

Chapter 17.

Research and development activity of the largest Polish companies – problems and challenges

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17.1. Low enterprise spending on R&D - the main problem barrier to increasing the innovativeness of Polish economy

The level innovativeness of Polish economy is unsatisfactory. According to the 2005 Summary Innovation Index (SII) prepared by the DG Enterprise (European Commission, 2006), Poland was included in the group of countries described as “losing ground” (together with Bulgaria, Estonia, Romania, Slovakia, Spain and Turkey) – Poland was ranked 27th out of 33 countries and 21st out of the 25 EU member states. The report states that taking into account the value of SII for other European countries and using a linear extrapolation of current performance and the growth rate, the process of catching up to the EU-25 average level of performance in the case of Poland would take more than 50 years. The report concludes that this enormous time-lag should rise a question on which dimensions of the innovation policy have to be addressed better. This question becomes even more important in the context of progressive globalization and increasing technology competition from non-European countries – the reports states that basing on current trends it would take more than 50 years for the EU-25 to reach the US level of innovation performance. The report shows that Poland exceeds the EU average only for four indicators:

- » youth education attainment level,
- » total innovation expenditures,
- » ICT expenditures, and
- » new-to-firm product sales.

All these are the indicators for future success in adopting new technologies. On the other hand, the report stresses that the conditions for knowledge creation are worsening, particularly due to a decline in business R&D and indicated the following major challenges: to strengthen the financing system supporting the R&D and innovative activities, to stimulate cooperation between industry and science as well as clustering (EC, 2006).

The main reason for a low level of innovativeness and innovative capacities of the Polish economy is a low and decreasing level of R&D financing during the last decade (Górzyński *et al.*, 2006). According to GUS (2002), the level of R&D spending in Poland in 1998 amounted to 0.72% of GDP, while the business enterprise R&D spending (BERD) amounted to 0.28% of GDP. In 2005, gross domestic expenditure on research and development activity in 2005 prices amounted to PLN 5,574.6 million (€ 1,384.85 millions)¹, which accounted for 0.57% of GDP. At that year, state's share in financing R&D activity amounted to 57.7%. It means that non-budgetary funds aimed at financing the R&D activity in Poland accounted for 0.24% in relation to GDP. In contrast, in 2003 in the OECD countries the state's share in financing of R&D activity amounted to 30.2% and in the EU to 35%. At the same period the total expenditures on R&D activity in OECD countries amounted to 2.26% of GDP and in the EU to 1.81% of GDP.

These data clearly indicate that in order to increase the innovative capacities of the Polish economy and to direct innovation policy towards meeting goals of the Lisbon strategy, the main strategic goal of the Polish innovative policy should be a significant increase in spending on R&D and stimulation of innovative activities by the private sector.

However, the need of increasing the R&D activity by the enterprise sector is not only the issue of improvement of R&D statistics (although the R&D indicators very well reflect innovativeness, innovative capacity and technological competitiveness of the enterprise sector and the economy). Equally important is the role of the innovative companies in the process of shaping the effective National Innovation System (NIS), especially in the catching-up and developing economies. Freeman (2006) showed that the low level of R&D expenditure at enterprise level affects negatively on the NIS effectiveness. He also pointed out that the way in which enterprises develop innovation is not simply a matter of R&D, but is also dependent on the way in which markets operate and production is organized, as well as on the legal and cultural norms of the society. On the other hand, he showed, presenting Asian experience that companies can influence the way the market's forces function within the framework of the NIS.

¹ The EUR-PLN conversion rate used throughout the chapter is an average exchange rate published by the National Bank of Poland.

17.2. Innovative performance of the largest companies in the developed countries²

According to NSF (2004), parent companies of the U.S. multinational corporations (MNC) accounted for two-thirds of the R&D spending of all industrial R&D performers in the United States in 2000. These parent companies at that time spent on R&D activity \$131.6 billion in the United States. These data were confirmed by Mataloni and Yorgason (2002). They pointed out that expenditures for research and development activities performed by the U.S. multinational companies accounted for 68% of total U.S. R&D expenditures in 1999, while in both 1982 and 1989 they accounted for at least two-thirds of the US total. They also indicated that for U.S. parents, the ratio of R&D expenditures to the gross product of all U.S. parents was 7%. The ratio of R&D expenditures to the gross product of U.S. parents that performed R&D was 11%. R&D intensities were particularly high for companies in several industries within manufacturing, such as computers and electronic products (particularly communication equipment), chemicals (particularly pharmaceuticals and medicines), and transportation equipment. In the case of computers and electronic products, the ratio of R&D expenditures to the gross product of all U.S. parents was 29%, as almost all entities in this industry conduct R&D.

