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ANALYSIS OF RESEARCH AND DEVELOPMENT SECTOR IN PODLASKIE PROVINCE AND ITS POTENTIAL OF DEVELOPMENT

Summary

The Research and Development sector is created by the institutions involved in activities of increasing the knowledge and exploring new applications. Products created in the sector are innovations which are a factor of rapid economic development. The problem of R&D sector is still a low level of funding, especially in the private sector. The number of patents and commercialization of solutions is small compared to other European countries. Enterprises do not use opportunities to cooperate with universities and other research institutions, and opportunities for the development of R&D sector, taking into account the potential of the existing academic and research institutes, are still huge. This is why the aim of this study is the analyze of the R&D sector structure and a short description of research and development activities in the Podlaskie Province. The level and method of financing the R&D sector in Poland is characterized by a relatively low share of expenditure on R&D activities, the domination of the public sector financed and a low spending on applied research and development work. Poland is among the group of countries with the highest share of basic research in the overall structure of research.

Key words: research and development, innovation, academic institutions, knowledge, sustainable development

1. Introduction

The aim of this study is the analyze of the R&D sector structure, the types of organizations which cooperate in this area, the comparing of the organizations structure operating in Poland and the European Union, indicators definition which determinate the level of R&D sector development, an indication of the role of research and development organizations in the process of economic innovation and a short description of research and development activities in the Podlaskie Province. The presented statistics generally relate to the period 2005-2010, in some cases the data for this period were not available and therefore was present the most current information which was possible.

The system of innovations is created by the structure and quality of educational system, forms of financing, as well as the type of R&D institutions and their ability to adapt technologies. An analysis of the business entities in the area of R&D and innovation activity against the background of the European Union countries, points to the weakness

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of our country in this regard. In today's world the sphere of research and development should be one of the main sources of knowledge and innovation, and awareness of this condition should lead to the concentration of activities in the area of R&D.

2. Analysis of the R&D potential structure

The changing the development paradigm adopted the Europe 2020 Strategy provides Europe on the path of smart and sustainable development. At the basis of the Europe 2020 Strategy are to achieve three priorities [*Komunikat Komisji Europa 2020*…, s. 11]:

1. smart development (economy development based on the knowledge and innovation);
2. sustainable development (support the effective economy which using the resources, environment friendly and more competitive economy);
3. development foster to social inclusion (economy supporting which is a high-employment economy and which provides social, economic and territorial cohesion).

Actions which should to be taken by EU countries are: increase the investment spending on R&D sector. Currently, the expenses on the research and development sector in Europe are below 2%, while in the U.S. it is 2.6% and in Japan 3.4%. The difference formed from the lower level of private sector investment. It is important the amounts spent on R&D, but also the impact and structure of expenditures on research and improving the conditions for private R&D activity in the EU [*Komunikat Komisji Europa 2020*…, s. 13]:

According to the Lisbon Strategy, which main aim, in the area of regional policy was creating in Europe, up to 2010 the most competitive and dynamic economy in the world, based on knowledge, capable of sustainable development; Member States were obliged to perform the actions within the four major areas: innovativeness (economy based on knowledge), markets' liberalisation (of telecommunication, energy, transport and financial markets), entrepreneurship and social cohesion. The records of strategy document pointed out better use of the existing potential of the EC regions namely: work, knowledge, fund, as well as creating new forms of regional competitive advantage through the increase of investment in pro-growth activity, that is research and development, education, infrastructure of information society [*Strategia zwiększania nakładów*…, 2004, p. 3].

In 2008 the Cabinet accepted the document prepared by Ministry of Economy*: the National Reform Programme for the period 2008-2011 for the implementation of the Lisbon Strategy*. One of the key actions highlighted in this document is Action 3: *Implementation of solutions supporting pro innovating as well as research and development (R&D) activity, including improving the knowledge transfer and innovation diffusion* [*Krajowy Program Reform*…, 2008]. It follows that development activities are the basis for socioeconomic development based on knowledge.

