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Patenting propensity in the Czech Republic

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We have compared patenting propensity in the Czech Republic with eight EU countries: Germany, Austria, Hungary, Poland, Finland, Belgium, Ireland and Greece. In comparison based on the EPO and USPTO patents listed per million inhabitants, the Czech Republic ranks rather low. The Czech Republic also generated fewer patents per R&D employee than most other countries. The time series data have shown a decrease of number of Czech patents after 1990 with some revival after 1996. As our analysis indicated, the decrease was partially caused by dissolution or transformation of major patent generators, but the most important cause may lie in a little interest of local enterprises.

Introduction and methodology

Applied research in the Czech Republic has not been performing very well [RESEARCH AND DEVELOPMENT COUNCIL OF THE CR, 2005; IMD, 2004] but a long-term comparison of its results with those of other comparable countries has not been published. No causal analysis of its poor state has been done, either. In order to evaluate performance of applied research in the Czech Republic, we have monitored the number of patents, which represent one of its main results [OECD, 1994; OECD, 2002].

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We have compared the number of EPO and USPTO patents of inventors from the Czech Republic with four countries of the Central European region – Germany, Austria, Hungary and Poland – and other four small or medium sized EU countries – Finland, Belgium, Ireland and Greece. In the second part of the paper we analyze the reasons for a low patenting activity in the Czech Republic.

Patent data were obtained from three sources: Industrial Property Office of the Czech Republic (IPO-CR), Eurostat and the US Patent and Trademark Office (USPTO). Eurostat publishes statistical data on the number of patent applications at the European Patent Office (EPO) from various countries. It also publishes data on the number of patents granted by the USPTO. All these data are classified according to the International Patent Classification (IPC). Statistical data on patents granted by the USPTO are also available directly from this office, but these are classified according to the US classification, which is considerably different from the IPC. However, the USPTO updates the patent data more frequently than Eurostat. Therefore we have used the USPTO database as a source for the total number of USPTO patents as well as for their long-term trends. Numbers of USPTO patents in individual IPC sections were obtained from Eurostat as well as all data on EPO patent applications. With the exception of two long-term studies, we have focused on the period from 1994 to 2003 or to 2005, depending on the availability of patent data. The patent data were used according to guidelines set by the Patent Manual [OECD, 1994].

Results

Comparison of patent numbers for the Czech Republic with eight selected EU countries.

From 1994 to 2005 the IPO-CR granted 3913 patents to the inventors from the Czech Republic. However, the IPO-CR ensures protection only in a relatively small Czech market and important patents are therefore registered at the EPO or USPTO. According to the Eurostat data, Czech inventors applied for 921 EPO patents from 1994 till 2003. After normalization by population number the Czech Republic ranked the seventh out of nine monitored countries, far behind Finland, Germany, Belgium, Austria and Ireland (Figure 1). Also Hungary was performing somewhat better, while only Greece and Poland were doing worse.

From 1994 to 2005, the USPTO granted 222 patents to the inventors from the Czech Republic and other 84 patents to the inventors from Czechoslovakia. Because Czechoslovakia broke up into the Czech Republic and Slovak Republic in January 1993, the Czechoslovak patents were obviously submitted before 1993 or they represented errors in the name of the country introduced either during filing up or processing the application. When a part of the Czechoslovak patents proportional to the

number of inhabitants (i.e. ~2/3) was considered to be of Czech origin, the USPTO granted approximately 278 patents to Czech inventors. When the USPTO patent counts were normalized by one million inhabitants, the Czech Republic ranked the seventh out of nine countries (Figure 1).