Mataloni and Yorgason (2002) pointed out that 87% of the R&D was performed by U.S. parents and 13% by foreign MNC. To a considerable extent, the parent's large share reflects their dominant share of overall U.S. MNC operations. It may also reflect the tendency of firms to locate complex research activities near their headquarters and the role of the United States as a leader in innovative scientific and engineering research and in the development of new technologies. 88% of the U.S. MNC R&D spending was funded by the MNC's themselves. The remaining 12% was funded by other entities, such as governments, other private firms, and non-profit organizations.

The data of National Science Foundation (2007) show concentration of R&D spending, which are mainly driven by large companies. Industrial companies employing over 25 thousand people in US financed over 41.1% of total indus-

² In order to prepare the comprehensive analysis and assessment of the innovative performance of the Polish largest enterprises the reference presentation of the situation in the most developed countries in that field is required. This chapter presents the U.S. example as one the most innovative economies and the enterprise sectors in the world, the worldwide leader of R&D spending at enterprise level. That part of the analysis is based on the data coming from the Bureau of Economic Analysis of U.S. Department of Commerce and from National Science Foundation. The chapter presents also the selected findings coming from *The 2006 EU Industrial R&D Investment Scoreboard*, Industrial Research and Innovation, prepared by Directorate-General Joint Research Centre of European Commission.

trial R&D in 2003, while the share in financing total industrial R&D by the companies employing over 5,000 people accounted for 62.2%.

The data and the findings for the EU companies come from the 2006 edition of the "EU Industrial R&D Investment Scoreboard". EC (2006a) contains the data on the top 1000 EU companies and the top 1000 non-EU companies ranked by their investments in research and development. The report confirmed the role of large companies as the main drivers of R&D spending and innovation activities of the enterprise sector worldwide. 2000 surveyed companies invested €371 billion in the year covered by the *Scoreboard* (i.e. 2005/6). This equals to nearly 80% of the total business R&D expenditure worldwide. The concentration of R&D spending was also observed in EU. The top 50 EU companies invested €80 billion in R&D, representing 70.7% of the R&D investment by the EU companies on the *Scoreboard* as a whole. Over 2005, there has been strong growth in industrial R&D investment worldwide. The 1000 EU companies invested €112.9 billion (growth by 5.3%) and the 1000 non-EU companies €257.7 billion (growth by 7.7%). The proportion of EU firms increasing their R&D investment in 2005 amounted to 76%, while non-EU – to 84%. Over the past three years, R&D investment has grown on average by 1.7% p.a. in the EU 1000 and by 6.7% p.a. in the non-EU 1000.

According to the EC (2006a) the overall R&D intensity³ of EU companies amounted to 2.9%, while the R&D intensity for the US companies amounted to 4.4%. The list of top 1000 EU companies consists of 327 companies from the UK, 167 from Germany, 112 from France, 81 from Sweden, 70 from Finland, 44 from Netherlands, 37 from Belgium and Denmark, 28 from Austria, three from Hungary, two from the Czech Republic and only two from Poland: TP SA and KGHM ranked 488th and 864th respectively. TP SA reported the R&D spending at the level of €14.31 million, while KGHM €4.21 million. For comparison, in 2005 the leader of the list of 1000 EU companies according to R&D spending DaimlerChrysler from Germany invested €5,649 million and Siemens, ranked the second – €5,155 million.

Industrial R&D investment worldwide are highly concentrated in three sectors: automobiles and spare parts, technology hardware and equipment, pharmaceuticals and biotechnology, while sectors such as telecommunication, services, food producers or oil and gas have relatively low average R&D intensities. Together, they accounted for more than a half of global R&D investments by the top *Scoreboard* companies in 2005. R&D is also highly concentrated in just a few companies in each sector. EU companies are relatively strong in the automobiles and parts, as well as in chemicals sectors. The highest average annual R&D investment growth rates in 2005 and over the last five years as a whole

³ R&D intensity was defined in the *Scoreboard* as a percentage of R&D investment over net sales.

were shown by companies operating in pharmaceuticals and biotechnology as well as in a number of services sectors: software and computer services, travel and leisure, media, health-care equipment and services, support services.

The survey confirmed that companies continue to prefer to locate R&D activities in their home-country. Therefore, the top locations for R&D activity in Europe continue to be Germany, the United Kingdom, and France. Outside the EU, the U.S. remained by far the most attractive place for locating R&D activity, followed by China and India.

17.3. R&D activity of the largest Polish companies – results of the survey

Starting from 2002, the CASE (Center for Social and Economic Research) and CASE-Doradcy, the research institutions based in Warsaw, together with a daily newspaper Rzeczpospolita have been preparing the list of the most innovative companies in Poland. Each year the questionnaire prepared by CASE is sent to the largest Polish companies. In 2006, the questionnaires were sent to over 3500 largest companies with the total income of at least 50 million PLN in 2004 (at least €11 million). Last year 134 companies sent the questionnaire back. The goal of the chapter is to present the main results of the survey.