Pro innovative activities include creative work undertaken systematically to increase the stock of knowledge (about human, culture and society) and finding new possibilities of using this knowledge. A vital feature that distinguishes the activity in the research and

development area from other activities is the newness and technical or scientific uncertainty, as well as some economic risk. Research and development are the basis of knowledge, which is the source of innovative processes, continuous pursuit of improving the products, organizational structures, production and business processes, and human resources. Innovativeness considered, among the others, as improvement and development of existing production or developing technologies, the introduction of new solutions in organization and management, involves the continuous exploration and exploitation in practice, the results of research and development, new concepts, ideas and inventions [Goliński, 2002, p. 145]

In Poland, research and development activities are carried out by the following entities [*Sektor badawczo-rozwojowy*…, 2010 p. 2]:

1. research institutions of Polish Academy of Sciences (institutions carrying out basic research financed mainly from the state budget);
2. research and development units (units with the task of conducting research and development, the results of which should be applied in specific areas of the national economy and social life, which are subject to various ministries, including research institutes, central laboratories and research and development centres);
3. development units (economic entities, mainly industrial companies, possessing own R&D backup; laboratories, research and development facilities and centres, research and technological departments, design and design-technological offices , technology development facilities, offices of studies and projects, as well as agricultural and zoo technical farms and experimental stations);
4. institutions of higher education (public and private institutions operating in the field of R&D)[2].

R&D unit is a business entity running a business, that, at the same time, represents a type of academic institution, specializing in the implementation of new technologies and their improvement. Units have been established by the Act of 25 July 1985 on Research and Development [*Ustawa o jednostkach*…, 1985; *Ustawa o zmianie ustawy o jednostkach*…, 2007]. Since 1 October 2010 the R& D units acting on the basis of the Act of 25 July 1985 on Research and Development units which received a category 1, 2, 3, 4 or 5 under the provisions of the Act of 8 October 2004 on the principles of science funding, have become the research institutes within the meaning of the Act of 30 April 2010 on the research institutes [*Ustawa o instytutach badawczych*…, 2010]. R&D units within the meaning of the Act, are state entities distinguished in terms of legal, organizational, economic and financial sense, created in order to conduct the research and development work [*Ustawa Przepisy wprowadzające ustawy reformujące*…, 2010].

Institutional division of the R&D sector in the European Union is slightly different. The structure of employment consists of following sectors: government, higher ed-

[2] The data published by the GUS in the universities research and development works include only the expenditures and employment information associated with this activity, just after the turning off university teaching function.

ucation and the business one. The government sector corresponds to academic entities of Polish Academy of Sciences and includes a part of the R&D units. The quantity of research within the university colleges and the number of employment can be compared with the Polish data. Unfortunately, the biggest differences are in the group of Research and Development units in the sector of enterprises [*Statistics on Science*…, 2004, p. 40].

Three types of research are distinguished in the structure of the R&D activity [Gaczek, 2004, p. 11]:

1. *Basic research* as theoretical and experimental works, implemented in order to gain or enrich the knowledge concerning certain causes of phenomena and facts. The works are not aimed at direct use in practical activities, however. The basic research can be divided into the so-called *pure and targeted* (oriented) basic research.

   Pure research is conducted with a view of knowledge advancement, without directing to achieve long-term economic or social benefits, without making efforts to apply the results of the research to solve the problems of a practical nature, or to give the results to the entities that may be concerned with their application.

   Targeted research is conducted in order to create a vast knowledge base as the basis for solving of known or anticipated future problems [Baruk, 2006, p. 56-57].
2. *Applied research* concerns the research work undertaken to acquire new knowledge, to subsequently enter specific practical applications. They rely on searching for new possible practical applications for the basic research's results or searching for new solutions allowing to gain preconceived practical goals. The results of applied research are test models of products, processes or methods.
3. *Development work* is the work of a structural, technological and design character as well as the experimental one, involving the implementation of existing knowledge gained through the research work or as a result of practical experience, to work out new, or improve the existing materials, devices, products, processes, systems, methods or services[3]. It is not related to deployment development works, going beyond the scope of the R&D activity, connected with the implementation of technical documentation, instrumentation, trial installations, trial series of new product, carrying out amendments after testing, etc. The development works use the existing knowledge.

