knowledge transfer but also a sufficient level of independence and openness of universities and public research institutes, recruiting experienced people for knowledge transfer and increased mobility between the public and business sector are among pre-conditions for a successful knowledge transfer. Involving company representatives in management boards of public research institutes is an option.

[2] Communication from the Commission, "Improving knowledge transfer between research institutions and industry across Europe: embracing open innovation", COM (2007) 182

[3] Communication from the Commission, "Putting knowledge into practice: A broad-based innovation strategy", COM (2006) 502

[4] Voluntary guidelines for universities and other research institutions to improve their links with industry across Europe, SEC (2007) 449

... to enhance entrepreneurial thinking ...	Supporting the entrepreneurial spirit and relevant skills of the research community can lead to the reduction of cultural differences between public research and the business sector. It is necessary to improve business education, management of intellectual property and training focused on setting up and running a business. Horizontal mobility between the public sector and companies and a system for staff evaluation and remuneration may also have a positive impact.
... and tackle issues related to the improvement in the use of tools for protecting intellectual property.	Each institution should also have a policy in place to deal with intellectual property and its use, to identify a way of increasing the interest of its staff in the implementation of R&D results and to eliminate possible conflicts of interest. This policy should solve ownership principles for R&D results and handle financial and non-financial benefits from use of the intellectual property, including issues related to the distribution of revenues from the sale of licences among individual partners (institutions, faculties/departments and inventors). Universities should not therefore see the income from licences as a source of their financing but rather as a motivation for their staff to get actively involved in the process of technology transfer. Aspects related to the establishment of technology start-ups (including spin-off companies) from R&D institutions and universities are of no less importance.
It is important to create appropriate financial tools and consequently evaluate their effectiveness.	Member states and institutions should fully utilize funding resources available to them (EU Framework Programmes, EU Structural Funds, and private resources etc.) for supporting the knowledge transfer process. It is also essential to clarify the rules of public support for R&D and innovation. Increased effort should be made to support cooperation between research institutes and small and medium sized enterprises (SMEs) and to improve the evaluation of research institutions, which will take into account the use of R&D results in practice.
Financial resources available from the SF, which represent an important opportunity to improve knowledge transfer, ...	Financial resources from the Structural Funds of the EU (SF) in the framework of the EU cohesion policy can be used to support knowledge transfer from public research into practice. These resources may effectively support the introduction of knowledge onto the market and create links between public research and small and medium sized enterprises. The creation of an innovation infrastructure (e.g. incubators) and the corresponding services could also serve as an important tool for technologically advanced knowledge transfer.
... must be coordinated with the EU 7th Framework Programme.	Formulating a strategy for coordinating funding from the EU Structural Funds and from the 7th Framework Programme[5] is of a key importance for developing a knowledge based economy. The potential of SF and the FP7 should be utilized in particular to strengthen and develop research, education and innovation infrastructures, increase excellence, develop international cooperation and coordination, strengthen R&D in small and medium sized enterprises and utilize R&D results.
The European Commission has also begun discussion on the role of universities, ...	
... which would lead to the strengthening of their links to en-	One of the most significant European problems is the insufficient cooperation between universities and industry. Therefore the European Commission initiated a discussion on the role of universities in Europe with its communication

[5] Guideline "Coordination of the research framework programme and the structural funds to support research and development" (April 2007), EURAB, April 2007.

terprises and other subjects.	entitled "The role of the universities in the Europe of knowledge", which was published in the beginning of 2003.[6] This discussion continues, at the end of 2006 the Science-Business News Service published a manifest entitled "Nine ideas to bridge the industry-academia gap"[7] on their website which analyses current problems related to technology transfer, seed investment, fiscal incentives and patents.
The so-called third role of universities is supported, which consists mainly in their closer cooperation with industry.	At present the so-called third role of universities is generally supported, which consists in a closer cooperation between universities and industry, but at the same time the basic mission of universities consists further on in its two main roles, i.e. education and research. Licences for intellectual property and newly established enterprises (start-ups) are considered to be two main mechanisms for transferring knowledge and expertise to the industry.
Increased involvement of universities in this cooperation is most often stimulated by direct funding tools.	Research on the third role of universities has shown[8] that funding is most often used for activities like joint projects and organizations, networks or clusters consisting of universities and commercial subjects. Another typical approach consist in establishing and supporting service centres for technology (knowledge) transfer set up at universities. Hiring university researchers by enterprises to work on specific research tasks, where the state support partly covers salaries of researchers, is another approach.
An active approach of universities is also important, ...	Active approach of universities towards cooperation with companies is also essential, like for example identification and creation of subject fields and capacities corresponding to the interests of companies, creation of interdisciplinary research teams taking into consideration the needs of companies, or adaptation of their research offer towards goals of important companies in the region.
... as well as solution to shortcomings in the system, in particular protection of intellectual property, ...	In addition to specific programmes in place for financing projects or cooperation between universities and industry, systemic measures supporting creation of favourable conditions are also important. Also legislation may represent a key to success, either in terms of setting conditions for functioning of the system and supporting cooperation, or solving specific issues (e.g. intellectual property).
... and improvement in the management of universities.	Improvement in the management of universities is also essential for developing cooperation with industry. In order to improve cooperation, representatives of industry (and other relevant institutions) should participate in the management of universities and their strategic decision-making.

[6] Communication from the Commission "The role of the universities in the Europe of knowledge", COM (2003) 58

[7] "Nine ideas to bridge industry-academia gap", http://cordis.europa.eu/fetch?CALLER=NEWS_ERA&ACTION=D&RCN=26473&DOC=1&CAT=NEWS&QUERY=4

[8] Cooperation between universities and the industry, the so-called third role of universities – research on foreign practices prepared by Technology Centre AS CR for the Ministry of Education in September 2007

2.2.3 Innovation in the EU

Significance of the EU innovation policy increases in relation to fulfilling the objectives of the Lisbon strategy, ...

... and therefore the European Commission formulated a strategy for innovation policy, which is generally focused on three key areas - ...	The focus and objectives of current EU innovation policy are specified in the Commission Communication, "Putting Knowledge into Practice: A Broad-based Innovation Strategy"[9], issued in September 2006. The key challenges of the EU innovation policy are set out in three basic dimensions (regulation, financing and institutions), which are then divided into ten actions. These actions set out the European Commission's current trend towards policies which will strengthen the competitiveness of the EU. At the same time, the Communication calls on member states to increase their emphasis on removing shortcomings in these areas with the help of national policies in the framework of their fulfilment of National Reform Programmes.
... regulation, ...	In the area of regulation one of the main priorities of the EU policy is to create a single internal market in the service sector and an effective patenting system, to strengthen awareness of the possibilities for using public procurement to support innovation and to create an attractive labour market for researchers (see the abovementioned Green Paper on ERA). The key measure for creating a single internal market in the service sector consists in completing relevant legal directives, where at present the impacts of legislative measures on the area of digital goods and services are being monitored through the e-Business W@tch initiative. The strategy for creating an effective patent system[10] strives to reach a consensus on the Community Patent, including a harmonized legal system for litigation in the area of intellectual property. A working document of the Commission[11] contributes to strengthening the role of public procurement in supporting innovation by presenting rules for using public procurement to stimulate innovation.
... financing ...	In the area of financing one of the main themes of the EU innovation policy consists in an effective utilization of Structural Funds for financing innovation, supplemented by initiatives of European lead markets and establishment of rules for state aid for R&D and innovation. Support to innovation on regional level is implemented through cohesion policy programmes which are based on the Communication from the Commission, "More research and innovation"[12] and on Community Strategic Guidelines on Cohesion[13]. The strategy establishing an initiative for European leading markets [14] identifies six markets in the initial stage of the initiative (eHealth, protective textiles, construction, recycling, bio-products and renewable energies), where increased attention will be placed on the areas of legislation, public procurement, standardization and other measures increasing effectiveness of these markets. From the point of view of rules for providing state aid in the area of R&D and innovation the

[9] Communication from the Commission "Putting knowledge into practice: A broad-based innovation strategy", COM (2006) 502

[10] This strategy comes from the Communication from the Commission, "Enhancing the patent system in Europe", COM (2007) 165

[11] Document, "Guide on dealing with innovative solutions in public procurement", SEC (2007) 280

[12] Communication from the Commission, "More research and innovation", COM (2005) 488

[13] Council Decision (2006/702/EC) "Community strategic guidelines on cohesion"

[14] This strategy comes from the Communication from the Commission, "A Lead Market Initiative for Europe", COM (2007) 860

	pivotal document is the Community Framework for State Aid for Research, Development and Innovation (2006/C 323/01). For an increase in the effectiveness of indirect tools supporting R&D and innovation the Commission issued a Communication[15], which summarizes the main principles for the application of indirect tools supporting R&D and innovation.
... and institutions.	In relation to the increase in effectiveness of the institutional system for innovation the Commission places particular importance on the support of partnerships between universities and enterprises and establishment of an educational system for innovation. The approach towards strengthening links between universities and industry[16], covering institutional measures for an effective knowledge transfer, is complemented by the effort to modernize the educational system reflecting the needs of the innovation development of enterprises.[17] A key priority of the EU innovation policy consists in establishing the European Institute of Innovation and Technology (EIT)[18] which is supposed to create conditions leading to effective links between education, research and innovation in the EU (the EIT as a flagship in cooperation between these sectors).
An important tool of the European Commission for the support of innovation between 2007 and 2013 is the Framework Programme for Competitiveness and Innovation.	The Competitiveness and Innovation Framework Programme (CIP) for 2007 – 2013 is a new and important tool for supporting innovation, which is a follow-up to the previous programmes supporting innovative business, ICT and utilization of renewable energy sources, and harmonizes their administration. The CIP is made up of three programmes: the Programme for Enterprise and Innovation, the Programme for the Support of Information and Communication Technologies and the Programme for Intelligent Energy – Europe. The CIP should create synergies with and complement the FP7. Another initiative of the European Commission for supporting the development of innovation in the EU is the Europe-Innova project which is focused on creating a broad international network for communication between research, enterprise and governmental sectors. The PRO-INNO Europe initiative for the development of innovation policy through the exchange of experience between individual countries and improvement of analytical and conception tools for formulating policies supporting innovation is also significant.

[15] Communication from the Commission, “Towards a more effective use of tax incentives in favour of R&D”, COM (2006) 728

[16] Communication from the Commission, “Improving knowledge transfer between research institutions and industry across Europe: embracing open innovation”, COM (2007) 182

[17] Communication from the Commission, “Delivering on the modernisation agenda for universities: Education, research, innovation” COM (2006) 0208

[18] Proposal of the Commission “European Institute of Technology”, COM (2006) 604

3. Current situation of knowledge based economy in the Czech Republic

3.1 Macroeconomic framework

3.1.1 Macroeconomic performance

The Czech Republic is characterized by a good macroeconomic performance and stability but ...

... the business cycle is not in alignment with development in the EU, ...	Economic growth in the Czech Republic shows a very good dynamic with the GDP increasing year-on-year by more than 6% since 2005. In comparison with growth dynamics of the European economy, the growth of the Czech Republic is above-average, which is positively reflected in the real convergence of the Czech economy towards the EU-27 average. From the point of view of production factors the source of the economic growth of the Czech Republic is a stable increase in capital stock, which grew by more than 20% between 1995 and 2005. Disharmony of the business cycle of the Czech Republic and the EU may represent a risk for the future macroeconomic development. The risk of negative economic impacts due to the disharmony of the business cycle will increase with gradually abandoning monetary policy tools related to the accession of the Czech Republic to the Eurozone.
... rapid growth in consumption is beginning to show its effect which is bad for inflation, ...	On the demand side, domestic absorption is the driving force of economic growth in the Czech Republic. The most significant share of domestic absorption in the growth of GDP was in 2006, when it contributed to a 5.5% year-on-year increase in GDP. As for the individual components of domestic absorption, private expenditure and investment have the most significant influence on the economic growth. Whereas a high investment activity is good for preserving the competitiveness of Czech companies and maintaining stable macroeconomic development, a too rapid increase in private consumption could put an excessive pressure on price increase which may subsequently lead to a disturbance in the macroeconomic balance. From the point of view of external relations, the Czech Republic has recorded a significant rise in external trade in connection with the increasing openness of the Czech economy. Despite the fact that the Czech Republic shows a negative balance in external trade, the large share of export in the GDP indicates that companies from the Czech Republic can assert themselves on foreign markets.
... labour productivity reaches half of the average of the EU-15 countries, ...	A high investment activity, reflected in the dynamic growth of capital stock in the Czech Republic, has a positive effect on the growth of/in labour productivity. Despite the fact that the growth of labour productivity in the Czech Republic between 2000 and 2004 was higher than in advanced European countries it is still low in comparison with the other new member states. At present labour productivity in the Czech Republic reaches only half of the average of the EU-15 countries. From the point of view of the development of a knowledge based economy it is most alarming to note that this small increase (or even decrease) in labour productivity was recorded in knowledge based services, i.e. ICT services and research and development. In research and development the decrease in labour productivity is mainly due to a decrease in added value.

... structural changes proceed slowly and less technologically intensive sectors still prevail...	The Czech Republic is a country with a stable economic structure characterized by the manufacturing industry contributing relatively highly to the creation of added value and employment. On the contrary, the service sector has a below average contribution to the creation of added value and employment in the Czech Republic. There is a high share of the primary sector in employment which is probably a result of a slow structural adaptation in employment influenced by rigidities of the Czech labour market. High-tech or medium-high-tech sector, characterized by a relatively high level of productivity and high level of innovation activity, make up 39% of total added value in the Czech Republic (compared to 43.5% in EU-25). Due to the fact that most of this is made up of medium-high-tech sector there is a risk that production is relocated to areas with lower costs, in particular to developing countries in South-east Asia or South America. A trend shows that in the Czech Republic there is a positive transformation of production from less technologically intensive sector to highly technologically intensive sector. Also growth of the share of high-tech export in all Czech exports indicates that manufacturing companies in the Czech Republic are able to assert themselves on foreign markets with relatively high priced technologically intensive production. In the service sector the Czech Republic in comparison with the European average is characterized by a relatively lower share of knowledge intensive services (KIS) in the creation of added value.
... and character of the growth is rather extensive.	A look at the energy intensity of production shows that the Czech Republic together with other post-communist countries is characterized by a much higher energy consumption per unit of value added than older EU member states. Among other things, these results reflect the fact that growth of the Czech economy has an extensive character which leads to an increase in the volumes of production based on a relatively high consumption of material and energy inputs.
The inflow of foreign direct investment into the Czech Republic plays an important role in the development of the economy, but this can be replaced by an outflow ...	An important role in the economic development of the Czech Republic is played by foreign direct investment (FDI), with a gradual shift from investment connected to privatization (in particular in the financial and telecommunication sectors) to investment in the form of the acquisitions of private Czech companies or greenfield investments (in particular in the automobile industry). In the sectoral structure of FDI the majority of investment is in the service sector, which is stable from the point of view of frequency of geographic shifts. The risk of a possible outflow of foreign investment is higher for the manufacturing industry (generally motivated by low labour costs), where investment in the automobile industry is the most significant. The inflow of FDI is reflected in the increase in the share of companies under foreign control in the value added. These companies are characterized by a higher labour productivity which increasingly spills over to national companies. In sectors where this positive spillover does not happen there is a risk of a dual economy due to the displacement of national companies (which can be particularly seen in the retail trade).
... if conditions are not created for the localization of R&D and high-tech manufacturing.	The most significant factors for localization of FDI in the Czech Republic are a high level of education of the labour force and a low risk of fluctuation, relatively low labour costs, good infrastructure and cultural proximity. On the other hand, low satisfaction of foreign investors with professional skills of workers indicates that the educational system in the Czech Republic does not react quickly enough to the changing demands of the labour market. Creation of beneficial conditions for localization of research and development activities and top technology production are key factors for maintaining the attractiveness of the Czech Republic for FDI.