Total sales income of the surveyed companies in 2005 amounted to PLN 153.7 billion (€ 38.2 billion). They employed 337.8 thousand people. Total investments of the companies amounted to PLN 8.9 billion (€ 2.2 billion). In terms of number of the surveyed companies, private domestic companies made up 57.5% of the sample. However, in term of sales, investments and employment the group of the analyzed companies was dominated by state owned companies (sales, investments and employment of the state-owned companies accounted for 47.1%, 52.8%, and 65.8% of the total sales respectively, investments and employment of the analyzed firms). General economic characteristic of the analyzed companies according to the type of ownership is presented in table 17.1.

In 2005, the surveyed companies spent PLN 1,045 million (€ 259.6 million) on R&D activity, which accounted for 59% of gross domestic expenditures on R&D activity in the business enterprise sector reported by Central Statistical Office (2006a).

It is worth noticing that the total BERD in Poland in 2005 reported by Central Statistical Office accounted for only 7.8% of R&D expenditures of Daimler-Chrysler – the leader of the 2006 EU Industrial R&D Investment Scoreboard.

The R&D expenditures were driven mainly by the domestic private companies, which spent almost 65% of the total reported expenditures of the analyzed companies (table 17.2).

Table 17.1. General economic characteristic of the analyzed companies according to the type of ownership, 2005

	State-owned companies	Private domestic companies	Foreign companies	Total
Number of companies	40	77	17	134
- share in total	29.9%	57.5%	12.7%	100%
Sales incomes, PLN (k)	72,367,299	66,873,754	14,525,997	153,767,049
Sales incomes, euro (k)	17,977,667	16,612,946	3,608,585	38,199,197
- share in total	47.1%	43.5%	9.4%	100%
Gross profit, PLN (k)	6,338,910	6,491,727	1,637,538	14,468,175
Gross profit euro (k)	1,574,728	1,612,691	406,801	3,594,220
- share in total	43.8%	44.9%	11.3%	100%
Gross profitability	8.8%	9.7%	11.3%	9.4%
Investments, PLN (k)	4,695,306	3,444,187	758,278	8,897,770
Investments, euro (k)	1,166,420	855,614	188,373	2,210,406
- share in total	52.8%	38.7%	8.5%	100%
Employment	222,342	90,529	24,980	337,852
- share in total	65.8%	26.8%	7.4%	100%

Note: "k" – thousand.

Source: own calculations based on CASE and Rzeczpospolita survey.

Table 17.2. Selected R&D indicators for 2005 of the surveyed companies according to the ownership structure

	State-owned companies	Private domestic companies	Foreign companies	Total
R&D expenditures, PLN (k)	231,719	676,195	137,162	1,045,076
R&D expenditures, euro (k)	57,564	167,982	34,074	259,620
%	22.2%	64.7%	13.1%	100%
R&D intensity	0.32%	1.01%	0.94%	0.68%
R&D employment	1,026	2,097	344	3,466
R&D expenditure per one R&D employee, PLN (k)	225.9	322.5	399.3	301.5
R&D expenditure per one R&D employee, euro (k)	56.1	80.1	99.2	74.9
R&D expenditure per one employee, PLN (k)	1.0	7.5	5.5	3.1
R&D expenditure per one employee, euro (k)	0.3	1.9	1.4	0.8
R&D employment over total employment	0.46%	2.32%	1.38%	1.03%

Note: "k" – thousand.

Source: own calculations based on CASE and Rzeczpospolita survey.

The results of the survey showed that 90 companies increased and 44 firms decreased the R&D spending in 2005 comparing to 2004. However, total R&D expenditures of the surveyed companies in 2005 decreased in comparison to 2004 by 2.3%. As in 2005, the surveyed companies increased the sales over 2004 by 9.8% the R&D intensity in 2005 decreased to 0.68% – in 2004, the R&D intensity was estimated at the level of 0.76%⁴. It is worth mentioning that in 2005 the highest R&D intensity – 1.01% was reported by private domestic companies, while by the state-owned companies – the lowest – 0.32% (table 17.2).