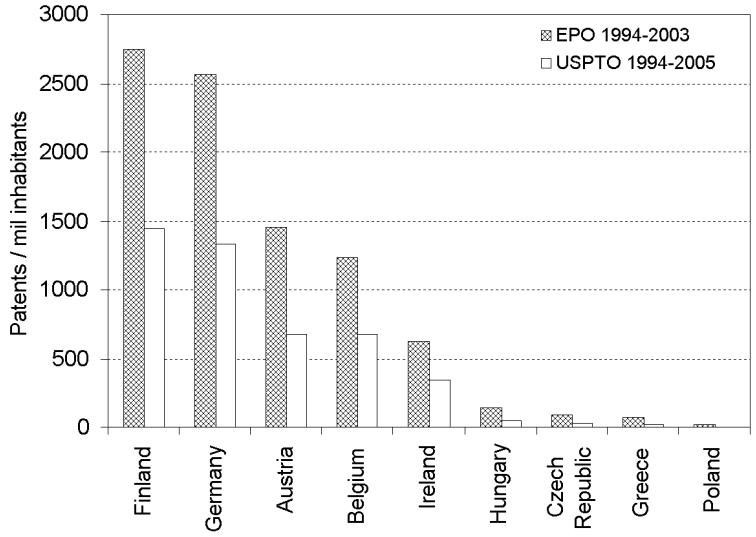

Figure 1. EPO patent applications (1994 to 2003, full bars) and USPTO patents granted (1994 to 2005, empty bars) per 1 million inhabitants: comparison of nine EU countries. Number of the Czech patents granted by the USPTO was calculated by adding up patents filed as Czech and 2/3 of the patents filed as Czechoslovak. Data source: Eurostat and USPTO

The counts of the EPO patent applications authored by the Czech citizens stagnated or declined from 1992 till 1995, and then slightly but steadily increased until 2003 (data not shown). In most other EU countries studied, the number of patent applications increased for the whole monitored period. Comparison of trends shows that the Czech Republic may be slowly catching up with Hungary but has no chance of catching up with the EU-15 countries.

The USPTO has been publishing patent counts for individual countries already since 1963, thus allowing for a long term analysis of trends. However, in the case of the Czech Republic, the long term analysis is complicated by the split of Czechoslovakia in January 1993. Till 1992, the number of Czech patents is included in the number of Czechoslovak patents. In order to evaluate the trends for the Czech Republic, we had to estimate the Czech patent numbers from the numbers filed for Czechoslovakia according to the number of inhabitants. Till 1992 the numbers of Czech patents were

calculated as 2/3 of the values filed for Czechoslovakia. After 1992, a proportional number of the Czechoslovak patents (i.e. ~2/3) was added to the patents filed for the Czech Republic. Analysis of the long term trends resulted in interesting finding. The number of patents significantly declined during the period 1990–1995 in all three postcomunist countries (Figure 2). However, the number of Czech patents started to decline already long before this period, around the year 1976, despite the fact that in most other European countries including Hungary, the number of the USPTO patents went steadily up. Even after 1995 the number of Czech patents increased more slowly than in the developed EU-15 countries.