Cheap but qualified labour force remains the deciding factor for localization of R&D in the Czech Republic, ...	In addition to the cheap and at the same time qualified labour force, the main factors for locating R&D activities of multinational corporations in the Czech Republic are a good level of local R&D and universities as well as tradition and experience in R&D. Other positive factors include the geographical position close to Germany (or EU-15 countries), cultural proximity, good technical infrastructure and accessibility. Last but not least membership of the Czech Republic in the EU is also an important factor.
…but there are signals of a shortage of technically educated labour force.	Despite the fact that one of the major reasons for building R&D capacities of multinational companies was the cheap and qualified labour force in the Czech Republic, the greatest weakness at present is the lack of human resources, in particular technically skilled workers. Development of R&D activities of multinational corporations in the Czech Republic is further limited by insufficient cooperation between public research and companies and the absence of an integrated R&D and tertiary education policy.

3.1.2 Competitiveness

Future economic development in the Czech Republic depends on maintaining competitiveness.

However, the position of the Czech Republic in international comparison of competitiveness worsened in 2007.	Competitiveness of countries is generally understood as a set of factors, policies and institutions, which affect the level of economic productivity.[19] Results of an international comparison of competitiveness show that from the point of view of these factors the Czech Republic is not ranked among countries featuring a high level of competitiveness, which represents a potential risk for sustainability of the current high rate of economic growth. The Czech Republic has relatively the most competitive position in the area of innovation, where a relative availability of scientific workers plays a significant role. On the other hand, the institutional environment is the greatest weakness.
Requirement for increasing the competitiveness of the Czech Republic include creation of a favourable environment for innovation ...	The economic development of countries accompanied by the increase in productivity (and labour costs) is linked with the decreased significance of a competitive advantage based on low labour costs. In order to sustain the competitiveness of domestic products on a global market other factors of competitiveness become more significant in the economies of advanced countries, which make space for increasing the effectiveness and implementation of innovation. Based on the relative level of gross domestic product the Czech Republic currently lies in the phase of transition from an economy whose competitive advantage is based on the increase in performance to an economy asserting itself on the global market by implementing innovation in form of new products, technologies and business strategies. Creating conditions for an increase in innovation effectiveness in the Czech Republic is therefore an essential requirement for the ability of Czech products to compete on the global market.
... and removal of main deficiencies in the field of business environment.	Main areas decreasing competitiveness of the Czech Republic in an international comparison is the institutional environment connected with a low effectiveness of the state administration. Especially the administrative complexity of tax collection and procedures for closing a business are negatively assessed. Restrictive and inflexible labour law is a persistent drawback. On the

[19] Among respected indicies for the international evaluation of a country complettitiveness are: the Global Competitiveness Index (GCI), compiled by the World Economic Forum, and the IMD Index, published annualy in the World Competitiveness Yearbook.

contrary, foreign direct investment, which is reflected through technology transfer in a sufficient level of adoption of modern technologies and keeping pace with the global technological development, has a positive effect on the increase in competitiveness.

3.1.3 Innovation performance

The Czech Republic is ranked among the catching-up countries in the evaluation of innovation, but ...

... it is still lagging behind the European average, ...

In an international comparison of the level of innovation performance according to the Summary innovation index the Czech Republic was placed 13th out of the EU-27 countries in 2006. However, it still lags behind the European average along with the other new member states of the EU. From the point of view of a short-term dynamics of the growth of innovation performance the Czech Republic occupies the seventh place among the EU-27 countries, which means there is potential for improving the position of the Czech Republic in an international comparison. The most recent comparison of the level and dynamics of the summary innovation index shows that since 2004 the Czech Republic has moved from the group of countries lagging behind to the group of catching up countries.

... mainly due to the lack of university educated people in the population and a low number of graduates from natural science and technical universities.

A more detailed look at individual factors of innovation performance of the Czech Republic in an international comparison helps us identify areas where the Czech Republic notably lags behind the European and global level. In the area of innovation drivers the Czech Republic falls short in particular in the broadband penetration rate, where it reaches only 41% of the EU average. This area can be considered one of the barriers (even if it is probably less important) for disseminating knowledge and utilization of Internet services (e-commerce, e-government etc.). The most problematic issue in this area appears to be an insufficient share of university educated people in the population and a low percentage of graduates from science and engineering universities. In both of these indicators the Czech Republic is ranked below 60% of the European average.

The development of innovation activity is also hindered by insufficient cooperation between universities and the business sector ...

Despite the fact that public expenditure on R&D in the Czech Republic does not reach the desired 1% GDP, the volume of resources for R&D is not regarded as the main drawback in the creation of knowledge (the Czech Republic is ranked at approximately 70% of the EU average in this field). Poor cooperation between universities and companies in the area of R&D is a more significant weakness, which is indicated by a low proportion of business sector resources spent on financing R&D carried out at universities. In comparison with the EU the Czech Republic reaches only 14% of the European level of this indicator[20]. Insufficient interconnection between universities and companies can be a significant factor in the ineffective financing of R&D, where resources are spent on research whose results are not utilized in practice. Weak links between university research and the business sector represent also a possible barrier to an effective transfer of knowledge from universities.

... and unavailability of capital for start-up innovation enterprises.

In innovation & entrepreneurship the greatest weakness of the Czech innovation environment consists in an insufficient financing of innovative enterprises in the start-up phase of their development through venture capital. The venture capital invested into innovative start-ups (as a share of GDP) was close

[20] Data in comparison with 2005.

	to zero in the Czech Republic in 2005. This gap in the capital market can be considered as a significant barrier to the growth of innovation activities of start-ups, because the access to external financing through bank loans for innovative entrepreneurs in this phase of development is significantly hindered.
Relatively good results in the application of knowledge are affected by the relatively high employment rate in the automobile industry, ...	In knowledge application the Czech Republic is in a relatively satisfactory position. The comparatively high employment rate in medium- tech sector (in particular in the automobile industry) and also the sales of innovated products (as a share of turnover) significantly contribute to this. The impact of foreign direct investment and the existence of a direct knowledge transfer between foreign and domestic companies may be among the factors affecting the relatively good results in these indicators.
... on the other hand, utilization of tools for intellectual property rights remains traditionally a weakness of innovation performance in the Czech Republic.	Utilization of the protection of intellectual (in particular industrial) property is traditionally a weakness in the innovation performance of the Czech Republic. In the number of patents, the Czech Republic lags behind the European average both from the point of view of the level and the dynamics of development. The Czech Republic has recorded a stagnating to decreasing trend in the proportion of awarded patents per 1000 inhabitants. The only positive trend in the innovation output in the form of industrial property is represented by an increase in the number of registered Community trademarks, which to a certain degree can be explained by the entry of the Czech Republic onto the European internal market.

3.2 Environment for R&D and innovation

3.2.1 Institutional and legislative environment

The institutional environment for R&D and innovation in the Czech Republic ...

… is given by the legal framework, in particular the Act on the state administration competence and the Act on R&D support.	The institutional environment in this case refers to institutions on the state level, e.g. the legal framework given by legislation and organizations ensuring its formulation and observance. Competences of individual central authorities of the state administration are defined by the so-called Competence Act.[21] The main competence in research and development is given by the Act No. 130/2002 Coll., on the support of research and development from public funds.[22]
The main competence in the field of R&D policy has the Ministry of Education …	The central body of the state administration for high schools and universities, science policy, research and development, and international cooperation in this field, is the Ministry of Education. The Ministry of Education is responsible especially for the preparation of the National Policy for Research and Development of the Czech Republic and supervises its realization, establishes research priorities in the form of the National Programme for Research and implements some of them, prepares legal regulation on research and development and assesses the impact of other legal regulations on research and de-

[21] Act No. 2/1969 Coll., on the establishment of ministries and other central state administration authorities of the Czech Republic in the wording of further legislation

[22] Further legislation related to R&D is included on the website www.vyzkum.cz.

	velopment and is in charge of international cooperation of the Czech Republic in research and development.[23]
… as well as the Council for Research and Development.	The Research and Development Council is a professional and advisory body to the government in the field of research and development and pursuant to the Act[24] its responsibilities include elaboration of long-term principle directions in research and development for the Czech Republic through its advisory bodies, preparation of yearly analyses and assessment of the state of research and development in the Czech Republic, proposal of the volume of overall expenditure on research and development in individual budget categories and its allocation.
The system of public support is complicated both by thematic and administrative coordination.	In total 22 providers take part in the system of R&D support in a varying degree which very much complicates both thematic and administrative coordination and leads to public support being significantly fragmented (see the chapter below - The current system of public support for R&D and innovation).
In the field of innovation there is no competent body at the level of the state administration, …	There is no legally defined institution (body) responsible for innovation that prepares and implements innovation policy. Even though the Competence Act does not explicitly delegate competence for competitiveness or innovation policy to any of the existing central authorities, there are at least three authorities performing activities towards increasing the competitiveness of the Czech economy. In other countries, the formulation and implementation of innovation policies generally falls under the competence of the ministries of economy, industry or trade.
… innovation is the most closely covered by the competence of the Ministry of Industry and Trade .	In the Czech Republic the responsibility and the internal organization of the Ministry of Industry and Trade (MIT) is the closest to a ministry of such a mission. Pursuant to the Competence Act the MIT, among other things, is the central authority of the state administration for state industrial and trade policy, issues of small and medium-sized enterprises, industrial research, and the development of engineering and technologies. In other countries major activities related to competitiveness are also secured by ministries for regional affairs. In the Czech Republic this body is the Ministry for Regional Development (MRD). Since competitiveness is closely linked to research and development, innovation issues are also linked to the Ministry of Education. Individual regions are responsible for the development of innovation, however, the results of their effort differ.
The activity of central administrative bodies is further complemented by activities on regional level and activities of professional asso-	Other institutes and organizations acting on the central and regional level are regional and district branches of the Czech Chamber of Commerce, information and advisory agencies, the Association of Research Organizations, the Association of Innovative Entrepreneurship, the Science and Technology Parks Association, the Czech Association of Development Agencies and other associations and societies. On the other hand, professional associations of small and medium-sized enterprises can be considered as being insufficiently

[23] Article 33 of Act No. 130/2002 Coll., on the support of research and development from public funds and on the amendment of several related Acts (Act on the support of research and development)

[24] Article 33 of Act No. 130/2002 Coll.,on the support of research and development from public funds and on the amendment of several related Acts (Act on the support of research and development)

[25] See Barriers to the Growth of Competitiveness of the Czech Republic, Chap. 4.3.5, http://www.strukturalni-fondy.cz/evaluace/bariery-rustu-konkurenceschopnosti-cr

ciations.	developed.[25]
National Innovation Policy strives to establish responsibility for innovation policy by amending the competence Act; however this responsibility has not been established yet.	The principle documents for research, development and innovation approved at the governmental level are the National Policy for Research and Development of the Czech Republic for the period 2004 to 2008 and the National Innovation Policy of the Czech Republic for the period 2005 to 2010, which initiated the harmonization of both policies. Both policies deal with issues of the institutional environment; the National Innovation Policy stipulates specific measures which specified bodies of the state administration have to implement by specified deadlines. Many tasks of institutional character set by the National Innovation Policy related to the state administration have yet to be fulfilled. These tasks deal in particular with amendments to the Competence Act and other acts with the purpose of simplifying the system of support for research and development (in particular focusing resources for research and development into a significantly smaller number of budget categories[26]) and delegation of responsibility for innovation to one of the departments[27].
A change in the status of public research institutes is a step forward ...	The Act on Public Research Institutes[28] whose objective is to transform the unsatisfactory legal form of allowance organizations into public research institutes (PRI)[29] contributed to a major shift in the creation of more favourable institutional conditions for intensive and effective improvement in research and development. The purpose of this new legal regulation is to provide especially a clear specification of the status of public research institutes, to regulate their establishment and bankruptcy, to ensure a greater independence of these institutes in making decisions on research, in developing various forms of cooperation with universities and the business sector and to ensure a greater transparency in the utilization of public financial resources.
... and tertiary education is also due for reform. A discussion on this subject was started by a proposal of theses for the preparation of the White Paper on Tertiary Education.	Czech universities need to be reformed with the following objectives: differentiation and stratification of universities based on the level of their involvement in R&D, greater openness, feasibility of academic careers, reform of management and self-administration, division of roles, autonomy, responsibility, reforming of financing universities and student support, opening resources and opportunities, and opening universities for cooperation with regions and employers. At present a White Paper is under preparation which will be a starting point for the formulation of the new Act on Tertiary Education and whose initially proposed theses specified the above-mentioned objectives.[30]
The current system of public support of R&D and innovation in the Czech Republic ...	
...is significantly fragmented…	Public support for research, development and innovation in the Czech Republic is provided from the resources of the state budget and also from the resources of the EU Structural fund since 2004. Resources from the state budget for R&D are allocated through 22 budget categories, which results in an excessive fragmentation of public support for R&D aggravating the support

[26] National Innovation Policy of the Czech Republic 2005-2010, measure No. 41

[27] National Innovation Policy of the Czech Republic 2005-2010, measure No. 42

[28] Act No. 341/2005 Coll., on public research institutes, and Act No. 342/2005 Coll., on the amendment of several acts related to the adoption of the Act on public research institutes

[29] National Innovation Policy of the Czech Republic 2005-2010, measure No. 21

[30] Initial theses for the preparation of the White Paper on Tertiary Education (source material for the 12th session of the Board of the Council of Universities 21st of June 2007)

	of more complex research projects of an interdisciplinary character. The fragmentation of the system of public support for R&D is also negatively reflected in an excessively complex administration of the implementation process.
.. .and institutional support exceeds project-based support.	Public support for R&D has been mostly provided in the form of institutional resources. Budgetary resources earmarked for co-financing programmes for supporting R&D and innovation utilizing the resources of the EU Structural Funds partly contribute to this. The most significant providers of institutional support for R&D are the Ministry of Education and the Academy of Sciences of the Czech Republic, which together distribute more than 86% of the institutional resources for R&D. A targeted (project-based) support for selected R&D projects is distributed mainly by the Ministry of Industry and Trade, the Ministry of Education, the Czech Science Foundation, the Academy of Sciences of the Czech Republic and the Ministry of Health.
Structural Funds of the EU contribute to the development of the infrastructure for R&D and innovation, however its sustainability remains a challenge, ...	The most significant providers of support for R&D and innovation from the EU Structural Funds are the Ministry of Education and Ministry of Industry and Trade. In this period the Ministry of Education implement programmes in the framework of the Operational Programme Research and Development for Innovation (OP RDI) with a budget of approx. 2.4 billion EUR and the Operational Programme Education for Competitiveness (OP EC) with a budget of more than 2.1 billion EUR, and the Ministry of Industry and Trade will implement programmes in the framework of the Operational Programme Enterprise and Innovation (OP EI) with a budget of approx. 3.5 billion EUR for the period 2007 – 2013 (though these resources are only partially earmarked for activities related to R&D&I). These three programmes complement each other and form an important tool to support development of knowledge based economy in the Czech Republic. In comparison to the programming period of 2004 – 2006 there is a remarkable shift in focus towards expansion of research infrastructure of universities and public research institutes (OP RDI). Concerning the support of innovation from the Structural Funds (OP PI) emphasis was increased in the area of ICT, research potential of businesses and protection of industrial property rights. Considering the fact that resources in the framework of OP EI and OP RDI will be invested mainly in developing, expanding and modernizing research and innovation infrastructure, the potential for financial sustainability of the infrastructure after putting the infrastructure into operation and termination of financing from public resources must be taken into consideration. The issue of support for the development of research and innovation infrastructure in Prague, which does not fall under the Convergence Objective of the EU SF remains unsolved. The amount of support for the development of innovation infrastructure and innovation activities in Prague, provided from the OP Prague Competitiveness is significantly lower in comparison to the resources available in the above mentioned thematic Operational Programmes.
... as well as creation of tools for supporting the innovation process in the phase from development to pilot-operation.	From the point of view of the coverage of individual phases of the innovation process by public support tools for R&D and innovation it can be said that individual tools cover the whole innovation process with the exception of the phase of transition from development to pilot operation, or the phase where innovative products are created based on the testing of prototypes. This phase of the innovation process characterized by testing prototypes is usually related to considerable costs and there is also a high risk of failure. For this reason projects in this phase of the innovation process are not attractive for external resources of private and risk financing and the risk and costs are usually completely covered by innovating subjects. This gap in the area of public support should be covered by the OP RDI. From the sectoral point of view insufficient emphasis is placed on the support of knowledge intensive services. A progress in this area is represented by support provided from the OP EI to the ICT sector.