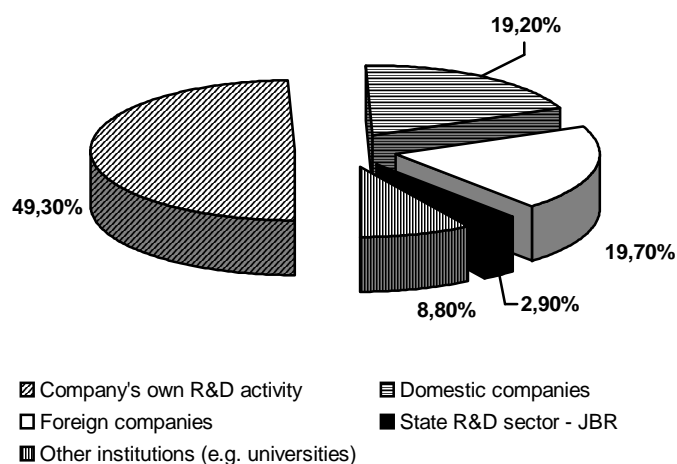
In 2005, 3,466 employees in the surveyed companies were dedicated to R&D activity. Comparing to the data from 2004, an increase in employment in R&D was reported by 391 persons (increase of 11%). The decrease of R&D expenditures as well as an increase in the number of personnel dedicated to R&D activity were reported in 2005 comparing to 2004, the R&D expenditure per employed in R&D decreased from PLN 347.9 thousand (€76.7 thousand) in 2004 to PLN 301.5 thousand in 2005 (€ 74.9 thousand). In 2005, the highest R&D expenditures per one employee in R&D activity were reported by foreign companies (PLN 399,300), while the lowest spending was reported by the state-owned companies (PLN 225,900). The share of employees in R&D activity over the total employment in the surveyed companies in 2005 was higher than in 2004 and amounted to 1.03% (in 2004, it amounted to 0.97%) – the highest value for that indicator was again observed in the group of private domestic companies – 2.32%. The total R&D spending in 2005 per one employee amounted to PLN 3.1 (€768).

49.3% of the R&D funds in 2005 were consumed by the firm's R&D divisions (see figure 17.1). The second and the third most important source of R&D for the surveyed companies were: the purchase of R&D results from the foreign (19.7%) and domestic (19.2%) companies. Only 2.9% of the funds went to state R&D sector (so-called JBR sector), which indicates very limited cooperation. 8.8% of the funds were aimed at other institutions and organizations (universities, Polish Academy of Sciences – PAN etc.).

It is worth noticing that foreign companies almost did not report R&D contractual cooperation with Polish companies or domestic R&D sector. Majority of the R&D activity of foreign companies was performed by own R&D departments (83.1%) or was purchased abroad (12%). What is more, private Polish companies hardly ever reported cooperation with domestic R&D institutions – only 3.3% of the private domestic firm's R&D expenditures went there.

On the other hand, these firms are the most active in developing contractual R&D relations with other firms – foreign and Polish (almost 50% of the R&D expenditures of private domestic firms were channeled to other companies).

⁴ R&D intensity was defined in as the percentage of R&D investment over sales.

Figure 17.1. Structure of R&D expenditures in 2005 of the surveyed companies

Source: own calculations based on CASE and Rzeczpospolita survey

The results of the survey show that the state-owned companies are the most frequently cooperate with domestic R&D sector – 41.5% of R&D expenditures of the state-owned companies were incurred by the JBR sector, universities and science institutions (table 17.3).

Table 17.3. Structure of R&D expenditures in 2005 of the surveyed companies according to the ownership structure

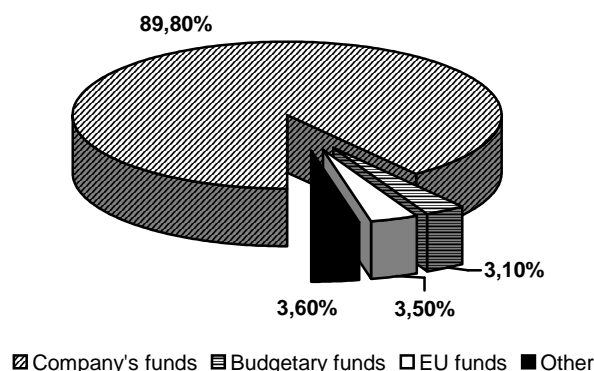
	State owned companies	Domestic, private companies	Foreign companies
Company's own R&D activity	35.3%	47.5%	83.1%
Domestic companies	14.6%	24.1%	1.9%
Foreign companies	8.6%	25.1%	12.0%
State R&D sector – JBR	8.5%	1.2%	3.0%
Other institutions (e.g. universities)	33.0%	2.1%	0.0%

Source: own calculations based on CASE and Rzeczpospolita survey.

It is worth noticing that despite massive privatization process of the Polish economy or rapid private sector development during the last two decades, state-owned companies are still the most important clients for the domestic (mainly public) R&D sector. It means that the R&D institutions are not looking for cooperation or are not able (or not competitive enough) to cooperate with private (domestic and foreign) companies.

The results of the research showed that the R&D activity is financed mainly by the companies – almost 90% of financing in 2005. The companies are not active in obtaining EU and budgetary funds. The share of public money accounted for only 6.5% of total companies R&D financing (figure 17.2).