In Poland the basic research is mainly conducted in the academic institutions of Polish Academy of Sciences, applied research and development activities dominate in the R&D and development units. Scientific research and development activities are conducted by universities, the academic institutions of Polish Academy of Sciences, R&D units and enterprises. The biggest differences, as far as the forms of performance are concerned, can be seen in the institutions of Polish Academy of Sciences, dominated by basic research and deployment activities. It is difficult to point out a uniform type

[3] Including preparation of the experimental prototypes and pilot fittings.

of activities conducted at higher colleges, because the basic research, as well as particular applied activities, surveys used in practice are conducted there Development activities of university employees also includes deployment works. The participation of non-public university colleges conducting R&D activities is still minor. From year to year the number of units operating on the basis of the act on research and development is decreasing. On the other hand, the number of enterprises conducting R&D activities is increasing. However, the scope of enterprises' activity in the area of R&D is a minor one, both in terms of the amount of expenditure on R&D, as well as staff employed [*Strategia Rozwoju Kraju*…, 2007 p. 7].

The activity of the R&D and development units plays a major role in improving the innovativeness of economy. The R&D units are a part of institutional innovation system next to the manufacturing and service companies, university colleges, independent R&D units cooperating with enterprises, institutions of supporting and transferring the knowledge and innovativeness. Entities conducting R&D activities have a major influence on the type of research conducted in a region. Diversified sources of financing may be the state budget, business entities, international organizations and foreign institutions as well as the budget of the European Union. From the point of view of funding for research and development by the minister responsible for science. Three types of entities involved in this activity and financed by the state budget can be distinguished, namely: colleges, institutes of Polish Academy of Sciences and the R&D units. In the case of colleges own research and associated statutory activity are financed. The institutes of Polish Academy of Sciences receive resources within statutory activity connected with the conducted research. The R&D units have the possibility of receiving grants from the representatives of ministries, which they are directly subjected to [Czerniejewski, 2002, p. 1].

An analysis of characteristics and evaluation of the R&D sector structure is determined by examination of the employment structure within the units conducting R&D activities. The Evaluation of the structure of employment by individuals, from the point of view of implementation the results into economy, should be compared with the assessment of expenditure direction in R&D sector, with the division of expenses into basic activities, applied and developmental ones.

Generic structure of financing development activities conducted at colleges is a varied one. Academic institutions of Polish Academy of Sciences concentrate on basic research, in the regions with the average R&D potential. As far as the transfer of scientific solutions and implementation of innovations into economy are concerned, it is vital that the expenditures were incurred within the units of development. In Poland participation of these units in the usage of expenditures in R&D sector is slightly higher than that of academic institutions of Polish Academy of Sciences.

3. Formation of research and development potential

The connections between R&D potential and innovativeness of economy require diagnosing of sources financing the R&D activity and analysis of their regional diversity. Sources of financing expenditures on the R&D activity may be [*Mały Rocznik Statystyczny*…, 2009, p. 34]:

1. funds from the state budget;
2. own funds of business entities;
3. funds of academic institutions of Polish Academy of Sciences and the R&D units;
4. funds of international organizations and foreign institutions.

Development of education sector in Poland lays within the competence of government administration, where the division into departments is visible. Funds for the bailout of statutory activity are granted to three types of entities: colleges (only within the statutory activity connected with the conducted research and own research, didactic activity is financed by the Minister of Education), institutes of Polish Academy of Sciences (within the statutory activity connected with the conducted research), and the R&D units (subsidised by other representatives of resorts they are subjected to). Research units of private schools may apply for grants by way of competition. Research at the position of lower-level schools is financed by local authorities.