It would also be beneficial to better utilize the system of investment incentives for development of R&D and innovation in the business sector ...	In the area of supporting private investment to R&D and innovation a progress is seen in the expansion of investment incentives also to developing technology centres and centres of strategic services. It appears that development of such R&D centres prevails, whose R&D results are utilized abroad, or which adapt the original know-how for the market in the Czech Republic. The most desirable case where a multinational enterprise builds a research capacity in the Czech Republic and results of its R&D are subsequently utilized not only in the branch of the multinational in the Czech Republic but serve also the needs of the whole concern is to-date an exception.
... and extend indirect support of R&D and innovation, which is currently applied only to a limited extent in the Czech Republic.	Traditional indirect tools of public support for R&D and innovation include tax incentives and public procurement. Tax incentives in the Czech Republic for R&D were introduced in 2005 in the form of tax-deductible items from R&D expenditure.[31]Despite a positive stimulation effect tax incentives carry the risk of strengthening the in-house R&D (mainly in large companies) to the detriment of cooperation with research institutes, universities and small research companies, which is in conflict with the attempt to form closer ties between public research and the needs of industry. Tax incentives are also less stimulating for innovative start-ups which usually record loss in the initial phase of large investments into R&D.[32] In addition to a tax-deductible item there is a tax relief for donations for R&D in the Czech Republic although effectiveness of this tools is relatively low. Another tool for indirect support (public procurement) in the area of R&D and innovation is not yet widely used in the Czech Republic.
Research financed from public resources has been systematically evaluated since 2004...	Regular evaluation of research supported from public resources is carried out on the basis of the Governmental Decree No. 644 of 23 June 2004. Methodology of this evaluation is up-dated each year by an Interdepartmental Working Group made up of representatives from the R&D Council, Ministry of Education, providers of R&D support, universities, industry and the Academy of Sciences of the Czech Republic. Methodology for the Evaluation of Research and Development and its Results in 2007 was elaborated and approved by the R&D Council on the 14 September 2007.
... with the aim of projecting this evaluation to a new system for allocating public resources for R&D.	The Interdepartmental Working Group also tackles an issue closely related to evaluation, which is the allocation of resources for institutional support of R&D after adoption of the Amendment to the Act No. 130/2002 Coll., on the support of research and development. The Amendment will considerably change the system of providing institutional support. It will depend entirely on the evaluation of R&D results achieved in relation to the amount of support provided to achieve them.
The current legislation does not allow the new method of allocation of institutional R&D support to be applied.	Taking into consideration the current legislative situation, the new method of allocating institutional R&D support cannot be sufficiently applied before the Amendment of Act No. 130/2002 Coll. comes into power, because the R&D Council has no legislative competence to limit the previous commitments of governmental departments. For this reason there is no pressure to improve results either in the form of scientific publications or practically applicable results, including patents, and thus achieving a greater benefit for the Czech economy.

[31] See Article 34 para. 4 of Act No. 586/1992 Coll., on inclome tax, in the valid wording

[32] This deficiency is usually remains for start-up innovative companies even if it is possible to apply the deduction in three tax periods after the deduction entitlement is created.

Private resources represent a key source of financing of R&D and innovation.

Investments in private equity play a significant role for start and initial development of innovative companies, ...	The basic groups of private resources for financing R&D and innovation are debt financing (bank loans, leasing etc.) and financing in form of entry into private equity (business angels, venture capital etc.). Whereas debt financing represents a valuable source of financing in the development or growth phase of innovative companies, in the initial phases this financing tool is not usually accessible. In the initial phases of the development of a company the availability of investments into private equity is very important.
...however, these investments almost do not exist in the Czech Republic.	The Czech Republic is among those countries on the bottom of the European ranking when it comes to venture capital investments. From the point of view of the potential of venture capital for solving financial needs in the development phase of a company the situation in the Czech Republic is rather poor because investments of "early stage" venture capital have been almost negligible since 2004.
This is caused by both tax and regulatory barriers and also insufficient demand for investment into equity capital on the side of entrepreneurs.	The reasons for insufficient venture capital investments can be seen both in the legislative and tax environment and also in the demand for this type of financing. From the point of view of the legislative and tax environment the most significant drawback in the Czech Republic is the existence of a multiple taxation and a strict regulation of pension funds and insurance companies not allowing these institutes to invest in private equity of enterprises. In the Czech Republic there are no fiscal incentives for venture capital investors. From the demand point of view, growth of venture capital investments is hindered by a prevailing fear of entrepreneurs from their loss of independence. In addition, active approach by the government in this field (support of seed and pre-seed capital) is insufficient.

3.2.2 Infrastructure and cooperation

Effective cooperation between public research and educational institutions and the business sector is a key precondition for a knowledge based economy, ...

... however, from analyses of systemic issues of R&D and innovation it follows that this cooperation in the Czech Republic is hindered by a whole range of barriers.	Analyses and surveys performed over the past few years in the Czech Republic verify quite unambiguously that cooperation between companies and public research and educational institutes is still insufficient. From the results of surveys[33] it follows that a significant barrier in this field consists in the lack of demand from companies for R&D results, which is probably caused not only by the lack of financial resources in smaller companies but also the orientation of companies towards the use of the hitherto relatively cheap labour force and products with a lower value added. A significant impediment to cooperation is also the lack of motivation for R&D workers towards application orientated research. Exactly this clearly reflects shortcomings in the system of R&D evaluation, which features an insufficient interconnection between the allocation of public resources for research and its results. The absence of agencies for the transfer of research findings from universities and research institutes and also a lack of motivation of researchers at public universities and research institutes to transferring knowledge have adverse effects. Another barrier consists in the requirement of companies to have the new knowledge from

[33] See Barriers to the Growth of Competitiveness of the Czech Republic, http://www.strukturalni-fondy.cz/evaluace/bariery-rustu-konkurenceschopnosti-cr

	public research worked on and completed all the way to the prototype or semi-operational stage. In addition, conditions for creating spin-off companies are missing. A targeted search for ideas on new technologies for research (so-called "technology scouting") is a hitherto underrated activity.
Statistical data confirm the lack of co-operation between public research and enterprises.	The lack of cooperation between public research and business has been confirmed by some statistical data. The Czech Republic is one of the countries with a low share of private financial resources in R&D expenditure in the public sector. A very low share of private financial resources is apparent in the higher education sector, where private resources made up less than 1% of the overall expenditure on R&D in 2005.
Cooperation among companies in clusters is beginning to develop, ...	In addition, cooperation between companies in the framework of sectoral and regional groupings (clusters) is not sufficiently developed in the Czech Republic. The Berman Group[34] study identified important clusters in several sectors in the Czech Republic – automobiles and their components, electrical engineering, mechanical engineering, chemistry and beer production, which are often parts of supra-regional groupings connected to the global trade. Also some areas of cross-sectoral activities were identified which have a long-term potential to contribute to the international competitive advantage of the Czech Republic (e.g. biology with electrical engineering and mechanical engineering, environmental technology and alternative sources of energy, information and communication technologies, intelligent control systems and components).
... but the significance of clusters in the public and private sectors is not sufficiently appreciated at present.	Even though cooperation among companies in form of clusters was supported from the EU Structural Funds between 2004 and 2006, a field survey performed in this study showed that the concept of clusters and their significance for regional economic development are not sufficiently appreciated either in the public or private sectors and that clusters are not a vital priority of public policies at a lower than the national level yet.
The principles of private public partnerships are not sufficiently applied.	Principles of the public private partnerships (PPP) are not sufficiently applied In the Czech Republic. Experience of other European countries shows that setting up venture capital funds for investments into innovative start-ups is a suitable field of cooperation based on PPP. The significance of this cooperation consists in the stimulation of private investment into the private equity of innovative start-ups by risk sharing between private investors and the public sector. This form of cooperation is suitable for both the national and regional level.
The research infrastructure is regionally concentrated, but concerning tools and capacity it is undersized.	The infrastructure for R&D in the Czech Republic is characterized in particular by a strong concentration of research facilities in Prague. The location of institutes of the Academy of Sciences of the Czech Republic, of which 70% are seated in Prague, has a significant effect on this situation. The developing trend shows that there is a gradual deconcentration of R&D infrastructure and its diffusion into other regions of the Czech Republic. An insufficient level of equipment is one of the main problems of the research infrastructure, which is negatively reflected in the attractiveness of research facilities for quality scientists (brain-drain effect) and in a lower involvement of Czech science teams in international research projects. From the point of view of size, research infrastructure, whose equipment, finances and human resources would enable conducting large research projects, is missing in the Czech Republic. In relation to this, it is encouraging that the issue of research infrastructure, discussed in the framework of ESFRI, is one of the priority topics of the Czech presidency for R&D.

[34] Clusters Identification project, National Report– summary of know-how, Berman Group study

Innovation infrastructure exists in the Czech Republic but it generally does not provide sufficient business services.	A functioning innovation infrastructure in form of science and technology parks, business incubators and centres for technology transfer is an important component in the environment for innovation activities of enterprises. In the Czech Republic there are currently 28 parks (data from the Science and Technology Parks Association of the Czech Republic) with an average occupancy of around 60%. However, science and technology parks and business incubators in the Czech Republic are mostly orientated towards leasing business space without providing additional business services, and therefore they are not sufficiently attractive for innovative enterprises. In relation to this, innovative enterprises would particularly welcome services in the area of technology transfer, mediation of contacts and consulting in the area of intellectual property.
An opportunity for improvement in this area comes with the financial resources from the EU SF.	Financial resources from the EU Structural Funds 2007 – 2013 present an excellent opportunity for further improving cooperation between business and research and educational institutes and developing research and innovation infrastructure. However, lack of human and financial resources to operate newly constructed facilities represents a possible threat.
Involvement of the Czech Republic in ERA and international cooperation in R&D is currently insufficient, ...	
... which is reflected in the low participation of Czech teams in the EU Framework Programmes.	Participation of Czech teams in the 6th Framework Programme of the EU (FP6) was somewhat higher than in the previous Framework Programme but nevertheless the number of participants per 1 million inhabitants placed the Czech Republic on the 22nd position in the EU-27. Evaluation of participation in FP6 also shows that the Czech Republic has the lowest number of project coordinators of all the EU-27 countries. The low participation of Czech research teams in international research projects can be to a certain extent caused by a lack of motivation due to an easy access to public support for R&D from national sources.
Also the total amount of support obtained is lower than in the EU-15 countries.	The Czech Republic occupies the 17th place among the EU-27 countries according to the total amount of support obtained. It follows from the analysis that participation of the Czech Republic will be higher in FP6 than FP5. If in FP5 (i.e. during the period 1999 – 2002) Czech teams contracted support of approx. 68 mil. EUR, everything indicates that in FP6 (i.e. for the period 2003 – 2006) support for Czech teams will exceed 125 mil. EUR. From the point of view of the financial volume of projects it corresponds to nearly doubling the amount of activities.
Participation is low in particular in thematic priorities for which the FP6 has allocated most of its budget.	Despite the fact that the number of participating Czech teams and the support obtained in contracted projects between 2003 and 2006 clearly increased, in the first three thematic priorities (Life sciences, Genomics and Biotechnologies; Information Society Technologies and Nanotechnologies, Nanosciences, Multifunctional Materials), to which approximately 3/4 of the overall budget of the FP6 thematic priorities are allocated, participation should be higher. As in the case of FP5, FP6 confirms that Czech teams successfully participate in projects in the area of sustainable development and the EURATOM programme. The present course of development also indicates that in comparison with FP5 the programmes supporting mobility of research workers have been better utilized.
The Czech Republic is quite well involved in demanding projects, ...	Contrary to the other new member states, which often participate in support or preparatory projects, Czech teams participate in demanding research projects (Integrated Projects, STREP projects and Networks of Excellence), and almost in the same proportion as teams from the EU-15.

... and participation of Czech industry is also relatively high.	If participation of Czech universities is lower than it is the case for the EU-15 or the other new member states, participation of Czech industry on the other hand is relatively high. According to the summary budget of industrial partners, the Czech Republic is a way ahead on first place among the new member states and on the 13th place overall in the EU-27. Participation of Czech industry in aerospace research and in the area of global climate change has been extremely successful.
The Czech Republic successfully participates in the Eureka programme.	The Czech Republic is one of the most successful countries in the international initiative EUREKA. This international cooperation programme is characterized by its focus on R&D projects close to the market and a significantly high percentage of SMEs participating in it. One of the reasons for the successful position of the Czech Republic is the fact that public financial resources are dedicated to its support which is not the case in other countries.

3.3 Inputs for R&D and innovation

3.3.1 Human resources for R&D and innovation

Human resources for R&D represent one of the key factors for the development of a knowledge based economy and it is encouraging ...

...that the number of R&D personnel and researchers is rapidly increasing.	The number of R&D personnel and the number of researchers has been continuously rising in the Czech Republic since 1995 and over the past two years[35] (i.e. between 2006 and 2005) the number of researchers expressed in the full-time equivalent (FTE) has increased by more than 7%.
Nevertheless, the Czech Republic has not reached the EU-15 level yet.	Although the growth rate of R&D personnel and researchers is much higher than in most European countries, from the point of view of an international comparison the Czech Republic is still below the EU-25 average. In 2005 the total number of researchers in the equivalent of a full time employment reaches nearly 80% of the EU-25 average. The difference is most remarkable when comparing the CR with advanced EU-15 countries because in comparison with Finland or Sweden the Czech Republic has only 30% and 40% of researchers per 1000 employees respectively.
It becomes clear that researchers are often employed on a part-time basis...	Comparison between the full-time equivalent (FTE) and Head Count (HC) of R&D personnel also reveals that researchers in the Czech Republic do not devote their whole working capacity to R&D activity. This can have several reasons but one of the main reasons lies in the financial and social standing of R&D personnel in the Czech Republic in comparison with the attractiveness of other employment opportunities for a highly qualified labour force.
... and also the share of researchers in total R&D personnel remains below the EU average.	The share of researchers in R&D personnel in the Czech Republic is below the European average. Whereas in the EU-25 the share of researchers in R&D personnel exceeds 62%, in the Czech Republic researchers make up only 55% of all employees in R&D. This comparison indicates that in the Czech Republic a relatively high number of technical staff participate in R&D.