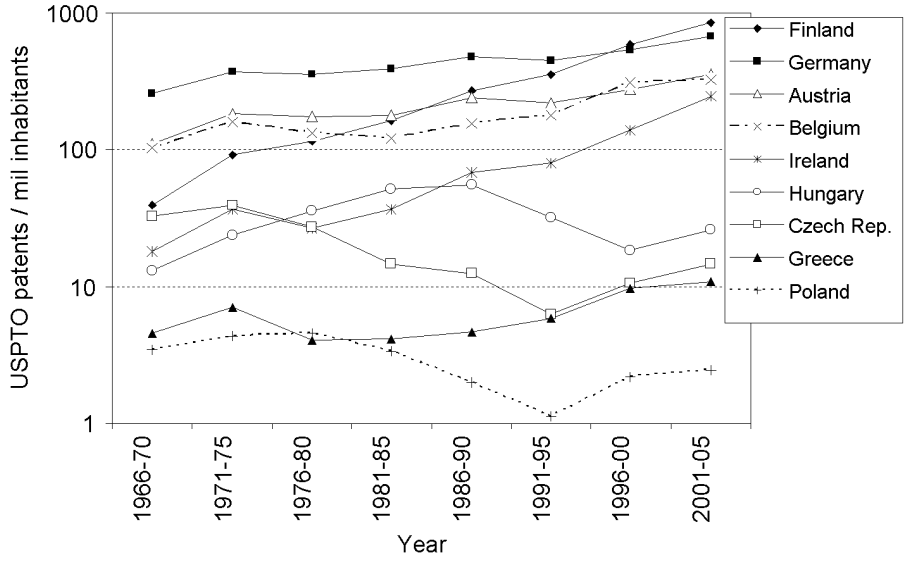

Figure 2. Long term trends of USPTO patents granted to nine EU countries. The points represent 5-year totals for each country. The number of Czech patents was calculated by adding up patents filed as Czech and 2/3 of the patents filed as Czechoslovak. Data source: USPTO

In order to reveal possible sectoral differences in the patenting activity, we have performed a detailed analysis of the number of EPO patent applications in the major IPC sections. In five IPC sections, the Czech Republic ranked the seventh among nine EU countries and in two other sections it ranked even worse, the last but one. Only in section B (performing operations, transporting) the Czech Republic overtook Hungary, Greece and Poland and ranked the sixth and in section D (textiles, paper) the Czech Republic overtook also Ireland and ranked the fifth (Table 1). The Czech Republic

accomplished somewhat better results in the evaluation of the USPTO patents. In two sections it ranked the sixth (E-fixed constructions and G- physics) and in one it was on the fifth place (D-textiles, paper). In five other sections the Czech Republic ranked the seventh and in one it took the eighth place, the last but one.

Table 1. EPO patent applications (1994–2003) and USPTO patents granted (1994–2002) in individual sections of International Patent Classification: comparison of nine EU countries. Data source: Eurostat; data are normalized on 1 million inhabitants

EPO applications / mil inhabitants	Czech Rep ranking	Czech Rep	Poland	Hungary	Greece	Ireland	Austria	Finland	Belgium	Germany
Section A – Human necessities	8	15.0	4.5	34.7	19.4	167.3	218.0	231.4	167.9	293.6
Section B – Performing operations; transporting	6	18.9	4.3	18.2	11.9	84.0	332.7	388.3	222.6	612.2
Section C – Chemistry; metallurgy	7	17.1	4.2	32.7	8.8	62.4	199.3	231.9	369.6	400.8
Section D – Textiles; paper	5	5.9	0.3	0.3	0.7	2.1	44.4	201.9	41.0	52.2
Section E – Fixed constructions	7	5.6	1.8	7.3	4.9	22.7	134.3	84.1	50.9	114.8
Section F – Mechanical engineering; lighting; heating; weapons	7	10.4	2.5	11.4	7.6	25.0	170.3	132.4	59.9	323.0
Section G – Physics	7	10.4	2.8	19.3	8.2	132.0	162.4	381.8	174.7	362.8
Section H – Electricity	8	6.5	2.3	20.4	7.6	130.2	192.7	1094.4	147.9	400.9
total	7	89.7	22.6	144.3	69.1	625.7	1454.2	2746.2	1234.4	2560.4
USPTO patents / mil inhabitants										
Section A – Human necessities	8	3.9	1.1	10.0	4.5	54.7	74.1	91.7	57.8	103.0
Section B – Performing operations; transporting	7	3.0	0.6	3.0	2.3	37.7	121.1	176.9	91.9	241.7
Section C – Chemistry; metallurgy	7	4.0	0.8	8.9	2.0	15.3	64.8	84.9	126.7	141.9
Section D – Textiles; paper	5	1.8	0.0	0.0	0.3	0.9	16.0	69.5	15.9	22.0
Section E – Fixed constructions	6	0.7	0.1	0.2	0.6	6.1	25.9	18.3	8.3	18.7
Section F – Mechanical engineering; lighting; heating; weapons	7	2.1	0.2	2.8	0.8	11.9	66.2	61.2	19.1	132.1
Section G – Physics	6	4.2	0.6	3.9	1.7	58.2	56.1	137.3	95.0	143.4
Section H – Electricity	7	3.4	0.4	7.2	1.4	77.8	57.3	384.0	58.7	138.1
total	7	23.2	3.9	36.1	13.5	262.6	481.3	1023.8	473.5	940.9