Figure 17.2. Structure of R&D financing of the surveyed companies in 2005



Source: own calculations based on CASE and Rzeczpospolita survey.

The structure of R&D financing of the surveyed companies according to the ownership structure indicates that the private domestic companies are the most active in attracting the EU funds, while the state-owned companies are the most successful in attracting budgetary funding (in that group of companies budgetary funding accounted for 9% of total R&D financing) (table 17.4).

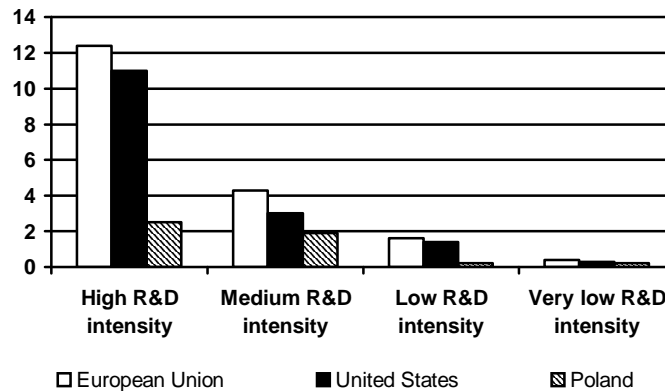
Table 17.4. Structure of R&D financing of the surveyed companies in 2005 according to the ownership structure

	State owned companies	Domestic, private companies	Foreign companies
Company's funds	84.7%	92.3%	86.1%
Budgetary funds	9.0%	1.7%	0.0%
EU funds	0.1%	5.4%	0.0%
Other	6.2%	0.6%	13.9%

Source: own calculations based on CASE and Rzeczpospolita survey.

Figure 17.3 presents the comparison of R&D intensity of the top R&D investing companies in Poland, EU and US according to sectors⁵.

⁵ R&D sector's intensity was defined according to the EC (2006a).

Figure 17.3. R&D intensity of the most R&D investing companies from Poland, EU and the U.S. by sector in 2005

Source: For EU and US – EC (2006a), for Poland – own calculations based on CASE and Rzeczpospolita survey.

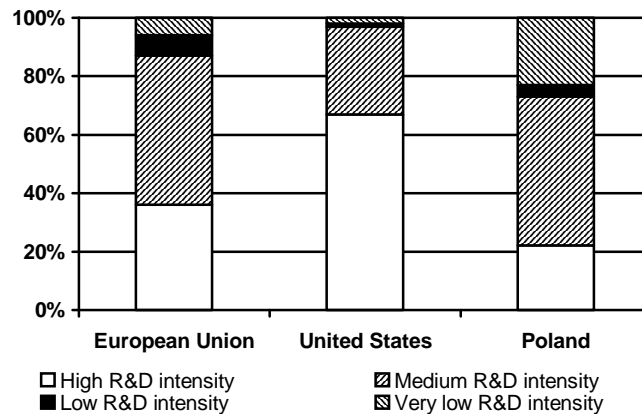
The results of the analysis indicate significantly lower R&D intensity of Polish companies in all analyzed sectors except for the companies from the very low R&D intensity sector. It is worth noticing that the R&D intensity of Polish companies from the high R&D intensity sector is almost five times lower than of the EU companies. According to the EC (2006a) methodology, these Polish firms should be rather classified as medium R&D intensity companies. The data presented in figure 17.3 may suggest that taking into account the R&D intensity, Polish companies are not able to build R&D competitive advantage in high R&D intensity sectors and R&D activity should be intensified in medium R&D intensity sector – for the EU companies R&D intensity in 2005 amounted to 4.3% and for Polish companies 1.9%.

The crucial role of companies from medium R&D intensity sectors in the process of increasing the level of R&D activity and innovativeness of Polish enterprise sector are confirmed by the data presented in figure 17.4. The sectoral composition of most companies investing in R&D in Poland show that majority

1. High R&D intensity sectors (intensity above 5%): Pharmaceuticals & biotechnology; Health care equipment & services; Electronics & electrical equipment; Technology hardware & equipment; Software & computer services; Leisure goods.
2. Medium R&D intensity sectors (between 2% and 5%): Automobiles & parts; Aerospace & defence; Industrial engineering & machinery; Chemicals; Personal goods; Household goods; General industrials; Support services; General retailers.
3. Low R&D intensity sectors (between 1% and 2%): Food producers; Beverages; Travel & leisure; Media; Oil equipment; Electricity; Fixed line telecommunications.
4. Very-low R&D intensity sectors (less than 1%): Oil & gas producers; Industrial metals; Construction & materials; Food & drug retailers; Transportation; Mining; Tobacco; Multi-utilities.

of R&D investments (51%) are located in medium R&D intensity sector. Only 22% of R&D spending of the largest Polish companies are located in high R&D intensity sectors. It is worth underlining that 23% of R&D expenditures in Poland is located in a very low R&D intensity sector, while in the US only 2% and in the EU 6%. The data presented in figure 17.3 and 17.4 present limited ability of the Polish enterprise sector to generate high quality of R&D activities on a massive scale and indicate that the competitiveness of the Polish economy may be driven by medium R&D intensity sectors.