[35] A comparison of the data from 2005 with previous years in full time equivalent (FTE) is not possible because in 2005 the Czech Statistical Office changed the way it calculates FTE indicators, which between 2004 and 2005 caused a disproportionately high increase in the number of R&D and researchers. Since 2005 the data provided from the CSO are in conformity with the Eurostat method and therefore are comparable with the data from statistical offices of other EU member states.

In particular, there is a lower number of researchers in the business sector in comparison with the EU-15 countries.	The highest proportion of researchers is in the business sector (43% in 2006) and this number is still increasing. Nevertheless, in 2005 in the Czech Republic the number of researchers in the business sector per 1000 employees was only 65% of the EU-15 average, which is even less than in the case of the total number of researchers. This shows that the business sector is more undersized than the public sector from the point of view of human resources for R&D.
The fastest increase in the share of researchers has been recorded at universities.	Between 1995 and 2006, the governmental sector noted a decrease in the proportion of researchers (from 36% in 1995 to 25% in 2006), which was connected to the gradual strengthening of other sectors to the detriment of the previously dominant Academy of Sciences of the Czech Republic. The highest growth in the proportion of researchers has been recorded at universities which had almost 32% of the total number of researchers in the Czech Republic in 2006. Nevertheless the number of researchers in the university sector is only at the level of 70% of the EU-15 average. The insufficient involvement of academics at universities in research activities can be reflected negatively in the preparation of university graduates, in particular future researchers and top professionals for demanding positions in industrial sectors.
The highest share of researchers is in technical and natural sciences.	Division of researchers into individual scientific fields shows that researchers are mostly represented in technical sciences (43% in 2006). The second highest percentage is recorded in natural sciences (27%), then social sciences and humanities with 14%, medical sciences with 10% and agricultural sciences with around 6% of the total number of researchers. Between 2001 and 2006 the proportion of social sciences and humanities and medical sciences increased, whereas the total proportion of technical and natural sciences on the other hand decreased in the same period by several percentage points. A trend appears that the proportion of researchers in technical sciences is decreasing in the long-term in all sectors of performance.
In the enterprise sector a high number of researchers are employed in ICT and in automotive industry.	From the sectoral point of view most researchers are employed in high-tech sector – research and development (NACE 72) and ICT sector (NACE 73). In medium- tech sector the highest number of research workers is in automobile manufacturing (NACE 34) and the manufacture and repair of machines and equipment (NACE 29). The sharpest increase in the number of researchers since 2001 has been recorded in ICT sector. In this period there was also a three-fold increase in the number of researchers in the manufacture of electrical machines and equipment (NACE 31) and manufacture of medical, precision, optical and time measuring instruments (NACE 33).
The distribution of researchers on the regional level is very uneven.	R&D employees are markedly concentrated in Prague, Central Bohemia and Southern Moravian Region. Whereas in the business R&D sector these regions have a share of almost 65%, in the governmental sector the proportion is almost 90%. The lowest number of employees in R&D can be found in regions with the lowest expenditure on R&D, i.e. Karlovarský, Ústecký and Vysočina regions.
Numbers of students and graduates are steadily increasing, but ...	
... the number of university graduates including PhD graduates is still low in an international comparison.	In the total number of university graduates the Czech Republic is very much below the EU-25 average, however, the number of students and university graduates in the Czech Republic has been on the increase over the past few years. Also the number of PhD graduates has been rising more rapidly than the EU-25 average. Nevertheless, the Czech Republic, as well as most other European countries, has not yet reached the desired number of 1 PhD graduate per 1000 inhabitants between the age of 25 and 34.

Students in natural science and technical fields make up only a third of all university students, …	In the Czech Republic students of science and engineering fields (ISCED 5-6) make up about 30% of all students in tertiary education, which is nearly the same share as the EU-25 average. Between 2004 and 2005 the highest number of students was registered at universities offering Masters degrees, with the greatest interest being in technical fields, agriculture, and IT and computer technology. Concerning PhDs, the greatest interest was in technical, physical and chemical sciences.[36]
... most students graduate in the fields of social sciences, economics and law	Distribution of the number of graduates according to the fields of study in the Czech Republic was similar to most European countries in 2005. Most represented were: social sciences, economics and law (in total 32% of all graduates), pedagogic fields (17%) and technical fields (15%). The Czech Republic is very much below the EU-25 average in the share of science and engineering graduates aged between 20 and 29 per 1000 population (8.2 graduates per 1000 population in 2005, the EU-25 average is more than 13 graduates). It is encouraging, however, that between 2001 and 2005 the Czech Republic recorded a 3 times higher average annual growth than the EU-25 in this area.
... and there is also an imbalance between the proportion of students and graduates in technical fields.	A comparison of the proportion of students and graduates in scientific and technical sectors in 2005 shows that even though the proportion of students in scientific and technical sectors was around 30%, the proportion of graduates was only 23%. This indicates that students leave these universities, e.g. because the study is too demanding compared with other fields or because the study does not fulfil their original expectations.
A high share of graduates in technical fields in the overall population of the Czech Republic is encouraging.	The Czech Republic has a relatively high proportion of graduates from technical universities in the overall population. The number of graduates of technical fields aged between 25 and 64 is approx. 35% of the total number of university graduates in this age group, which is significantly higher than the EU-25 average where it is less than 20%. Considering the current structure of graduates this probably relates to older graduates because at present the proportion of graduates in these fields is lower. No shift has been achieved in this area despite the fact that the task of implementing measures to motivate students to study these subjects has been set by political and economic documents (e.g. the National Innovation Policy).
On the contrary, a relatively lack of interest of PhD graduates in a career in research is negative.	Despite the fact that studying for a PhD can be considered as a preparation for research work, research in the Czech Republic is only performed by one third of all PhD graduates. The main reason for choosing a career in research in the case of PhD graduates is the inventive nature and innovation potential of the work. However, only a low percentage of researchers with PhDs embark on a career in research due to good working conditions (less than 10%) or well-paid work (only 3%).
The number of employees in high-tech and medium high-tech sector in the Czech Republic is significantly rising ...	
… and their share in/of the labour force is nearly two times higher than in the EU.	The share of employees in high- and mid-tech sector surpassed 10% in 2006 which is a significantly higher figure than the EU-25 average (6.7%). Also in high-tech sector only the share of employees in the Czech Republic is higher than in the EU (in the Czech Republic 1.7%, in the EU-25 1.1% of the labour force) and is still increasing. Around 9% of the labour force in the Czech Republic works in medium high-tech industry and the annual growth between 2002 and

[36] Analysis of human reources for the proposal of National Research Programme III, 2006

	2006 was 5% on average, which is one of the highest percentage increases among all European countries. However, this positive trend must be taken with a pinch of salt because employees in the above mentioned high and medium high-tech sector are not statistically divided according to their level of education and therefore the data may not refer to highly qualified manpower.
The situation in knowledge intensive services is slightly worse.	In the number of employees in knowledge intensive services the Czech Republic is slightly below the EU-25 average and the proportion of employees in this sector in the Czech Republic has been decreasing since 2006 by almost 2% annually. Contrary to this the proportion of employees in this sector in EU-15 and EU-25 countries is relatively stable.
Sectoral structure of employees is uneven from a regional point of view.	In the Czech Republic an above-average share of employees in high-tech industry and in high-tech services can be found in Prague and the Pardubický region. The employment rate in medium high-tech sector is the highest in Central Bohemian, Plzeňský Ústecký and Pardubický regions. The lowest employment rate in medium high-tech industries is in Prague, which is caused by the space, manpower and materials intensive production being forced out of the city and substituted by more advanced sectors of industry and services.
The Czech Republic features a low mobility of the labour force, ...	
... with both geographical and horizontal mobility of the qualified human resources being low.	Mobility of the labour force in the Czech Republic in comparison with other European countries is at a low level, but among the post-communist countries the Czech population is the most active from the point of view of mobility. Also mobiity of qualified human resources in the Czech Republic is rather low. Besides inter-regional and international mobility the level of so-called horizontal mobility is also low in the Czech Republic (i.e. staff exchange between individual sectors, in particular public R&D and industry). Absence of programmes supporting horizontal mobility is one of the reasons for this situation.
International mobility of university students is also low.	From an analysis of international mobility of university students it follows that 1.8% of Czech students studied in EU-27 countries or associate and candidate countries in 2005, which is a below-average figure in comparison with other European countries. The proportion of foreign students in the Czech Republic, which indicates the attractiveness of Czech universities for foreign students, reached 5.5% in 2005. Values of both these indicators have increased since the year 2000. A significant proportion (almost 2/3) of the total number of foreign students at Czech universities was made up of students from Slovakia, which is influenced in particular by a language similarity, possibility to take exams in their native language and the fact that they can study for free.
The migration of university students is connected with a risk of brain-drain from regions.	At all universities and most large faculties the highest share of students lives in the region where the universities are based or in neighbouring regions. The character of the migration of university students is influenced to a great extent by the range of study fields offered in individual regions of the Czech Republic. The highest influx of university students is recorded for Prague and Southern Moravia due to both their central location inside the Czech Republic and the wide range of study field being offered. From the point of view of a well-balanced development of regions there is a risk that students do not return to regions of their origin after completing their study. This internal brain-drain is one of the most serious reasons for regions lagging behind in comparison to Prague.

Even if lifelong learning is one of the priorities of the EU, ...	
... the participation of Czech citizens in lifelong learning is rather below average.	The need for lifelong learning is getting in the forefront in particular in relation to a greater orientation of the economy towards knowledge creation. In an international comparison the participation of population in educational activity in the Czech Republic is below average, even in the group of post-communist countries. Insufficient development of the system for lifelong learning is the main reason for this situation.
Participation in educational activities increases with level of education.	In the Czech Republic the level of participation of the population in educational activities leads to a further deepening of socioeconomic differences. Participation in further education is the highest for population with a university education (in 2003 approx. 25% of the population with a university education participated in lifelong learning). The proportion of high school graduates was approx. 15%, participation of people who did not finish high school was 7.7% and participation of those with a basic education only 4.9%. Participation in further educational activities is significantly higher for employed population than the unemployed or the economically inactive population.
Language courses representing the most common educational activity ...	Based on the sectoral specialization of educational activity, participation of the population of the Czech Republic is highest in humanities (48. 5% of all participants), then in business and law (8.4%), informatics (7.1%) and security services (5.3%). A more detailed division of these fields shows that the study of languages prevails, followed by computer courses and transport services and communication (in particular driving courses).
... and the highest participation in educational activities is in Prague.	On a regional level the greatest participation in educational activity is in Prague. The difference between Prague and the other regions follows from the different educational structure of the inhabitants of regions, the professional composition of the workforce and the diverse conditions for further education.
It is evident that participation in educational activities decreases with age.	Participation in educational activity in the Czech population is the highest in the age group of 15 to 24, which reflects mostly the situation in attending high school or university education. From the age of 25 the proportion of the population who do not participate in any form of education prevails and this proportion increases with age.

3.3.2 Financing of R&D and innovation

The total expenditure on research and development in the Czech Republic is continually rising but ...	
... fulfilment of the objectives of the Lisbon Strategy is currently a long way ahead.	The intensity of research and development (i.e. the share of all expenditure on research and development in the total gross domestic product) in 2006 increased to 1.55% compared to 1.41% in 2005, but fulfilment of one of the main objectives of the Lisbon Strategy, where the overall expenditure on R&D should reach 3% GDP by 2010, is still a way ahead. Even with the current increases in expenditure on R&D we cannot expect the Czech Republic to fulfil this objective.
The gross expenditure on research and development is currently insufficient...	Even if the gross expenditure on R&D (GERD) increased by about 18% in the Czech Republic in 2006 in comparison with 2005 and reached almost 50 billion CZK, it is still insufficient in relation to the number of inhabitants. In Purchasing Power Standards (PPS) the overall expenditure on R&D per person in the Czech Republic in 2005 amounted to approx. 60% of the EU-25 average and 30% of the expenditure on R&D in countries with intensive re-

	search like Finland or Sweden. The expenditure on R&D in EUR per inhabitant in the Czech Republic is only one third of the average expenditure on R&D in the EU-25 and is less than 15% of the expenditure on R&D in Sweden or Finland. The low expenditure on R&D corresponds to the low number researchers, in the expenditure per researcher and in PPS the Czech Republic is approx. at 85% of the EU-25 average.
... and in this expenditure there is still a lower proportion of private financial resources.	In 2006 the share of private financial resources (financial resources from the business sector) in the overall expenditure on R&D was almost 57% (approx. 0.9% GDP). Despite the fact that the proportion of private resources has increased over the past few years, it is still lower than required by the Lisbon Strategy (2/3 of the total resources for R&D). The share of public expenditure in the overall expenditure on R&D decreased in 2006 compared with 2005 but it was still higher than the EU-25 average and even some of the advanced countries of the EU-15.
In comparison with EU-15 countries the expenditure on human resources in R&D is lower.	The share of labour costs in expenditure on R&D is low, which corresponds to the low salaries of researchers, amounting to the level of 30% of EU-15 countries. As a result of low salaries, scientific work loses social prestige and leads to quality research workers leaving for abroad (so-called brain-drain). In addition this creates barriers not only to the influx of researchers from other countries (brain gain) but also to the return of elite Czech scientists from their stays abroad.
The structure of total expenditure on R&D does not much support the development of a knowledge based economy in the Czech Republic.	Share of basic research in the overall expenditure on R&D is relatively high and has been rising over the past few years at the expense of applied research, whose share in GERD in comparison with EU-15 countries is rather low. The prevalence of basic research (at the expense of applied research) can result in a lack of research results that could be useful for commercialization. The low proportion of applied research and prevalence of experimental development in the business sector (see below) can create another barrier for the commercialization of research in innovation because when companies incorporate innovation they prefer solutions which are in the prototype or pilot operation stage. It is also evident that Czech companies often purchase know-how from abroad.
R&D expenditure in the corporate sector is increasing more rapidly than the total expenditure for R&D, but ...	
... it does not reach the level of advanced EU-15 countries yet.	Expenditure on R&D in the business sector increased in 2006 in comparison to the previous year by more than 20%, nevertheless it still does not reach the level which is common in advanced EU countries. In 2005, corporate expenditure on R&D in EUR per inhabitant was one third of the EU-15 average and in comparison with these countries the Czech Republic has a higher proportion of public financial resources in business expenditure on R&D. It is also clear that the highest proportion of public resources is in micro-businesses with up to 10 employees where public resources make up more than 40% of the total expenditure on R&D, and surprisingly even in medium-sized enterprises where more than a quarter of the expenditure on R&D comes from public resources.
The structure of expenditure on R&D in the business sector is not optimal yet ...	In the Czech Republic there is not only a low number of researchers and low expenditure on R&D in the business sector, but even the structure of the expenditure on R&D is not optimal. Experimental development is prevalent in Czech enterprises, whereas in EU-15 enterprises a larger proportion of expenditure is allocated for applied and basic research. Czech companies concentrate on the adaptation of products and technology for the local market

	and not on the generation of new knowledge, which can be reflected in the very low patent activity of companies in the Czech Republic. In comparison with EU-15 countries, where research is strong in particular in highly technologically intensive sectors, in the Czech Republic the highest proportion of R&D is carried out in industrial sectors with medium or low intensive technology. It is encouraging that over the past years the proportion of research in high-tech sectors is increasing.
... and Czech businesses invest a smaller proportion of their turnover into R&D than businesses in advanced countries.	Czech businesses devote approximately 0.5% of their turnover to R&D, whereas businesses in EU-15 countries allocate more than 1% of their turnover for research. In some countries, like for example Finland, Great Britain, Germany and Austria, expenditure on R&D exceeds 2% of companies' turnover, and in Sweden it reaches 4%. The most outstanding difference between the Czech Republic and EU-15 countries is evident in high technologically intensive sectors although in the Czech Republic the intensity of research in high-tech sector is slightly higher than in less technologically intensive sectors. The differences between the Czech Republic and EU-15 in the concentration of R&D in highly technologically intensive sectors indicate that in the Czech Republic companies focusing on the assembly of products with a minimum contribution to in-house R&D play a significant role even in high-tech sector. The low intensity of research in the business sector can also be related to the lower capital strength of Czech companies and this can result in low work productivity (or generated gross value added), which is evident in the Czech Republic in comparison with EU-15 countries.
Multinational corporations play a crucial role in R&D in the Czech Republic ...	
... spending most expenditure on R&D in the business sector.	The Czech Republic is a country with the most globalized corporate research. At present the share of expenditure on R&D carried out in multinational corporations or in foreign companies is close to 60% and rising. This high share on one hand means that corporate R&D in the Czech Republic is strongly associated with the international R&D in multinational corporations, has access to the most up-to-date knowledge and technologies and can successfully develop cooperation with other R&D facilities within the corporation. On the other hand this means that domestic corporate R&D is very weak. Taking into consideration that with higher expenditure on R&D less researchers are employed in foreign companies, it is clear that R&D in the branches of multinational companies is more effective and also more investment activities and modernization of R&D capacities occur there.
R&D performed by multinational corporations in the Czech Republic is significantly concentrated regarding sectors.	In the manufacturing industry the share of foreign companies in R&D expenditure exceeds 70% and in several sectors, like the automobile, chemical or pharmaceutical industries, the share of foreign companies in R&D is from 80% to 90%. Research activities of multinational corporations are mainly carried out in relation to their production activity in the Czech Republic and their investment focused purely on the utilization of local R&D is limited at present. Even through multinational corporations dominate R&D in high-tech and mid-tech sector they are also notable in less technologically advanced sectors. From interviews with managers of international corporations active in the Czech Republic in the framework of the international project LocoMotive[37] during 2006 it follows, however, that companies transfer development (adaptation of products) rather than research (obtaining new findings) to the Czech Republic from their headquarters abroad.