Causes of the Czech Republic lagging behind in patenting activity

Since it is known that the Czech Republic has lower number of R&D employees in comparison with the advanced EU-15 countries, we have normalized the number of patents by number of R&D employees (Figure 3, empty bars). However, it did not improve the ranking of the Czech Republic. It ranked the seventh again, far behind

Germany, Austria, Finland, Belgium and Ireland. As the OECD study [COMPENDIUM OF PATENT STATISTICS, 2006] has shown, 89% of all patents registered at the EPO is assigned to businesses. Therefore we have normalized patent counts also by R&D employees of business sector only (Figure 3, grey bars). However, ranking of the Czech Republic got even worse after this recalculation, because it was overtaken also by Greece. R&D employees in the Czech Republic are thus much less productive in patenting than R&D employees in most other studied countries. This is in sharp contrast to the situation in the output of scientific publications: although the Czech Republic is lagging behind in the publication number per million inhabitants, after normalization by the number of R&D employees it is performing somewhat better than Germany and only slightly worse than Austria [VANĚČEK & KUČERA, 2006]. This finding indicates either very little abilities or motivation of the Czech R&D employees to generate results suitable for patenting.

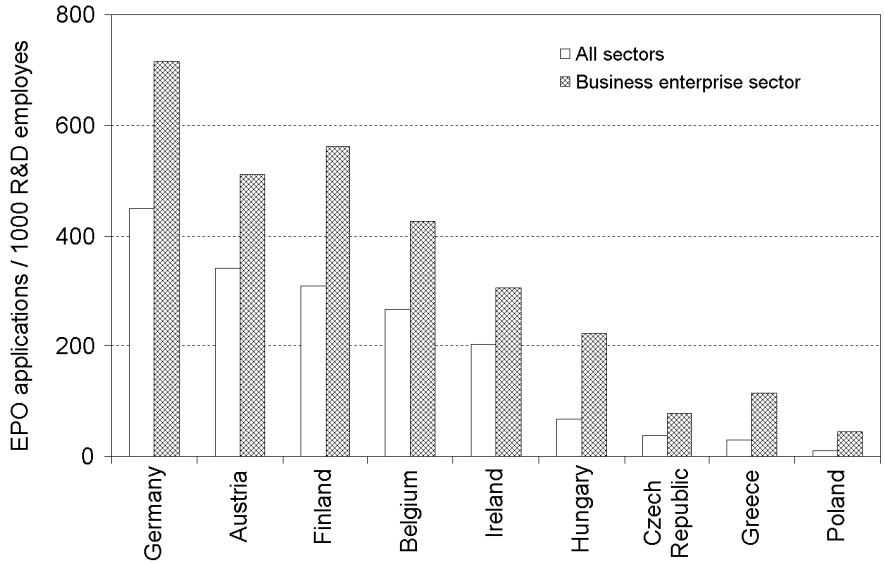

Figure 3. EPO patent applications per 1000 R&D employees (full time equivalents): comparison of nine EU states. Data source: Eurostat, period covered: 1994 to 2003

The ranking of the Czech Republic was even worse when the number of patents was expressed per 1 billion euro of R&D expenses (GERD). The Czech Republic generated the third lowest number of the EPO patents per 1 billion euro after Greece and Poland (Figure 4). Moreover, when normalized by business R&D expenses (BERD), the Czech

Republic ranked the last in the EPO patents. Ranking of the Czech Republic in the USPTO patents was equally low (data not shown).