Figure 17.4. Sectoral composition of most R&D investing companies from Poland, EU and the U.S.



Source: For EU and U.S. see EC (2006a), for Poland – own calculations based on CASE and Rzeczpospolita survey.

Table 17.5 compares the selected branches in Poland and EU according to the branch’s R&D intensity and the branch’s share in R&D investments of the largest companies. The data presented in the table show that Polish firms from all branches are characterized by lower R&D intensity than the EU companies. The largest R&D investors in Poland are located in chemical and software industries (35.5%). It is worth noticing that Polish chemical, automotive and food companies, comparing to other branches, have the smallest distance to catch up with the EU companies in the field of R&D intensity.

The results of the survey showed that only nine companies out of 134 (6.7%) sold any licenses, only 22 companies submitted patent application abroad (16.4%) and 49 firms submitted patent applications in Poland (36.6%). 25 companies (18.7% out of 134 surveyed ones) declared that they offer the products that are unavailable on foreign markets (there are no equivalents of these products on foreign markets) and 60 companies (44.8%) reported existence of R&D divisions.

Table 17.5. Branch share in R&D investment and R&D intensity in 2005 of the most R&D investing companies from selected sectors in EU⁶ and Poland⁷

	EU		Poland	
	Branch share in R&D investment	R&D intensity 2005	Branch share in R&D investment	R&D intensity 2005
High R&D intensity sector				
Pharmaceuticals and biotechnology	17,3%	12,4%	4,7%	1,8%
Electronics and electrical equipment	6,9%	5,3%	7,9%	1,6%
Technology hardware & equipment, software & computer services	14,8%	23,7%	13,6%	4,3%
Medium R&D intensity sector				
Automobiles and parts	23%	4,5%	8,4%	1,8%
Industrial engineering	3,9%	3%	3,4%	0,7%
Chemicals	5,7%	3,3%	21,9%	1,9%
Low R&D intensity sector				
Food producers	1,7%	1,4%	2,3%	0,8%
Very low R&D intensity sector				
Oil and gas producers	1,7%	0,3%	7,6%	0,1%

Source: For EU – EC (2006a), for Poland – own calculations based on CASE and Rzeczpospolita survey.

17.4. Conclusions

Taking into account R&D activity, the largest Polish companies are significantly less innovative than their EU and US counterparts.

According to the EC (2006a) the overall R&D intensity of EU companies amounted to 2.9%, while the R&D intensity of the US companies amounted to 4.4%. In the case of the largest Polish companies which reported R&D activity (the list of CASE and Rzeczpospolita of the most innovative companies in 2005), R&D intensity amounted to only 0.68%, while for 2004 the R&D intensity of these companies was estimated at the level of 0.76%. In 2005, the highest R&D intensity (1.01%) was reported by private domestic companies, while the state-owned companies reported the lowest (0.32%). The total R&D expenditures of the surveyed Polish largest companies in 2005 decreased by 2.3% in comparison to 2004. This trend is exactly opposite to the tendency observed in

⁶ According to the 2006 EU industrial R&D Investment Scoreboard.

⁷ According to the 2006 list of the most innovative, Polish companies of CASE and Rzeczpospolita.

the U.S. and EU at that time (EC, 2006a). The R&D expenditures of the analyzed Polish firms were driven mainly by private domestic companies, which spent almost 65% of the total reported expenditures. In order to illustrate the distance between Poland and other EU countries it is worth mentioning that the total BERD in Poland in 2005 reported by Central Statistical Office accounted for only 7.8% of R&D expenditures of DaimlerChrysler - the leader of the 2006 EU Industrial R&D Investment Scoreboard.

In the case of Poland, we observe lower concentration of R&D expenditure. 5% of Polish top R&D investors incurred around 45% of all R&D expenditures reported by the largest Polish companies (according to the list of CASE and Rzeczpospolita), while according to the 2006 EU Industrial R&D Investment Scoreboard 5% of the largest R&D investors from EU financed over 70% of total R&D spending reported by the largest companies in EU.

R&D expenditure per employee in R&D decreased from PLN 347,900 (€ 76.7 thousand) in 2004 to PLN 301,500 in 2005 (€ 74900). In 2005, the highest R&D expenditures per one employee in R&D activity were reported by foreign companies (PLN 399,300). The total R&D spending in 2005 per one employee in the surveyed Polish companies amounted to PLN 3.1 (€768).