[37]"LocoMotive - Dissemination of knowledge concerning current R&D localization motives of large regionally important private sector organizations, http://www.locomotive-project.org

The share of the university sector in public research is increasing, but...	
... research in the governmental sector still prevails.	In the university sector, similar to other post-communist countries, there is significantly less research carried out than in EU-15 countries, which is a consequence of the traditionally strong position of the Academy of Sciences. The low share of research performed at universities can have a negative effect on the development of human resources for R&D and reduce the quality of graduates (in particular PhD graduates) and their work in practice, not only in research but also in challenging positions in the business sector.
The expenditure on R&D per inhabitant in higher education is significantly below the average of EU-15 countries.	Even if the expenditure on R&D in the public sector has increased over the past few years it is still below the average of EU-15 countries. The R&D expenditure per inhabitant in the Czech Republic is at the level of 20% of the average EU-15 countries (e.g. Germany, France and Belgium) and only at the level of 10% of R&D expenditure in this sector in Sweden, Finland, Denmark or Austria.
Institutional financing still prevails in the financing of R&D from public resources...	In the Czech Republic institutional financing of research prevails with a share exceeding 50% and there has been little change in this over the past few years. The volume of allocated financial resources is also not sufficiently associated with ex-post evaluation of the research results. This reduces the effectiveness of the allocation of public financial resources because besides excellent institutes, average and even below-average ones are also supported. Low motivation of researchers towards scientific work, decrease in the quality of Czech research (excellence), and a lack of new findings applicable in innovation in the business sector are results of the lack of differentiation.
... and in the expenditure on R&D in the public sector the share of private financial resources is relatively low.	In the Czech Republic there has been a low share of private financial resources in expenditure of the governmental and university sectors on R&D. The situation is wholly unsatisfactory particularly in the higher education sector, where the share of private financial resources has been for a long time below 1%, whereas in EU-25 countries private resources provide on average 6% of R&D expenditure in this sector and in some countries, e.g. Germany, Slovenia and Hungary, this figure is higher than 10%. The lack of participation of private financing in public research is an indication of an insufficient cooperation between businesses and research institutes and universities. The unsatisfactory situation in cooperation between companies and public research also follows from surveys[38] that have recently been carried out in the Czech Republic.
From the point of view of expenditure on R&D there are major differences between regions, ...	
... several regions have an important position in R&D, and on the contrary some regions have a marginal significance in R&D ...	The same manner as the employment rate in research and development, the expenditure on R&D is strongly concentrated in Prague, and the regions of Central Bohemia and Southern Moravia, where almost 70% of all the expenditure on R&D in the Czech Republic is invested. This concentration is the highest in the governmental sector, in which the above-mentioned regions receive almost 90% of the invested resources. In the corporate sector the most significant amount of resources is concentrated in Prague and Central Bohemia (55% in total). Prague and Southern Moravia have the most significant share of the whole country's expenditure in the university sector. The share of

[38] E.g. Barriers to the Growth of Competitiveness of the Czech Republic, http://www.strukturalni-fondy.cz/evaluace/bariery-rustu-konkurenceschopnosti-cr

	other regions in the total expenditure on R&D is significantly low. The lowest expenditure on R&D is in structurally affected Karlovarský and Ústecký regions, where also the growth in expenditure on R&D is the slowest.
...and in most regions the target of 3% of GDP for R&D expenditures, which is one of the objectives of the Lisbon Strategy, is very far away.	The intensity of research and development (share of total expenditure on R&D in GDP) in most regions of the Czech Republic is well below the EU-25 average. The 3% target of expenditure on R&D from regional GDP, which is one of the main objectives of the Lisbon Strategy, is in the case of these regions unrealistic. Only Prague and Central Bohemia are exceptions in this regard, with their share of expenditure in GDP being close to this figure. There are also marked differences among regions in the share of GDP being invested in R&D – Central Bohemia on first place invests 20 times more than the region of Karlovy Vary on the last place.

3.4 Outputs of R&D and innovation

3.4.1 Results of research and development

The number of publications of Czech authors is increasing each year, but...

...in the number of publications per inhabitant the Czech Republic has been on one of the lowest places in the EU.	In the number of scientific publications per inhabitant the Czech Republic is significantly worse than EU-15 countries. During the twelve years monitored, the number of Czech publications annually increased and over the whole period grew by more than 50%. However, the number of publications was also increasing in other countries and it is evident that the Czech Republic not only failed to gain on the advanced EU countries but the gap is actually increasing.
The lag is caused to a greater extent by a low number of R&D personnel ...	The Czech Republic is on the level of the EU average in the number of publications per number of R&D personnel. On average, R&D personnel in the Czech Republic generate the same number of publications as other EU countries. The lag in the number of publications per inhabitant is possibly a result of the low number of R&D personnel in the Czech Republic.
... and a low expenditure on R&D, in particular expenditure on human resources.	In number of publication related to gross expenditure on R&D (GERD), the Czech Republic even get ahead of the advanced EU-15 countries but some new EU member states are doing even better. It is evident then that the cheap production of publications in the new EU member states is due to the lower costs and in particular the lower pay of R&D personnel.
The average citation of Czech publications is the lowest among peer countries.	Comparison of their citation rate is a decisive factor in the assessment of the quality of publications. During the monitored period, Czech works were cited 5.45 times on average and the average citation rate of publications was the lowest of all the EU countries compared. In the number of citations per R&D personnel the Czech Republic is not doing much better. R&D personnel in the Czech Republic generates the same amount of publications per year as their colleagues in advanced EU countries but these publications are cited one third less and have a lower impact. In number of citations related to the gross expenditure on R&D (GERD) the Czech Republic is ranked higher than some EU-15 countries but it lags behind the other post-communist countries.
Engineering and mathematical sciences are at a good level in the Czech Republic and also	In an international comparison of the productivity of research in various scientific sectors in the number of publications per inhabitant, the Czech Republic is best placed in agriculture and chemical sciences and is relatively well placed in material sciences, microbiology, physical sciences and in plant and animal sciences. Comparing the citation rate, the Czech Republic is relatively

computer science, environmental fields and molecular biology have a good position.	good at engineering sectors, ecology and mathematical sciences. The average citation rate of Czech publications in computer sciences and molecular biology fields was also relatively high. In pharmaceutical sectors, chemical sciences and clinical medicine the citation rate of Czech publications was lower and in other sectors the Czech Republic was completely absent.

Though number of patent registrations of Czech inventors has been gradually increasing on a year-by-year basis, ...

... we still produce a very small amount of EPO and USPTO patents.	Based on the information from Eurostat, a total of 829 applications by Czech authors were registered at the European Patent Office (EPO) between 1994 and 2003. In the number of EPO patents registrations per 1 million inhabitants the Czech Republic ranked far behinds the advanced EU-15 countries and even Hungary was ahead of us. The United States Patent Office (USPTO) granted a total of 222 patents to authors from the Czech Republic and further 84 patents to authors from Czechoslovakia between 1994 and 2005. If a proportional part of the Czechoslovak patents is considered (i.e. 2/3), the USPTO granted a total of 278 patents to authors from the Czech Republic. In the number of USPTO patents per 1 million inhabitants the Czech Republic is one of the last placed countries.
Their low number cannot be explained by the low number R&D personnel or the low amount of financing.	Although the Czech Republic has a lower number of R&D personnel compared with advanced EU countries, its ranking does not improve when comparing the number of patents per 1000 R&D personnel. The poor results of Czech R&D in the area of patents are even more evident when translated into the volume of financial resources spent. The Czech Republic has the third lowest number of EPO and USPTO patents per 1 Billion EUR of total expenditure on R&D (GERD) after Greece and Poland[39].
The number of patents does not correspond to the volume of investment put in R&D by the private sector, either.	As 89% of all patents registered at the EPO are applied for and owned by private companies, some of the patenting costs may be projected to R&D expenditure of the private sector (BERD). After recalculating into BERD the Czech Republic ended up in the last place in EPO patents and the last but one in USPTO patents. If it is true that most patents are applied for by companies and thus generated by their incentive and at least in part for their resources, these findings indicate that business sector in the Czech Republic is not greatly interested in patents, does not focus its resources on acquiring patents and does not sufficiently motivate its R&D personnel to produce patents.
Czech firms do not strive too much for foreign or Czech patents,...	Only 56% of all Czech patent registrations at EPO are applied for and thus also owned by private companies, which is significantly less than for advanced EU countries. Private firms are also represented among the owners of USPTO patents in the Czech Republic to a lesser extent than in advanced EU countries. On the other hand, as for Czech patents the authors are mentioned as both the applicants and owners in a significantly higher percentage. A low proportion of Czech patents in the ownership of Czech companies and on the other hand their relatively high proportion in the ownership of the inventors themselves clearly illustrates the general lack of interest of Czech companies in patents.

[39] The following seven countries were selected to compare international publications and patent activities – The Czech Republic, Hungary, Poland, Austria, Ireland, Finland and Greece (the selection of countries is specified in more detail in the Analytical part of the Green Paper).

... which is indicated by the fact that a major proportion of patents of Czech inventors are owned by foreign firms.	A relatively large proportion of patents coming from Czech inventors are owned by foreign companies. Ireland has also a relatively high proportion of patents from domestic inventors in the ownership of foreign companies but local firms own more than double the amount of foreign patents than is the case of the Czech Republic. Czech firms are clearly not interested in what the Czech Republic generates and there is not much interest in patents from abroad either.
The cancellation of ministerial research institutes and the reorganization of AS CR played an important role in this.	Prior to 1990, ministerial institutions were among the most significant applicants and owners of Czech patents at USPTO. After 1990, these institutes were closed or sold and today most of them pursue other related activities in addition to contracting research. After 1995 patents applied for by AS CR strictly speaking disappeared. This may be related to the closure of several academic institutes and changes in the system of the evaluation of institutes, when the main emphasis was placed on publications in high impact journals. After 1990 the number of patents applied for by companies and universities also decreased. Only the number of patents applied for by individual owners has increased. It is necessary to realize that the number of patents applied for by all significant subjects was continuously decreasing since 1975, but after 1990 this decrease further deepened.
In an international comparison the number of patents was relatively higher in environmental fields and material sciences.	The highest number of Czech patents at both patent offices fall into engineering sciences, material sciences, pharmaceutical fields and chemical sciences and in case of USPTO also computer science. Other countries also have the highest number of patents in the majority of these fields. In an international comparison regarding the number of patent applications, the Czech Republic was placed the highest in patents related to environmental fields and material sciences. However, even in these sectors the number of Czech patents is significantly lower than in advanced EU-15 countries.
The distribution of R&D results in individual regions is uneven, which corresponds to the uneven distribution of R&D capacities and resources.	The highest number of patents granted by the Industrial Property Office of the Czech Republic in absolute values fall on applicants from regions with the largest both industrial and research basis. Regions with by far the highest share in R&D expenditure and employment – Prague (30% of all patents awarded by IPO between 1994 and 2005), Central Bohemia and Southern Moravia – are joined by the region of Moravia-Silesia, important from the point of view of population and economy. The regions of Prague and Liberec have been featuring the highest number of patents per million inhabitants in the last years. The lowest patenting activity has been recorded in regions with a very weak research basis (Karlovarský, Ústecký, and Vysočina regions) and also Southern Bohemia.
Utilization of R&D results by industry in the Czech Republic is at a very low level, ...	
... the Czech Republic sells a very low amount of licences abroad….	In the sale of licences in the framework of international trade the Czech Republic is relatively weak and among selected EU countries the situation is only worse for Poland and Greece. This testifies to a very low performance of Czech R&D in the area of protected intellectual property.
...and payments for the purchase of licences are 2.5x higher than the revenue from their sale	Payments by Czech entities for the purchase of licences and trademarks from abroad have been increasing yearly and since 1996 these payments in EUR have almost doubled. Expressed as a percentage of GDP, the value of purchased licences since 1996 has remained unchanged and stagnates at around 0.16% GDP. Revenue from the export of licences has also stagnated at the level of approx. 0.055% GDP since 1996. Payments for purchased licences abroad are more than 2.5 times higher than the revenue from the sale of licences abroad.

The low purchase of licences from abroad testifies to the fact that new R&D results are not too much in demand by Czech firms.	Czech companies purchase a relatively low amount of R&D results from abroad for their innovation (i.e. patent licences, trademarks and know-how). The import of licences by Czech companies is one of the lowest in comparison with other EU countries. There is a difference not only in comparison with Ireland but even with neighbouring Hungary. Czech companies evidently need neither foreign nor domestic R&D results.

3.4.2 Innovation in businesses

Innovation activity in Czech businesses has been increasing, but...