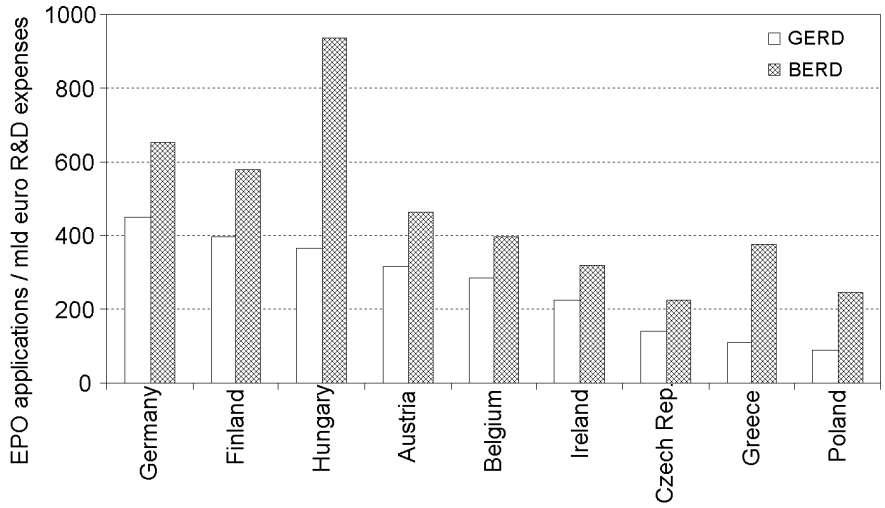

Figure 4. EPO patent applications per 1000 million euro of total intramural R&D expenditure (GERD) or business enterprise R&D expenditure (BERD): comparison of nine EU countries. Data source: Eurostat, period covered: 1994 to 2003

According to an OECD study, majority of patents are assigned to business enterprises [OECD, 2006]. This finding suggests that most patents are generated to satisfy the needs of companies and are financed (at least partially) from their resources. If true, the business sector in the Czech Republic has only a minor interest in patenting and it does not target its R&D financing towards patent production nor does it motivate their R&D employees sufficiently towards it. This hypothesis is further supported by additional evidence. Mere 56% of all Czech patents at the EPO are assigned to business companies (Table 2). This is significantly less than in developed EU-15 countries. Companies are represented among the Czech assignees relatively less frequently also in the USPTO patents (Table 3). In contrast, the Czech patents assignees have been more frequently classified as "others". Although Eurostat does not specify who is actually meant by "others", we suppose that these are patents assigned to their inventors. The USPTO publishes a list of major patent assignees, where a group of assignees named "individual patent owners" is included next to various institutions. Patent numbers registered for this group are very similar to those shown by Eurostat in the group of "others". Again, this indicates that the interest of Czech business companies in

patenting is so low that researchers often apply not only as authors but also as assignees. Moreover, a high percentage of Czech patents is assigned to foreign enterprises (Table 4).

Findings revealing that Czech enterprises own a relatively small share of Czech patents and an unusually large share is in the possession of patent inventors indicate a little interest of Czech firms in patenting. In addition, a relatively large share of patents of Czech inventors is assigned to foreign companies (Table 4). Belgium and Ireland have a comparatively high share of patents authored by local inventors in possession of foreign companies, but their domestic firms own more than a double share of foreign patents than it is true in case of the Czech Republic. Czech firms thus do not aspire to those few patents generated in the Czech Republic and have no interest in patents produced abroad.

Table 2. Patent applications at the EPO from 1994 to 2004 at the national level by institutional sectors (percentages of total applications 1994–2004). Data source: Eurostat

Country	Business enterprise	Government	Higher education	Private non-profit	Hospitals	Other
Finland	90.7	0.1	0.3	1.4	0.0	7.6
Germany	87.7	0.1	0.6	2.2	0.1	9.3
Belgium	81.0	0.4	5.8	1.8	0.0	11.0
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	0.4	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

Table 3. Patents granted by the USPTO from 1994 to 2002 at the national level by institutional sectors (percentages of total patents). Data source: Eurostat

Country	Business enterprise	Government	Higher education	Private non-profit	Hospitals	Other
Finland	92.0	0.1	0.5	0.9	0.0	6.4
Germany	90.6	0.7	0.3	1.7	0.0	6.6
Belgium	84.2	1.3	4.8	2.4	0.0	7.2
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