Significance of expenditures in the field of research and development economically depends on the structure of their financing and spending. It is vital, in what range creation of technological and scientific progress is financed by enterprises, especially the private ones, and the state budget on the other hand [Ptaszyńska, 2009 p. 182].

In addition to the budgetary and non-budgetary expenditures, supporting the innovative activity may be carried out through the use of systemic and organizational solutions, aimed at strengthening links between the R&D and economy [*Strategia zwiększania nakładów*…, 2004, p. 13-26]. In connection to this, investments in the development of institutional and academic environment of business are made and more regulations to allow the development or creation of direct financing and operation of the units of the environment are created. Examples of this type of entities are technological centres or centres of excellence. Among systemic and organizational, supporting innovativeness solutions, it should be remembered that there is a possibility of systemic and ownership transformations of the R&D units, often relevant to the development needs of the knowledge based economy.

Features characterizing the level and method of financing the R&D activity in Poland are [Koźlak, 2009, p. 1]:

1. rather low level of the R&D expenditures to GDP;
2. domination of budgetary financing and minor participation of business entities in total expenditure on the R&D;
3. relatively low expenditure on applied research and development activities, compared to expenditure on basic research.

The situation of science in Poland is illustrated by ineffective structure of budgetary expenses, because majority of resources is assigned ,within statutory activity, for protecting the basic needs of scientific units, other expenses on research and intentional projects, as well as on investments and scientific and technical cooperation with foreign countries. This kind of structure indicates that budgetary financing is in a small extend related to the usefulness of economic research, carried out by the subsidized research units. With this kind of structure Poland is among the countries with the highest participation in basic research (it is characteristic for underdeveloped countries). The main

performers of basic research are academic institutions of Polish Academy of Sciences and colleges [Łobesko, 2008, p. 23]. Units of particular sections rarely cooperate with one another, which is often the cause of ineffective use of staff potential, financial means and research equipment. Apart from development units, alternatively private colleges claim subsidies within the statutory activity.

Poland should restructure the economic strategy within the R&D. Stimulating this kind of activity may be the base of strengthening the position of Polish enterprises. It is connected with the need of substantial financing of this sphere, especially by enterprises. It is necessary to introduce new legal and financial solutions, which will urge on private entrepreneurs to invest in R&D [Barej, 2009, p. 10].

Implementation of the R&D activities is connected with involving the staff potential, which is characterised in Polish conditions by lower than average in the EU participation of researchers in the working population. Moreover, there is minor participation of the R&D workers employed in the sector of enterprises in the total number of researchers working in the country. Features characterising the staff potential of science and technology include [*Program Operacyjny Innowacyjna*…, 2011, p. 36]:

1. lower than average in the EU participation of researchers in the working population,
2. minor participation of R&D workers employed in the sector of enterprises in the total number of researchers working in the country,
3. relatively advanced age of gaining the degree of assistant professor and the title of professor,
4. increasing number of doctorates gained (still lower than the average in EU),
5. multi employment of science workers caused by low payments and boost of educational duties (almost fivefold increase of the number of students since 1990).

4. Measures describing research and development sector [4]

Selection of indicators being an important source of the R&D sector description is limited to indicators, for which comparative statistic information is regularly gathered in cross-section of countries and regions of the Community. The same kind of data is also helpful in the analysis of the situation in the EU regions within the realization of Lisbon Strategy's aims. List of indicators chosen by the European Commission to research the level of expenditures on the R&D includes both cost and performance indices, which are grouped in the following categories: financial, human resources, innovative potential, innovativeness of enterprises and competiveness [*Investing in Research: an Action Plan*…, 2003] and two synthetic indices.

The group of indicators in the financial category include [Gaczek, 2004, p. 6]:

1. participation of gross domestic expenditure on the R&D (GERD) in GDP,

[4] Pointed the indicators which are relevant to the implementation of the Lisbon Strategy.