According to the results of the CASE and Rzeczpospolita survey, the largest R&D investors in Poland are located in chemical and software industries. Additionally, Polish chemical, automotive and food companies have the smallest distance to catch up with the EU companies in the field of R&D intensity. It seems that Polish enterprise sector should look for competitive advantages in medium R&D intensive sectors. As the Polish companies are characterized by a low level of absorption capacities (Górzyński *et al.*, 2004), as well as limited financial capacities, they are not able to build R&D competitive advantage in high R&D intensity sectors. R&D activity should be rather stimulated in the medium R&D intensity sector. It is worth adding that at present 51% of R&D spending of the largest Polish companies are located in medium R&D intensity sector and only 22% in high R&D intensity sectors.

The results of the CASE and Rzeczpospolita survey showed that the R&D activity is financed mainly by companies (almost 90% of financing in 2005). Such structure is typical for developed economies (e.g. U.S.). In the case of Poland, such a high share of own financing is a serious barrier for R&D development, taking into account limited financial resources of Polish companies (private ones, in particular)⁸. The results of the survey showed that private domestic companies practically do not use the budgetary funding for R&D activity but more frequently rely on EU funds. The majority of the public money goes to the

⁸ These companies did not have enough time for sufficient capital accumulation to conduct at present R&D activity on at least the EU level.

state-owned companies. Taking into account the dominant role of private domestic companies in the process of stimulating R&D activity in the business sector, the present situation should be identified as a serious weakness of the financing system supporting the R&D and innovative activities in Poland. The low level of consumption of the EU funding by Polish companies should be additionally considered as a serious problem, which should be investigated more thoroughly.

49.3% of the R&D funds in 2005 were consumed by the firms' R&D divisions. Private Polish and foreign enterprises hardly ever reported cooperation with domestic R&D institutions. Moreover, foreign companies did not report R&D contractual cooperation with Polish companies – majority of the R&D activity of foreign companies was performed by own R&D departments or was purchased abroad. Private Polish companies are the most active in developing contractual R&D relations with other companies – foreign and Polish (almost 50% of the R&D expenditures of these firms were channeled to other companies). The results of the survey show that the state-owned companies most frequently cooperate with domestic R&D sector. The main two problems and challenges in that area are: the lack of cooperation between foreign and Polish companies as well as Polish R&D institutes (and as a result the R&D spillover effect from the foreign investments in R&D activity is limited) and the lack of cooperation between the R&D sector in Poland and the enterprise sector.

Low level of Polish companies' innovativeness negatively influences the overall competitiveness of the Polish economy. The main factor, which could improve the situation and reverse a current negative trend is an increase in interest of the business sector in R&D activity, especially of large companies. It is worth mentioning that the process of increasing involvement of large companies in R&D activity should not be limited only to increase of R&D spending but also should aimed at shaping more effective functioning of the National Innovation System. Taking into account recent, negative developments in that field, there is a strong need to propose necessary policy and actions aimed at stimulation of the R&D activity at the enterprise level. The results of the analysis presented in the chapter show that action should be mainly aimed at strengthening the financing system supporting the R&D and innovative activities of privately owned domestic companies, stimulation of R&D cooperation between foreign companies and domestic companies as well as Polish R&D institutes (e.g. creation of contractual R&D networks), stimulation of cooperation between industry and R&D sector (including the sector's restructuring and strengthening).

References

1. Central Statistical Office (2006) (CSO), *Innovative activity of industrial enterprises 2002-2004*, Warsaw: Central Statistical Office.
2. Central Statistical Office (2006a) (CSO), *Science and Technology in Poland in 2005*, Warsaw: Central Statistical Office.
3. Central Statistical Office (2002) (CSO), *Science and Technology in Poland in 2001*, Warsaw: Central Statistical Office.
4. European Commission (2006) (EC), *European Innovation Progressing Report 2006 – Trendchart*, Luxemburg: DG Enterprise.
5. European Commission (2006a) (EC), *The 2006 EU Industrial R&D Investment Scoreboard*, Seville: Industrial Research and Innovation, Joint Research Centre.
6. Freeman, Ch. (2006), “*Catching Up*” and *Innovation Systems: Implications for Eastern Europe*, In: K. Piech and S. Radošević (eds), *The Knowledge-Based Economy in Central and East European Countries: Countries and industries in a process of change*, New York and Basingstoke: Palgrave Macmillan.
7. Górzyński, M., Jakubiak, M., Woodward, R. (2006), *Key challenges to the development of the Knowledge-Based Economy in Poland*, In: K. Piech and S. Radošević (eds), *The Knowledge-Based Economy in Central and East European Countries: Countries and industries in a process of change*, New York and Basingstoke: Palgrave Macmillan.
8. Górzyński, M., Jakubiak, M., Woodward, R. (2004), *Innowacyjność polskiej gospodarki w kontekście integracji z UE – możliwości i bariery wdrażania w Polsce gospodarki opartej na wiedzy* [Innovativeness of Polish Economy in a context of UE integration – opportunities and barriers of knowledge based economy implementation in Poland], series: *Third stage of reforms in Poland*, Warsaw: CASE.
9. Mataloni, R., Yorgason, D. (2002), *Operations of US multinational companies: preliminary results from the 1999 benchmark survey*, Survey of Current Business, Bureau of Economic Analysis, U.S. Department of Commerce, March.
10. National Science Foundation (2004), *Science and Engineering Indicators – 2004*, Arlington, January.
11. National Science Foundation (2007), *Research and Development in Industry: 2003*, Arlington, January.