Table 4. Foreign owners of domestic patents and domestic owners of foreign patents from 1994 to 2003: comparison of nine EU countries. Data source: Eurostat

Country	Foreign owners of domestic patents (% total)	Domestic owners of foreign patents (% total)
Finland	9.4	20.9
Germany	13.3	11.3
Greece	33.5	8.8
Austria	35.5	24.5
Hungary	35.8	10.2
Ireland	39.2	43.7
Czech Republic	41.9	14.1
Poland	43.3	15.6
Belgium	46.7	29.0

Table 5. Counts of USPTO patents registered for Czech authors by the institutional sectors of the assignee. The table lists only assignees, which have registered five or more patents during the monitored period. Data source: USPTO

First-named assignee	1971–1975	1976–1980	1981–1985	1986–1990	1991–1995	1996–2000	2001–2005
Business enterprises	188	88	54	40	10	22	26
Branch research institutes	125	75	41	10	1	0	0
AS CR	84	78	22	41	15	3	0
Universities	4	14	12	8	1	0	0
Nuclear commission	0	4	1	0	0	0	0
Individually owned patents	20	8	2	3	12	21	22
Total	421	267	132	102	39	46	48

A closer look at the list of the most prominent assignees of Czech patents at the USPTO (Table 5) suggests the cause of the decrease in number of Czech patents. After the year 1990, patents assigned by branch research institutes are absent, as these institutions were closed down or sold. Also patents assigned to the Academy of Sciences (AS CR) almost disappeared after 1995, which correlates with the liquidation of some Institutes and with the change of the evaluation system in the Academy giving the main importance to publications in impacted journals. Also the number of patents assigned to enterprises and universities decreased after 1990. Only the number of patents assigned to individual owners (i.e. inventors) increased after 1990. It is necessary to realize that number of all patents assigned to major assignees (with the exception of individual owners) was continually decreasing already since 1975. Nevertheless, further significant decrease occurred after 1990. This finding correlates with the overall drop in number of the USPTO patents awarded to Czech inventors.

Application and utilization of R&D results by business companies in the Czech Republic

As our previous findings have indicated the low interest of Czech companies in patenting, we have decided to find out whether they need R&D results for their business performance. In general, the high-tech sector has the greatest need for R&D results. Manufacturing of high-tech products represented less than 5% of the total industrial production of the Czech Republic until 2000 (Figure 5). This result ranked the Czech Republic among the least technologically developed EU countries, explaining also the relatively low demand for R&D result by industrial companies. A considerably fast increase in the relative share of high-tech production was observed from 2001 till 2003. At present, the share of high-tech output in the Czech Republic reaches about 10% of the total industrial output, which is about the same as in Germany, Austria and Belgium. It is much less, however, than in Ireland, where high-tech production reaches about 30% or in Finland and Hungary, where it makes for about 20% of total industrial production. The growth of high-tech manufacturing is expected to increase the demand for R&D results by innovate firms. Indeed, R&D expenses in high-tech sectors have increased about 3-times since 1994 and the fastest growth occurred between 2001 and 2003. However, R&D expenses in the high-tech sector were only 36 mil euro in 2003, which is about 6% of the total R&D expenses in the whole private sector.