... foreign direct investments play an important role, ...	Despite the fact that the share of innovation companies in the Czech Republic is below the EU-15 average, the progress in the number of innovation companies means that innovation in the business sector plays a more and more significant role. A significant effect on this development can be seen in the inflow of foreign direct investments to manufacturing industry, through which a diffusion of new technologies and innovative processes to companies in the Czech Republic occurs. From the point of view of the type of innovation in the Czech Republic, there is a trend of implementing process innovation together with innovating products. In addition, there is a gradual increase in the significance of non-technical (in particular organizational) innovation.
... which on one hand stimulate international cooperation in the filed of innovation, ...	The effect of localization of R&D activities in the Czech Republic, related to the global trend in the internationalization of corporate R&D, is also shown in an increasing international cooperation among companies in innovation and R&D. Companies based in small countries with relatively advanced local R&D (Denmark, Luxemburg, Finland) are mostly involved in this cooperation. The level of international cooperation of companies based in the Czech Republic is relatively high and even surpasses strongly innovative countries like the Netherlands or France.
... but also determine the character of innovation processes in Czech enterprises, based rather on adopting advanced technologies.	The intensity of innovation (share of expenditure on innovation in the overall turnover of innovation companies) has significantly increased in the Czech Republic over the past few years and at present it slightly exceeds the average intensity of innovation in the EU-15. The increase in innovation intensity shows that Czech companies have begun to recognize the importance of innovation for maintaining competitiveness and have increased the volume of investments in innovation activity. The structure of expenditure on innovation shows that purchase of machinery and equipment (47% in 2005) is the dominant component. In contrast, only 22% of the overall expenditure on innovation was spent on in-house R&D activities in the same year. This structure indicates that the innovation process in Czech enterprises is generally characterized by adopting advanced technologies, processes and other methods related to production. In relation to the inflow of foreign investment it can be concluded that this transfer takes place from foreign controlling companies to subsidiary companies located in the Czech Republic.
It is positive that innovation in businesses has been attaining a greater significance,…	The increase in the share of turnover of innovated products on the total turnover of all innovative enterprises also testifies to the increase in significance of innovation in the business sector in the Czech Republic. It is positive that there is not only an increase in the share of turnover of innovation new to the firm but also of innovation new to the market. Increase in quality and expansion in the range of products and services are considered by innovative companies to be the most significant effect of implemented innovation. The fact that awareness of the importance of innovation in the business sector has been generally increasing testifies to a better understanding of the importance

	of innovation for maintaining the competitiveness of enterprises in the Czech Republic.
... on the other hand it is negative that the most significant barriers to innovation are of an economic character.	Development of innovation activities in Czech business sector is limited in particular by economic factors connected with a low availability of financial resources for innovation, high economic risks accompanying innovation activities and necessity to solve subsistence problems. Innovative companies also perceive a lack of qualified labour force and the negative role often played by the lack of market demand for innovative products (unsecure or non-existent demand) which points to the insufficiently developed innovation culture in the Czech environment.
Survey results also show that public support to business innovation has been insufficient.	In 2004 nearly 16% of innovating enterprises received public support for innovation, which is substantially less than for example in Netherlands, Italy, Finland and Austria, where more than 30% of innovating companies received public support. In some new member states, e.g. Hungary, the proportion of companies obtaining public support is higher. In the Czech Republic the highest percentage of companies obtained support from governmental or regional resources, and the lowest percentage obtained support from EU Framework Programmes. Statistical data also show that companies of technologically advanced sectors as well as of medium or lesser technologically intensive sectors were supported. It is also evident that support to innovation at the regional level has been insufficient.

4. SWOT analysis of R&D and innovation

4.1 SWOT analysis in relation to the phases of the innovation process

The following SWOT analysis of research, development and innovation which outlines the strengths, weaknesses, opportunities and threats identified in the evaluation of the situation in the Czech Republic, ...

... is divided into four individual blocks ...	The following pages contain tables summarizing the strengths, weaknesses, opportunities and threats of research, development and innovation, which were revealed by the evaluation of the situation in the Czech Republic. This SWOT analysis is divided into four separate blocks – environment and systems, human resources, financing, and infrastructure and cooperation in research, development and innovation.
... and their individual items are categorized according to the phases of the innovation process.	Identified strengths, weaknesses, opportunities and threats are classified in each block according to the phases of the innovation process in which they are best reflected, i.e. the creation of knowledge (i.e. in research and development), knowledge transfer or application of knowledge (business). Individual items are determined by blocks and the length of each block corresponds to the phase in which the given item dominantly acts. If the block stretches only into a half of the field of the given phase of the innovation process this means that the item only partially affects that phase.

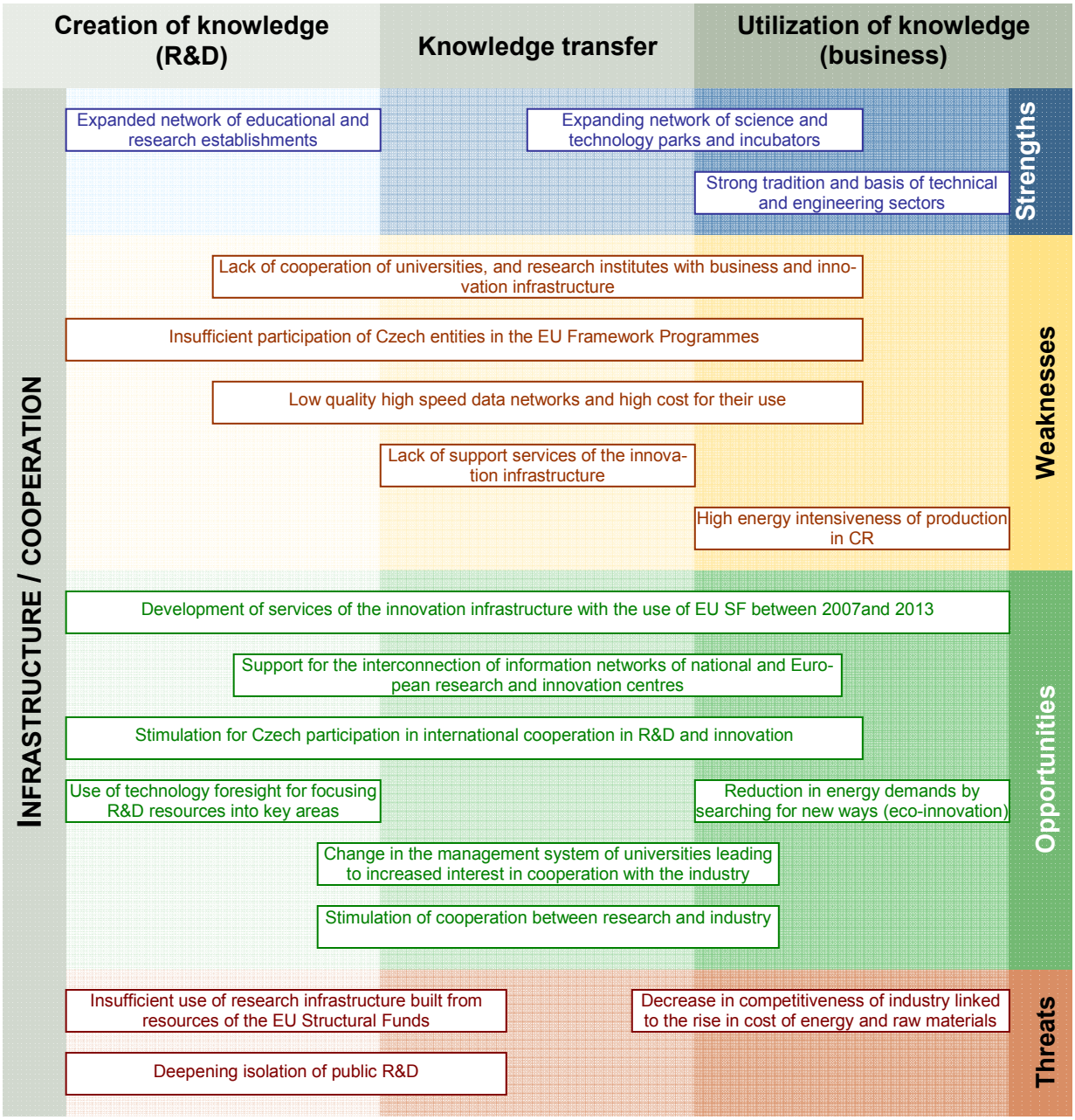
	Creation of knowledge (R&D)	Knowledge transfer	Utilization of knowledge (business)
ENVIRONMENT AND SYSTEMS			
Strengths	Existence of a National Innovation Policy and its implementation		
	Development of strategic development plans (including innovation strategies) on the regional level		
	Attractiveness for foreign investment		
	Growing impact of Czech research over the past years		High openness of Czech economy linked to growing export volume
		Increased competitiveness of high-tech sector	
Weaknesses	No assigned competence innovation policy at the national level and a related lack of coordination of education, R&D, innovation, and industrial policies etc.		
	Excessive number of state budget R&D-related categories		A low share of high-tech industry and services for value added generation
	R&D evaluation system not taking into account quality of results and leading to an ineffefctive allocation of public finances to R&D		
		Double taxation of venture capital investments	
	Fragmentation of R&D at the project level – insufficient concentration of financial and human resources for excellence		Unfavorable business environment (complicated tax collection and procedural complications in closing business)
		Absence of tax incentives for investment into venture capital (in particular seed capital)	
		Lack of flexibility in the labour market connected with a demotivating social system	
		Weak innovation culture	
		Low innovation activity in industrial companies based on R&D results	
Opportunities	Improved conditions for coming of qualified labour force to the Czech Republic		
	Increased interest of firms (e.g. high-tech) in R&D in CR as a result of a growing knowledge intensity of production		Creation of an environment stimulating use of public procurement to support innovation
		High investment activity creating potential for a growth of competitiveness of the Czech Republic	
	Adoption of R&D reform leading to an effective allocation of public resources to R&D and increased interest of universities and public research institutes in knowledge transfer		
		Inflow of foreign investment to technologically intensive sectors and localization of R&D of multinational companies in the Czech Republic	
Threats	Decrease in quality of research and intensity of use of its results due to insufficient links between public support and evaluation of R&D results		Decrease in competitiveness of Czech enterprises
	Insufficient interconnection between support from EU SF and the reforms of R&D, innovation and tertiary education		Decrease in economic stability (non-alignment of business cycle with EU)
	Rise in regional disparities and creation of a dual economy (also due to uneven use of resources from EU SF)		
		Decrease in the attractiveness of CR for foreign investment into R&D and technologically demanding productions	

	Creation of knowledge (R&D)	Knowledge transfer	Utilization of knowledge (business)
Strengths	Number of research personnel has been growing far more rapidly than in EU-25 and EU-15 countries The number of publications of Czech researchers corre-sponds to that of the EU-15 average Comparable level of some research teams with the global elite Tradition of education in technical fields		High employment rate in medium high-tech and high-tech sector
Weaknesses	Low number and unsatisfactory structure of tertiary education graduates including PhD Low number of research personnel in the labour force Low regional and sectoral mobility of researchers and other professional and technical staff and low mobility between the academic and business sectors Low ability and motivation of researchers to achieve results for practical use and patent protection Low production of quality publications by Czech researchers (low number of citations) Unsatisfactory age structure of research and pedagogic staff Low awareness in industrial property rights Low international mobility of university students		Insufficient knowledge and use of modern management methods Slow structural adaptation of employment Low participation in lifelong learning
Opportunites	Use of resources from SF 2007-2013 for the development of human resources in R&D, innovation and enterprise, inter alia to support horizontal mobility Rise in motivation of young researchers Rise in attractiveness of CR for foreign R&D personnel due to a relative increase in salaries Increased awareness in industrial property rights Adoption of reform in tertiary education	Strengthening of the “entrepreneurial spirit“ in research institutes and universities Creation of conditions for qualified labour force coming to the Czech Republic Development of entrepreneurial skills of students	
Threats	Critical shortage of researchers in the public sector in relation to extending R&D capacities through EU Structural Funds between 2007 and 2013 Brain-drain of researchers for abroad and a barrier for brain-gain of foreign researchers due to low salaries Demotivation of quality researchers and their leaving the research sector	Rigid educational system and its detachment from the needs of innovative businesses	Critical lack of qualified labour force in business related to the development of production and services Decrease in qualified labour force due to opening of the EU labour market

HUMAN RESOURCES

	Creation of knowledge (R&D)	Knowledge transfer	Utilization of knowledge (business)
Strengths	Expenditure on R&D in the CR is increasing more rapidly than in EU-25 and EU-15 countries The cost of a single publication and citation is lower in CR than in EU-15 countries Existence of tax incentives for R&D investments		Stable rise in capital stock (reflected in the investment activity in CR)
Weaknesses	Insufficient expenditure on R&D in the public and business sectors Structure of expenditure on R&D unsuitable for developing knowledge based economy Low effectiveness of public and private R&D expenditure reflected in a low patenting activity Low share of private financing in public research The system of tax incentives for R&D investments stimulates strengthening in-house business R&D at the expense of cooperation with research institutes and other enterprises	Venture capital not used for financing innovative projects Fragmented financing of R&D from the state budget	Low corporate expenditure on innovation Prevailing purchase of machines and equipment in the innovation expenditure of enterprises Insufficient support to R&D and innovation in enterprises Lack of resources of Czech enterprises for purchasing foreign licences
Opportunities	Increasing expenditure on R&D, commercialization of results and implementation of innovation using finances from the EU Structural Funds in 2007 - 2013 Development of infrastructure for early stage venture capital investments through initiatives of the European Commission and EIB - JEREMIE Stimulating tax environment for of venture capital investments (removal of double taxation, enabling investments by pension funds and insurance companies, tax relieves for VC and business angels) Increase in the interest of enterprises in patents and innovation due to strengthening their capital and shift from a labour intensive to technologically intensive production Implementation of tax incentives for purchasing R&D by enterprises from research institutes and universities	Use of public procurement to support innovation	Inflow of foreign investment to technologically intensive sectors and localization of R&D of multinationals in CR High investment activity creating a potential for growth in competitiveness of enterprises in CR
Threats	Dependence of public research infrastructure newly developed from the EU SF entirely on public funding Ineffective use of EU SF for financing an excessive number of educational programmes		Decrease in the attractiveness of CR for foreign direct investment

FINANCING


Creation of knowledge (R&D)
Knowledge transfer
Utilization of knowledge (business)
INFRASTRUCTURE / COOPERATION
Strengths
Expanded network of educational and research establishments
Expanding network of science and technology parks and incubators
Strong tradition and basis of technical and engineering sectors
Weaknesses
Lack of cooperation of universities, and research institutes with business and innovation infrastructure
Insufficient participation of Czech entities in the EU Framework Programmes
Low quality high speed data networks and high cost for their use
Lack of support services of the innovation infrastructure
High energy intensiveness of production in CR
Opportunities
Development of services of the innovation infrastructure with the use of EU SF between 2007and 2013
Support for the interconnection of information networks of national and European research and innovation centres
Stimulation for Czech participation in international cooperation in R&D and innovation
Use of technology foresight for focusing R&D resources into key areas
Reduction in energy demands by searching for new ways (eco-innovation)
Change in the management system of universities leading to increased interest in cooperation with the industry
Stimulation of cooperation between research and industry
Threats
Insufficient use of research infrastructure built from resources of the EU Structural Funds
Decrease in competitiveness of industry linked to the rise in cost of energy and raw materials
Deepening isolation of public R&D

4.2 Overall assessment of a knowledge based economy in the Czech Republic

The insufficient interconnection between research, development and innovation seems to be the greatest weakness in the knowledge based economy of the Czech Republic.