Table 17.6. Annex 1. The list of the top 15 R&D investors in the EU in 2005

Rank	Company	Sector	Country	R&D Investments (mln euro)	R&D/ net sales	R&D/ employees (thousand euro)
1	DaimlerChrysler	Automobiles & parts	Germany	5,649.00	3.8	14.6
2	Siemens	Electrical components & equipment	Germany	5,155.00	6.8	11.7
3	GlaxoSmithKline	Pharmaceuticals	UK	4,564.13	14.5	45.9
4	Volkswagen	Automobiles & parts	Germany	4,075.00	4.3	12.6
5	Sanofi-Aventis	Pharmaceuticals	France	4,044.00	14.8	41.6
6	Nokia	Telecommunications equipment	Finland	3,978.00	11.6	69.9
7	BMW	Automobiles & parts	Germany	3,115.00	6.7	30.1
8	Robert Bosch	Automobiles & parts	Germany	2,931.00	7.0	11.7
9	AstraZeneca	Pharmaceuticals	UK	2,864.51	14.1	44.1
10	Ericsson	Telecommunications equipment	Sweden	2,729.95	16.9	50.4
11	EADS	Aerospace & defense	The Netherlands	2,367.00	6.9	20.9
12	Philips Electronics	Leisure goods	The Netherlands	2,337.00	7.7	17.0
13	Renault	Automobiles & parts	France	2,264.00	5.6	17.9
14	Peugeot (PSA)	Automobiles & parts	France	2,151.00	3.8	10.3
15	BAE Systems	Aerospace & defense	UK	2,108.88	13.2	28.5

Source: European Commission (2006a).

Table 17.7. Annex 2. The list of the top 15 R&D investors in Poland in 2005

Ra nk	Company	Sector	Country of ori- gin	R&D In- vestments (mln euro)	R&D/ total sales (%)	R&D/ em- ployees (thousand euro)
1	Zakłady Azotowe Anwil SA GK, Włocławek	Chemicals	Poland	43.28	11.7	14.6
2	Kompania Węglowa SA GK, Katowice	Mining	Poland	16.65	0.8	0.2
3	ComArch SA GK, Kraków	Software & computer services	Poland	16.52	15.0	9.4
4	ComputerLand SA GK, Warszawa	Software & computer services	Poland	12.79	6.0	5.2
5	Polski Koncern Naftowy ORLEN SA GK, Płock	Oil and gas producers	Poland	12.25	0.1	0.6
6	BSH Sprzęt Gospodarstwa Domowego sp. z o.o., Warszawa	Electrical components & equipment	Poland	10.88	2.4	10.1
7	Bumar sp. z o.o. GK, Warszawa	Aerospace & defense	Poland	9.36	1.8	1.6
8	Huta Stali Częstochowa sp. z o.o., Częstochowa	Industrial metals	Poland	8.50	2.2	4.4
9	GlaxoSmithKline Pharmaceuticals SA GK, Poznań	Pharmaceuticals	GB	7.56	1.7	4.8
10	Pojazdy Szynowe PESA Bydgoszcz SA, Byd- goszcz	Transportation equip- ment	Poland	5.57	7.1	3.7
11	Sitech sp. z o.o., Polkowice Dolne	Automobiles & parts	Poland	5.04	2.5	3.9
12	Grupa Kapitałowa Remontowa SA GK, Gdańsk	Transportation equip- ment	Poland	4.84	1.6	1.1
13	Prokom Software SA GK, Warszawa	Software & computer services	Poland	4.78	1.0	1.0
14	Valeo Autosystemy sp. z o.o., GK Skawina	Automobiles & parts	MNC	4.11	1.5	2.0
15	Grupa Lotos SA GK, Gdańsk	Oil & gas producers	Poland	3.96	0.2	0.7

Source: own calculations based on CASE and Rzeczpospolita survey.