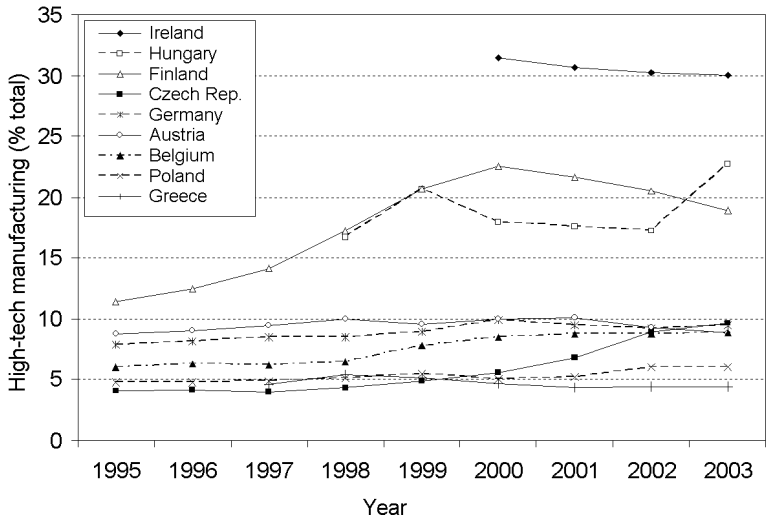

Figure 5. High-tech manufacturing as a percentage of total production value in nine EU countries. Data source: Eurostat

The purchase by Czech entities of licenses and trademarks from abroad have been increasing slowly every year since 1996 and almost doubled by 2005. However, when expressed as a GDP percentage, the payments for license imports stagnate at about 0.16% of GDP. Also receipts for the sale of licenses and trademarks to abroad have been stagnating since 1996 around 0.055% of GDP. Payments for license purchase significantly (~2,5 fold) exceed receipts for license sales. Czech companies obviously buy most R&D results for their innovation (i.e. licenses for patents, trademarks and know-how) from abroad.

However, purchase of licenses by Czech businesses is not too high, either. In comparison with other eight EU states, license imports to the Czech Republic were the second lowest, after Greece (Figure 6). A significant lag is clear not only in comparison with Ireland, which is even out of the scale of the Figure 6, but also with the neighboring Hungary. Czech enterprises thus do not need R&D results too much, neither the domestic nor the imported ones. International comparison of receipts for license sale ranked the Czech Republic the seventh among nine EU countries, far behind Finland, Belgium, Germany, Hungary and Ireland (Figure 6). This is a further evidence of low outputs of Czech R&D in the area of internationally protected results of applied research.

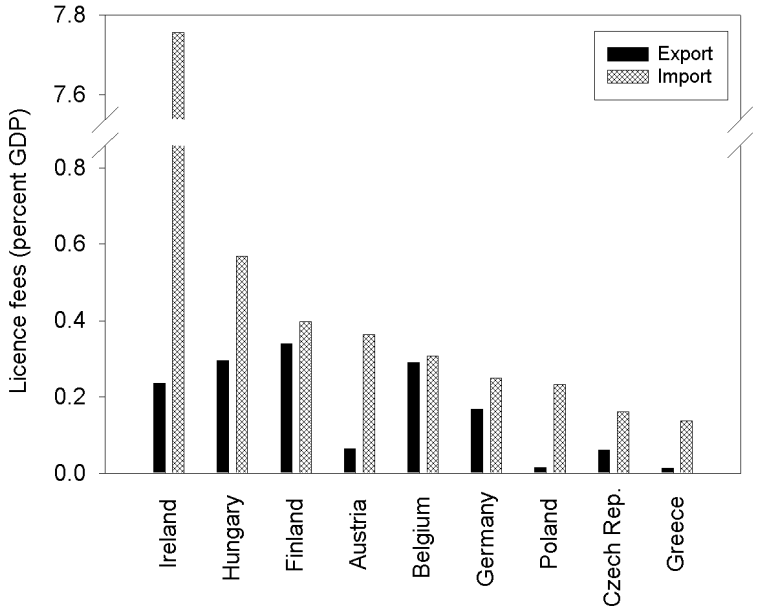

Figure 6. Balance of payments for royalties and license fees from 1994 to 2005: comparison of nine EU countries. Data source: Eurostat

Discussion and conclusions

Patenting activity of the Czech R&D is very low. In comparison of nine EU countries based on the EPO and USPTO patent counts per million inhabitants, the Czech Republic ranked the seventh, leaving behind Poland and Greece. Not even a detailed analysis of the number of patents in individual IPC sections brought any positive surprise. In most IPC sections the Czech Republic lacked in the international comparison. Section D (textile goods and paper) represented the only exception, with the Czech Republic ranking the fifth, and, to some extent, also sections B (industrial technology and traffic), E (construction industry) and G (physics), where it ranked the sixth. This comparison indicates that the Czech R&D has a very low productivity in all sections of patents.