This affects negatively especially a successful utilization of R&D results in practice.	Lack of linkages in the process of creation, transfer and utilization of new knowledge is marked in particular by a low innovation performance and is reflected in an insufficient growth of competitiveness of the Czech Republic. This problem is most notably felt in a weak linkages between research and business sectors but also in other fields of social life (healthcare, state administration etc.) as well as in non-technical processes (services, management etc.) where these missing links represent a significant barrier to developing competitiveness of the Czech Republic. Innovation-friendly environment is not being created either, which may result in a loss of competitiveness of Czech companies in relation with the increase in labour cost and decline in this formerly greatest comparative advantage.
Public support for R&D is significantly fragmented, ...	Support for research and development from public resources is significantly fragmented, at present there are 22 budget categories that have their own administration. The system of public support is complicated and the support is allocated through many small and medium-sized research programmes. This fragmentation leads to smaller projects being supported, which in turn does not allow reaching critical mass for complex research and thus excellence of Czech research cannot be achieved on international level. In addition, this system cannot guarantee that these research projects are financed only from one public source. An opportunity for improvement in this area consists in a reduction in the number of budget categories and a clear prioritization of research directions based on established methodologies (foresight), which require ongoing elaboration of strategic analytical studies.
... institutional support prevails and the allocation of financial resources is not interlinked with the evaluation of R&D.	There is a negative prevalence of institutional support at the expense of project-based support. Distribution of financial resources in form of institutional support is currently not sufficiently connected with the evaluation of results of scientific work, besides quality teams average or below average scientific teams are being supported further on. This results not only in an insufficient quality of research output which is reflected in the low citation rate of Czech scientific publications in most scientific disciplines but also in the lower motivation of researchers to perform a quality scientific work.
And the research structure does not support ties between individual phases of the innovation process.	In financing research from public sources, expenditure on basic research prevails with the share of basic research in the total R&D expenditure growing over the past few years. In the business sector on the other hand experimental development prevails and the proportion of applied research is decreasing. Links between public research and the business sector are unsatisfactory, in public research there is a negligible contribution from corporate sources and patent protection of new knowledge from research is used insufficiently. Universities and research institutes are not adequately motivated to transfer knowledge, to utilize R&D results in form of patents and to establish new technology-based enterprises.

Large weakness in the area of knowledge creation consist in ...

... a low number of researchers ...	In comparison with other European countries there is a significantly lower number of researchers in the Czech Republic, which is evident in all sectors of

	performance. There is a particular lack of young researchers in practically every sector. Mobility of researchers has been low not only between the public and business sector but also between regions.
... and low salaries are among the main causes.	One of the main reasons for the lack of researchers is their low remuneration. Salaries are not sufficiently differentiated according to the quality of the scientific work leading to a lack of motivation of researchers and a decline in the prestige of the science profession. This results in a lack of interest among young people in a scientific career and a brain-drain of researchers to other countries or from research to other positions. Low salaries of researchers also significantly limit the brain-gain of foreign researchers and do not stimulate Czech scientists to return to the Czech Republic from aboard.
Lack of researchers can have a negative impact on the implementation of operational programmes.	The lack of researchers can be perceived as critical in particular in relation with the prepared operational programmes, which will be utilized among other things for developing or expanding research capacities in the Czech Republic and which will be financed from the EU Structural funds in the period 2007 to 2013 (Operational Programme Research and Development for Innovation).
The number of university graduates is not sufficient either, ...	The number of students and university graduates in comparison with most European countries is low. The number of PhD graduates is also low. In the total number of university graduates in comparison with EU-15 countries there is a below average proportion of graduates from technical and natural science fields, which can have a negative effect on further development of knowledge based economy of the Czech Republic.
... the educational system has been rigid and the structure of graduates does not correspond to the needs of the labour market.	Educational system is rigid and the structure of university graduates does not correspond to the needs of the labour market. Profiles of graduates often do not meet employers´ expectations; graduates lack independence in problem solving and necessary level of flexibility. In the area of primary and high school education there is a little emphasis placed on the development of independent thinking and creativity. Universities lack adequate management and the age structure of teachers and researchers is barely optimal. International mobility of university students is also low. The participation of the population in lifelong learning is insufficient and significantly decreases with age.
Expenditure on R&D in the Czech Republic is not insufficient at present.	Even if R&D expenditures in the Czech Republic have been increasing significantly faster than in other European countries they are insufficient and it cannot be expected that the Czech Republic fulfils the main objective of the Lisbon Strategy by 2010, i.e. that R&D expenditures reach 3% of GDP. At present there is also a relatively low share of private financial resources in the total R&D expenditure.
Public research does not pass the expected results ...	Results of public research have been insufficient. The number of publications produced by one researcher in the Czech Republic is at the level of the EU average but with the exception of certain fields their citation is well below the average for EU-15 countries. Involvement of research teams in international research has been insufficient, which to a certain extent could reflect the “satisfaction“ of Czech teams with relatively accessible national financial resources of public support. It is also evident that Czech research is not capable of satisfying the needs of business, in which the purchase of licences and know-how from aboard prevails. Compared with most other European countries there is a relatively low share of private financial resources in public research which reflects the lack of cooperation between the public sector and the business sector. In addition, public support of R&D is provided to a wide spectrum of fields which weakens the potential for the achieving excellence in selected scientific sectors. One particular feature of Czech public R&D consists in a high proportion of research carried out in state research institutes.

... and corporate research is not suitably developing either.	Private research is mainly concentrated in companies with foreign capital participation. Czech companies invest a lower proportion of their turnover in R&D than companies abroad and rather focus on the adaptation of products for the local market. In expenditure on innovation, purchase of technology equipment and know-how often from abroad prevails. Contrary to advanced EU-15 countries and even some new member states the majority of R&D expenditure is spent in medium or technologically less intensive industrial sectors.
On the positive side, the expenditure on R&D and the number of researchers and university graduates are rapidly rising.	However, it is important that R&D expenditure and the number of researchers in all sectors of performance have increased over the past few years at a faster rate than in most other European countries. The number of university and PhD graduates is also increasing. However it is essential to motivate students to study natural science and technical fields, to get involved in scientific work and other activities requiring a high level of professional knowledge. Therefore significance of medical faculties and medical research should not be forgotten for the health of the population and quality of life should not be neglected.
In the near future financial resources from the EU Structural funds can contribute to improving the situation …	A significant opportunity to improve the situation of knowledge based economy of the Czech Republic in the coming years consists in financial resources from the EU Structural Funds 2007 – 2013, which may positively contribute both to the development of human resources for R&D and innovation and the extension of research and innovation infrastructure, and to the improvement of cooperation between public research and the business sector and make the commercialization of new knowledge from research more effective. Effective utilization of these financial resources for a successful development of a knowledge based economy is the key question. There is a risk of a rash increase in capacities financed from OP RDI, which may subsequently lack financial resources. The environment for developing R&D in the Czech Republic may also be disturbed by a low interconnection between strategic management of R&D (Long-Term Principal Research Directions, National Programmes of Research and Development etc.) and the funding tools of the EU Structural Funds.
... and the economic growth recorded over the past few years may also have a positive impact.	The economic development of the Czech Republic and an increase in the economic productivity of companies can positively contribute to the development of a knowledge based economy. The interest of the business sector in R&D and innovation will also grow in relation to the increase in labour costs and the associated decrease in price competitiveness of companies. In relation to the economic development a gradual increase in pay in knowledge demanding professions can be expected, which will lead among other things to an increase in the prestige of scientific work, motivation of students towards scientific and technical fields and gaining foreign researchers and qualified professionals. The creation of suitable environment is essential not only for stimulating business to expand research activities but also for stimulating public research to cooperate with the business sector in the commercialization of new R&D findings in practice.
The environment for knowledge transfer, which is vital for the innovation process, ...	
... is not currently favourable in the Czech Republic and the research and corporate spheres operate to a certain extent separately.	One of the strengths of the Czech Republic on one hand is a developed network of educational and research institutes and on the other hand tradition and a strong basis of industrial and technical sector. Nevertheless, innovation carried out in the business sector is based on adopting existing technologies from abroad and not on utilizing knowledge from the research sector. Research and business sectors work in the Czech Republic to a great extent separately and cooperation between these two sectors is rare and limited. In addition, transfer of R&D results abroad, which would stimulate intensity and quality of Czech

	research, is not satisfactory in the Czech Republic. The causes for the lack of cooperation between research and business, which would lead to an effective knowledge transfer, can be found in the areas of infrastructure, human resources, awareness of intellectual property rights and the system of evaluation of research and development.
The main reason consists in insufficient services of innovation infrastructure, ...	Despite the fact that innovation infrastructure has begun to develop in individual regions over the past few years, an effectively functioning infrastructure for knowledge transfer is still missing. This role is usually played on one hand by technology transfer centres, which usually stem from universities, and on the other hand by business incubators creating an environment for start-up enterprises. In the Czech Republic there is a lack of qualified staffs for technology transfer centres, who are knowledgeable about both the research environment and also the needs of industrial practice and the development of market trends. Existing business incubators are often reduced to renting space at subsidized prices but the extent of services facilitating knowledge transfer remain inadequate. Funding opportunities for the development of a functioning infrastructure for knowledge transfer are available from the EU Structural Funds, which should be invested in providing more effective services for knowledge transfer between research and business sectors, which would strengthen the cooperation between these sectors.
... lack of awareness of intellectual property rights, ...	Contractual agreement on intellectual property rights is an important condition for cooperation in R&D and knowledge transfer. In the Czech Republic there is a very low level of awareness of industry related legal issues, which is reflected on one hand in an insufficient utilization of tools for the protection of industrial property rights and on the other hand in the isolation of research activity. Motivating measures addressing ownership of industrial rights generated by universities and research institutes represent another important pre-condition for increasing intensity of research activities directed towards industrially applicable results. In connection with this, public R&D should be regarded as a tool for the developing a knowledge based society with all consequences for responsibility in handling public resources obtained for R&D support.
... missing entrepreneurial training at technical and natural science universities ...	The undervalued role of entrepreneurship in the education of scientists contributes to the separation of research and business sectors in the Czech Republic. Teaching the basic principles of entrepreneurship and developing the entrepreneurial spirit in natural science and technical universities represent an opportunity for a more intensive knowledge transfer between research and business and also for increasing mobility of researchers between sectors. Mobility of researchers and human resources represents a further important channel for knowledge transfer between individual actors of the innovation process.
... and the system for evaluation of R&D results insufficiently motivates towards generating industrially applicable knowledge.	The system of evaluation of R&D results financed from public sources plays a significant motivation role in strengthening links between research and industry. A change in the system of evaluation of R&D financed from public sources would provide an opportunity for stimulating knowledge transfer by placing emphasis on industrial utilization (i.e. potential for commercialization) of applied R&D results, or on the potential impact of results of basic research.

Utilization of knowledge in innovation ...	
... begins to gather importance mainly in high-tech and medium high-tech sector, ...	The Czech Republic is an economy with a strong basis and tradition in technical and mechanical engineering fields, which is reflected in a relatively high contribution of high-tech and medium-high-tech sector to the creation of value added of the Czech economy. A considerable openness of the Czech economy is another important characteristic, which stimulates domestic companies to increased production effectiveness. Although low production costs (in particular wages) remain a significant factor for the competitiveness of Czech companies, the most recent surveys have shown that domestic companies have begun to appreciate the significance of factors of competitiveness other than costs and increase their investment in innovation.
... where knowledge of foreign (controlling) companies is mainly utilized and the innovation process is connected with adaptation of new technologies.	The innovation process of Czech companies is still mainly characterized by purchasing foreign machines and equipment, which they adapt to their own production process or completely replace this process with the new technologies. Innovation is thus based in particular on adapting knowledge developed abroad. Investments of foreign companies in the Czech Republic play a significant role in the diffusion of advanced technology into Czech companies, which leads to the transfer of knowledge and know-how and to the increase in effectiveness of production in domestic companies. Innovation based on utilization of in-house developed R&D results or R&D results developed by domestic research institutes in the Czech Republic is realized only to a limited degree.
Barriers to applying knowledge exist in the area of human as well as financial resources ...	Causes for the insufficient research activity in Czech companies are to be found in particular in the area of human resources, featured by a low number of graduates in science and engineering, and in the area of financial resources with practically non-existent private investments in equity to cover R&D costs in the business sector. Structure and management of companies also play a role here. An opportunity for increasing in-house research activities of the business sector consists in creating suitable conditions for attracting qualified human resources from abroad and removing legislative barriers to venture capital investments. In the long-term it is necessary to increase the attractiveness of study in natural science and technical fields and support horizontal mobility.
... and cooperation in R&D is hindered mainly by insufficiently functioning infrastructure for knowledge transfer.	The fact that Czech companies insufficiently utilize the capacity of research institutes in the innovation process is a result of the lack of cooperation between the research and business sector. An important pre-condition for intensifying cooperation between these sectors, which would lead to the implementation of R&D results in innovation, consists in developing a functioning infrastructure for knowledge transfer including its qualified staff for technology transfer. In addition to creating environment stimulating a closer cooperation between the research and business sectors with the aid of the EU Structural Funds, other stimulation may consist in extending tax allowances for R&D purchased by companies from research institutes.
Public procurement is an underrated tool for stimulating innovation activity in business.	To increase emphasis on in-house innovation activity, which leads to the introduction of new products or production processes, is a key challenge for the business sector from the point of view of maintaining competitiveness in an environment of rising labour costs. Public procurement for the development of innovative solutions for the needs of the public sector is one of economic and political tools that can stimulate the in-house innovation activity of companies. A successful use of this tool, however, depends on the capability of the public sector to formulate a qualified demand, on creating a quality legislative environment and last but not least, on the ethical maturity of society.

5. Vision

The following part of the Green Paper describes a vision of the Czech Republic in the area of research, development and innovation, which is based on a hypothetic position of the Czech Republic in this field. Although this vision looks rather "rosy" at the first sight, its achievement is not unrealistic should appropriate measures be implemented.

Report on R&D and innovation in the Czech Republic 20XX

In the area of R&D the Czech Republic has become a place, ...

... where excellent knowledge is created comparable with the global elite, ...	The Czech Republic has become a country where excellent knowledge is created, comparable with the global elite. The reputation of Czech research in selected scientific fields attracts foreign researchers who come to the Czech Republic to acquire knowledge and experience. They also bring know-how with them which is developed in cooperation with Czech researchers into a higher level of knowledge. Results of basic research performed in these sectors by top teams are published in foreign journals with a high impact, which increases prestige of Czech research. Prominent scientists are returning to the Czech Republic where they can complete their careers and develop new research centres.
... and Czech research teams are sought-after partners for international projects.	Research teams from the Czech Republic are sought-after partners for international research projects and these teams also coordinate several projects themselves. Participation of Czech research teams in international projects is facilitated by an effective information network working on both the national and regional level. International mobility and active participation in scientific symposia, where new cooperation partnerships in research and knowledge transfer are formed, contribute to the high quality of Czech researchers. Prominent foreign experts often occupy high positions in Czech R&D institutes.
The educational system produces quality graduates, ...	An effective educational system, which is able to produce extremely skilled university graduates, is a significant factor of the quality of Czech research. An indisputable advantage is the fact that students have a range of options during their study for gaining experience from studying abroad where they are also involved in international cooperation in research and establish contacts with recognized foreign experts.
... which are motivated to perform research activity in the Czech Republic.	Graduates from domestic and foreign universities are motivated to perform research activities in the Czech Republic because the environment here offers them highly competitive conditions for research, both from the point of view of state of the art equipment of research centres in selected (priority) sectors, and also from the point of view of social prestige which is reflected in salaries they get for their work. Excellence in the basic research performed in the Czech Republic also provides strong motivation.

Applied research, which provides results applicable in practice, ...