This finding is not very surprising. A recent study has shown a similar situation in six Central and Eastern European economies [RADOSEVIC & AURIOL, 1999]. Somewhat more surprising were results of the causal analysis. This failure is due to a low patenting activity of research institution as well as to a low demand for patents by Czech enterprises. A decrease in the number of patents after 1990 was, at least partially, caused by the transformation of their major generators (i.e. dissolution of sectoral research institutes) or by a change of their preferences (i.e. the new evaluation system of the AS CR). A similar decrease has occurred in all former centrally planned economies as a consequence of the economic changes after 1990 [MARINOVA, 2001]. Researchers at Czech universities and other public sector research organizations have a low motivation to file patents [KLUSACEK & AL, 2005]. They perceive the personal benefits resulting from this type of activity to be low and there are many difficulties associated with the patenting process. Besides, they receive only a limited support from their organizations, which lack proper competences. Similar feelings have been expressed by researchers from public research institutions from EU-15 countries [MOUTINHO & AL., 2007]. However, in EU-15 countries, universities are increasingly expected to take on technology transfer and commercialization as a part of their mission, next to teaching and research [RASMUSSEN & AL., 2006]. All research universities have "technology transfer offices" to patent and market faculty inventions [SAMPAT & NELSON, 2002]. However, this is not the case in the Czech Republic. There is a lack of technology transfer centres and cooperation among individual participants of the innovation process is insufficient. [KLUSÁČEK & AL., 2005]

One of the most important causes of the low patent activity seems to be the low interest of domestic companies. R&D expenses of businesses (BERD) in the Czech Republic are relatively low, but the number of patents does not correlate even with the financial resources invested. Czech enterprises do not sufficiently motivate their R&D employees to generate patents and they are not overly interested in protecting even those few suitable results of domestic R&D by patents, as a relatively high share of

Czech patents is assigned to foreign enterprises or to individual inventors. Czech companies do not even buy many patents and licenses from abroad and yet the share of high-tech manufacturing increased up to 10 percent in the past few years, which is comparable with developed EU-15 countries, such as Belgium, Germany and Austria. Since high-tech manufacturing requires a high yield of R&D inputs, an unresolved question remains here: what are these R&D results and where are they coming from? It is true that R&D expenses in the high-tech sector have increased about three times since 1994 and the fastest growth occurred between 2001 and 2003, however, R&D expenses in high-tech sectors were still mere 36 mil euro in 2003, which is less than 6% of the total BERD. It is not quite likely that this small share of R&D expenses covers all needs of the growing high-tech sector in the Czech Republic. Another unresolved question waiting for an answer is which results do the enterprises get for the remaining 94% of R&D expenses spent by the business sector.

All these findings determine convincingly that Czech companies do not have an overly high interest in patents and patenting. It may be possible that the process of patent development to the final product is much of a burden for financially weak Czech companies. Indeed, it has been shown that large companies have a stronger tendency to protect their intellectual property through patents and that smaller innovators feature a lower probability of applying for patents [CHABCHOUB & NIOSI, 2005; BROUWER & KLEINKNECHT, 1999].

In conclusion, our analysis has shown that a low patenting activity is due to deficiencies on the side of patent generation – mainly a low motivation of researchers – as well as on the side of clients – namely a low demand for patents by Czech companies. However, it has not fully clarified how is it possible that Czech companies are lagging behind so much in generation of their own patents as well as in the purchase of licenses from abroad while having a share of high-tech manufacturing in industrial production comparable with developed EU countries. Another remaining unresolved question is which results are accomplished for the majority (i.e. 94%) of R&D expenses spent by the business sector. We were not able to answer these questions by analyzing statistical data. To answer these questions, it would be rather necessary to organize a survey among business enterprises in the Czech Republic.

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