... is characterized by close ties with industry ...	While excellence is the main attribute of Czech basic research, the focal characteristic of applied research performed in the Czech Republic is its close tie to the business sector which assures direct utilization of R&D results. Long-term contacts between research and industry are ensured by intensive mobility of researchers between enterprises and research organizations, which on one hand helps the research sphere understand business needs and on the other

	hand strengthens transfer of knowledge and new technology to business. Exchange of knowledge, experience and information on new trends in the development of specific fields is further strengthened by setting up joint research teams, which ensures an adequate technological progress and long-term competitiveness of companies.
... and by cooperation facilitated by a consistent protection of intellectual property rights.	Cooperation between the research and business sectors is not hindered by concerns about uncertainty or even maltreatment in the area of industrial rights because there is a very strong awareness of industrial legislation in the Czech Republic and protection of industrial rights is an imbedded step before implementing R&D results. This allows the Czech Republic to export an ever increasing number of licences.
Universities and public R&D institutions obtain finances from various sources.	Public universities and public research institutions strive to obtain a significant proportion of their financing from private sources and from programmes of international cooperation. Responsibility towards society is an important feature of their management.
Implementation of R&D results is aided by centres for knowledge transfer ...	Decision-making of researchers on what to do with R&D results is facilitated by a highly effective infrastructure for technology transfer, in particular in form of centres established at universities and research institutes, which provide them with highly professional services. These centres are established in the framework of a knowledge transfer policy developed by each university and public research institute, which regularly monitor their impact.
... and a number of spin-off companies are established by research and educational institutes.	R&D results are not only utilized thanks to the effective cooperation between the research and business sectors. A number of new spin-off companies are set up in the Czech Republic by research institutes and universities, which strive to penetrate the innovation market using their own R&D results. This approach to commercializing R&D results is helped by entrepreneurial skills of researchers which they acquired during their university studies. Formation of new technology-based companies (including spin-off companies) is also helped by effective management of research institutes and universities, which creates favourable conditions for commercialization of R&D results in this way.
Development of these companies is aided by a corresponding infrastructure and accessible financial sources.	Business incubators help enterprises in their initial development by renting them space at subsidized prices and also providing them with professional consultancy services, including help in obtaining external funding. After their successful start a number of enterprises move to technology parks, where they have ideal conditions for their further development due to closeness to high-tech companies.
The innovation performance of Czech companies has been constantly increasing, ...	
... which due to utilization of R&D results manage to face a strong competition.	Local companies also profit from the excellent basic and applied research in the Czech Republic. Thanks to the utilization of research results they are able to stand the strong competition of European and global companies. Competitiveness of companies is not based on the low cost of labour force any more but rather on R&D and consistent application of innovation, including modern management methods.
The Czech Republic is also an attractive location for investments of foreign firms and localization	The Czech Republic has also retained its position of an attractive country for foreign investments. Contrary to the turn of the century, technologically demanding production and research activities of foreign companies are located in the Czech Republic, benefiting from the proximity of excellent research and availability of a highly qualified labour force (though not cheap any more). Uni-

of their R&D.	versities and research institutes cooperate with these companies on complex projects and local companies also get involved in research activities as sub-contractors.
Companies are also actively involved in the education process.	The quality of the labour force and in particular their usefulness in business practice is to a certain extent influenced by the fact that enterprises are actively involved in setting up study programmes and in managing universities. The skills of graduates thus correspond to the needs of business, which to a great extent is assisted by horizontal mobility of human resources between the educational, research and business sectors.
What is the main reason for this success?	
An effective institutional environment, ...	The Czech Republic has an effective institutional environment, which stimulates creation of excellent results in basic and applied research and their transfer to practice. The basis of this institutional environment consists in an explicitly attributed responsibility for research and innovation policies. These policies are also interlinked with educational and industrial policies and due to a close cooperation among all their authors the definition and execution of their individual measures is effectively coordinated, which results in a positive synergy.
... favourable business environment, ...	A quality background for doing business in the Czech Republic is created by a favourable business environment, which is not burdened by uncertainty or lengthiness in the area of law enforceability, or administrative burdens, which previously complicated doing business in the Czech Republic.
... a quality educational system, ...	After reforming the educational system, universities have been producing quality graduates whose knowledge corresponds to the needs of a knowledge based economy and requirements of the labour market. Some prestigious universities are being profiled whose graduates have no problem in asserting themselves in prominent international corporations. In addition, there is a system in place, allowing students to find all the necessary information on the profile and application in practice when selecting which university to attend.
... a quality system of public support …	In the Czech Republic there is a general consensus that R&D results have a significant impact on the whole society and this is reflected in the sufficient and effective support of R&D from public sources. Besides the introduction of tax assignations to R&D, a system of public R&D support was created which is based on clearly defined rules for the distribution of public resources. Selection of a limited number of thematic priorities for R&D support is based on results of independent analyses using modern approaches to policy-making (e.g. technological foresight).
… stimulating excellence in R&D ...	Institutional support to R&D is allocated for the operations and further development of research institutes (centres) and universities which achieve excellent research results. This is regularly assessed using a transparent system for evaluating R&D results. The system for allocating public R&D support ensures a concentration of funds in projects which are large enough to provide a significant progress in scientific knowledge.
... with an emphasis on practical utilization of R&D results, ...	Project-based support is focused on the execution of specific basic and applied research projects. Cooperation between the research and business sectors and financial contributions from private sources play a pivotal role in the selection of applied research projects. Results of research projects are continuously monitored even after the targeted support was allocated and upon completion projects are subject to ex-post evaluation.

… consistent evaluation of R&D results,…	The system of basic research evaluation places emphasis on excellence and benefits of its results for developing given science field. Criteria for evaluating applied research also take into account practical utilization of produced results.
... administratively undemanding distribution of support, ...	The system for administering programmes of targeted (project-based) support is not complex because the number of providers was significantly reduced and a Technology Agency was established to allocate targeted support to applied research. This leads to the fulfilment of the current goals and needs of the industry.
... accessible private financial sources for R&D and innovation, ...	Investments in private equity by business angels and venture capital funds play an important role in the industry where R&D results are transformed into innovation. They are supported both by a favourable tax environment (including tax incentives) and active participation of the state in venture capital funds that invest in start-up innovative enterprises.
... functional system of public procurement for innovation and	In addition to participation in venture capital funds working on the PPP (private public partnership) principle, the state also stimulates innovation in business through public procurement of innovative solutions to public sector needs.
... an effective research and innovation infrastructure.	Investments in research infrastructure on the national and regional level have created a dense network of effectively operating entities that make a sufficient research capacity for developing their own innovative solutions or meeting demands of others. The innovation infrastructure developed with state support facilitates setting up new innovative enterprises, supports knowledge transfer, and thus also contributes to an innovative development at the regional level.

6. Topics for discussion

The vision outlined in the previous chapter ...

... presents a basic framework, from which a whole range of topics for public discussion follow.

Vision of the Czech Republic outlined in the previous chapter, is based mainly on the analysis of strengths and weaknesses, opportunities and threats of a knowledge based economy in the Czech Republic and reflects main trends in R&D and innovation from the past few years. The outlined vision also presents a whole range of topics for discussion in a wider professional community, which should be focused both on setting relevant objectives and on possibilities and tools for its realization. In the following paragraphs there is a selection of topics or generally conceived thematic areas for discussion, whose results should form a background for preparation of the White Paper on Research, Development and Innovation in the Czech Republic.

Possible topics (areas) for discussion:

1. Is the vision outlined in the previous chapter clearly formulated and feasible?
2. If not, what other aspects or elements should be included?

What are the main pre-conditions for fulfilling this vision?

If the vision is to be fulfilled progress in all phases of the innovation process is necessary.

Positive changes must be made in all phases of the innovation process – in the area of knowledge creation (i.e. in research and development), knowledge transfer from research and development to practice as well as in the area of knowledge application (i.e. in innovation and business), which currently feature a number of deficiencies. For this reason it is essential to improve the institutional, legislative and business environment in the Czech Republic (A), the education system and the situation in the area of human resources for R&D and innovation (B), financing R&D and innovation from public (C) and private (D) sources and infrastructure for R&D and innovation and cooperation between the public and private sector in R&D and innovation (E).

Possible topics (areas) for discussion:

3. Are the main pre-conditions for fulfilling the outlined vision sufficient?
4. If not, what other pre-conditions are necessary for its fulfilment?
5. Which areas can be considered as priorities and which will be solved as a result of positive changes in other areas?

A. Environment and system

Possible topics (areas) for discussion:

A.1. What is the most serious problem in the current environment in the Czech Republic?

A.2. What should be the priorities in improving the environment considering the vision of the Czech Republic?

A.3. What should be the main elements and priorities of the policy on research, development and innovation in the Czech Republic and what should be the role of the assumed institution responsible for research and innovation policy?

A.4. How to ensure cohesion between national R&D and innovation policy with European policy?

A.5. What are regional disparities in R&D and regional innovation potential manifested, how should regions be motivated to place a greater empha-

	sis on R&D and innovation? A.6. How can the environment in the Czech Republic for investments by the private sector in R&D be improved and how can the Czech Republic be made more attractive for localization of R&D of multinational companies? A.7. How should R&D and innovation be promoted, how to increase prestige of these professions?
B. Educational system and human resources for research, development and innovation	Possible topics (areas) for discussion: B.1. What are the greatest weaknesses of present educational system in the Czech Republic? B.2. How should the educational system be reformed in order to meet the objectives proposed in the vision? B.3. How to ensure optimal university management, in particular regarding their third role, how to involve the business sector in the management of universities and public research institutions? B.4. How to develop research universities, what should be the rules for their financing? B.5. How can an increased quality of education be achieved, how can talented students be supported and how can the profile of university and high school graduates be improved considering the changing needs of the labour market? B.6. How can universities be more open to the demand for education and how to increase its quality at the same time, how can young people be attracted to studying natural science and technical fields? B.7. How can the education in entrepreneurship of universities and high school students be improved? B.8. How can horizontal mobility between business and R&D institutes and universities be stimulated and what financial tools could contribute to this? B.9. How can the number and quality of researchers be increased? B.10. How can quality foreign researchers and professionals be attracted to the Czech Republic and how can Czech scientists be motivated to return back from abroad and work in the Czech Republic? Note: At present the White Paper on Tertiary Education is under preparation. Topics for discussion proposed in this block correspond to development of knowledge based economy of the Czech Republic and identified problems in the area of research, development and innovation.
C. Financing research, development and innovation – public support	Possible topics (areas) for discussion: C.1. How can support from public resources be simplified and how can finances be best utilized? C.2. How should public support be optimally distributed on the national and regional level to achieve excellence in research? C.3. How can R&D and innovation be supported in the business sector (both in SMEs and large enterprises) and how should enterprises contribute financially to projects? C.4. How should be establishing technology-based enterprises supported (including spin-offs)? C.5. How can European funding be best utilized (in particular from Structural Funds and the 7th Framework Programme) for R&D and innovation and transfer of R&D knowledge into practice? How should they be interlinked with national sources? C.6. How should the present system of evaluation of R&D results be utilized or how should it be modified to accomplish the proposed vision?

	C.7. How should be the evaluation of R&D reflected in further distribution of public funding for R&D? C.8. How should the system of distribution of public funding for R&D be set up to improve commercialization of R&D knowledge in practice and stimulate cooperation between public R&D and universities and business? Note: Possibilities for support from public sources are proposed for discussion in connection with the specific objectives in other points as well.
D. Financing research, development and innovation – private sources	Possible topics (areas) for discussion: D.1. How should the private sector be motivated to increase its expenditure on R&D and innovation? D.2. How can the access to private funding of R&D be improved? D.3. How can the environment and conditions for venture capital investments be improved? D.4. How can the interest of private sector in purchasing research from public R&D institutes and universities be increased? What financial tools would positively contribute to this? D.5. How can the private sector become more involved in developing and managing complex R&D centres (in particular in relation to the newly developed R&D capacities from EU SF)?
E. Infrastructure and cooperation	Possible topics (areas) for discussion: E.1. How to achieve optimal utilization of R&D infrastructure (in particular regarding large projects of the Operational Programme Research and Development for Innovation), how to develop and operate first-class interdisciplinary R&D infrastructures including their administration and linking to European research? E.2. What services should the innovation infrastructure provide (in particular incubators and science and technology parks) and how to ensure adequate quality of provided services? E.3. How to optimally ensure operation of innovation infrastructure, how to improve its links to research and educational institutions and business? How to involve business sector in ensuring its operation? E.4. What functions should centres for knowledge transfer provide at universities and public research institutes, and how to ensure their operation? E.5. What currently hinders cooperation between the public and business sectors in R&D and innovation, what are the main differences in the approach (thinking, motivation) between the business and public sectors? E.6. How to stimulate cooperation between the public and private sectors in R&D and innovation? How to improve transfer of R&D knowledge into practice and what financial tools may help? E.7. What are the main reasons for the lack of interest in protecting intellectual property, how to stimulate this interest and what should the legal framework be for administering intellectual property in the public sector, including distribution of economic revenues? E.8. How to ensure a functioning system of public procurement of innovation be provided and what projects should be supported? E.9. How to increase the interest of the industry to locate their R&D at first-class universities, where they will have much better conditions for R&D on a global level?

7. List of abbreviations

CIP	Competitiveness and Innovation Framework Programme
CSO	Czech Statistical Office
EC	European Commission
EEA	European Economic Area
EIT	European Institute of Innovation and Technology
EPO	European Patent Office
ERA	European Research Area
ESFRI	European Strategic Forum for Research Infrastructure
EU	European Union
EURAB	European Union Research Advisory Board
EVCA	European Private Equity and Venture Capital Association
FDI	Foreign Direct Investment
FP6	6th Framework Programme of the EU for Research and Technological Development
FP7	7th Framework Programme of the EU for Research and Technological Development
GCI	Global Competitiveness Index
ICT	Information and Communication Technology
IMD Index	Competitiveness index used by the IMD
IPO	Initial Public Offering
IPO CZ	Industrial Propriety Office of the Czech Republic
KIS	Knowledge Intensive Services
MIT	Ministry of Industry and Trade
MRD	Ministry for Regional Development
NACE	Industrial Classification of Economic Activity
NIP	National Innovation Policy of the Czech Republic 2005 - 2010
NPR&D	National Policy of Research and Development 2004-2008
OP RDI	Operational Programme Research and Development for Innovation
PPP	Public Private Partnership
PRI	Public Research Institute
R&D	Research and Development
R&D&I	Research, Development and Innovation
SF	Structural Funds
SME	Small and Medium-sized Enterprises
STP	Science and Technology Park
USPTO	US Patent and Trademark Office

8. Literature, documents, Internet links and other references

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- National Innovation Strategy of the Czech Republic
- National Innovation Policy of the Czech Republic 2005-2010
- Long-term Principal Research Directions
- National Research Programme I (2004-2009)
- National Research Programme II (2006-2011)
- National Strategic Reference Framework 2007 – 2013
- National Development Plan 2007 – 2013
- Operational Programme Education for Competitiveness (www.msmt.cz)
- Operational Programme Research and Development for Innovation (www.msmt.cz)

- Operational Programme Enterprise and Innovation (www.mpo.cz)
- Approach of the Czech Republic to the material "Investing in research: An action plan for Europe" and other documents of the European Union for research and development
- Initial theses for the preparation of the White Paper on Tertiary Education (a source material for the 12th session of the Board of the Council of Universities on 21 June 2007)
- Study for the White Paper on the state of higher education (Matějů et al., September 2007)
- Basic principals of the Reform of Research, Development and Innovation in the Czech Republic (background material for the 229th session of the Research and Development Council, 11 January 2008)

Legislation of the Czech Republic on research, development and innovation policy

- Act No. 2/1969 Coll., on the establishment of ministries and other central state administration authorities of the Czech Republic in the wording of further legislation
- Act No. 130/2002 Coll., on the support of research and development from public funds and on the amendment of several related Acts (Act on the support of research and development) in the valid wording
- Act No. 341/2005 Coll., on public research institutes
- Act No. 342/2005 Coll., on the amendment of several acts related to the adoption of the Act on public research institutes
- Act No. 586/1992 Coll., on income tax, in the valid wording
- Governmental Decree No. 267/2002 Coll., on the information system of research and development
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