2. gross domestic expenditure on the R&D (GERD) as % of GDP according to sources of financing (governmental ones, business entities, other domestic sources, foreign sources),
3. business entities' share in expenditure on the R&D (GERD) in total expenditures on the R&D (GERD),
4. participation of the R&D activities executed in favour of enterprises financed by the government,
5. participation of small and medium enterprises (SMEs) in the R&D activities in favour of enterprises' sector and financed by the government.
6. intensity of expenditures on the R&D in particular branches of industry, counted as % of expenditures made to value added.

Indicators in the category of human resources include [Ibid, p. 6-11]:

1. participation of expenditures on higher education in GDP,
2. participation of the R&D and engineering-technical employees to the number of population,
3. working in the R&D sector according to institutional sectors (of enterprises, governmental, higher education) in relation to economically active population,
4. expenditures on the R&D in terms of the R&D employee taking into account institutional sectors,
5. the number of newly promoted Ph.Ds. in relation to the population aged 25--34 per year,
6. the structure of employed in the R&D sector by country of origin (the analysis of the domestic system only).

The group of indicators in the category of innovative potential include [Ibid, p. 12]:

1. patents granted by the European Patent Office (EPO) and the United States Patent and Trademark Office (USPTO),
2. patents granted in the field of high-tech by EPO and USPTO,

Indicators of the enterprises' innovativeness category include:

1. participation in GDP of venture capital funds intended for so called seed and initial capitals necessary for starting new companies,
2. whole economy's participation in seed and initial capitals, those that are dedicated to the development of high-tech sectors,
3. expenditures on innovations in relation to sales in industrial sector,
4. participation of SMEs introducing innovations at home (in % of the total processing industry),
5. participation of SMEs cooperating in the implementation of innovation (in others),
6. balance of payments in the field of technology per person,
7. import and export of hi-tech products per person.

The synthetic indicators include [Gaczek, 2004, p. 7]:

1. synthetic indicator of investing into economy based on knowledge (standardized weighted index based on the following partial indicators: GERD/per capita, the number of researchers per 1,000 economically active, newly promoted Ph.Ds. per 1000 inhabitants, expenditures on education per inhabitant,

participation of population in non-school age taking part in lifelong learning, on line public services' participation, investments in durable property except the construction);

2. synthetic indicator showing the effects of the transition to a knowledge-based economy (standardized weighted index based on the following partial indicators: GDP per working hour, the number of gained patents in EPO and USPTO per 1000 inhabitants, the percentage of companies using the internet to promote their products and services.

According to A.H. Jasiński measures describing the level of innovativeness of the R&D sector may be divided into two basic groups: signs of innovation and innovation basics. The former include: participation of new and modernized as well as technologically advanced products in the industrial production, participation of high-tech products in export, the number of particular country's inventions patented abroad, the number of licences sold abroad. The group of innovation basics include: the number of patent applications in a particular country, the number of granted patents, the number of foreign inventions patented in a particular country, participation of high-tech products in import, the number of licences bought abroad [Jasiński, 2006, pp. 180-183].

5. Human resources in the R&D sector

Human resources is the basic indicator of development, together with the level of education and qualifications, in every field of economy. Within the R&D activity the significance of this factor seems to be superior to other fields of economy. To emphasize the role of the R&D innovation in improving the economy may be, in addition to the educational level of employees, the structure of employment within the sector in the system of work and the types of organizational units.

Intensity of work resources in the R&D sector reflects the indicator of the employed in that sector (with specification of the number of researchers) in relation to the number of economically active. The most important element of human resources deciding about the R&D potential of a region is the level of education of people employed in the R&D sector, as well as the level of education of inhabitants. [5]Employed in the R&D sector work within the three main categories of positions: R&D employees, technicians, equivalent and support staff [Gaczek, 2004, p. 23].

The major significance for the work effects is that of: R&D employees, technicians and equivalent staff. The rate of growth of the number of employees in the whole sector should be bigger due to assumed in the country's development policy transition to a knowledge-based economy. Changes of inner structure in employees category in the R&D sector may be estimated positively, when they show a constant, gradual increase of researchers with the decrease of technicians, equivalent staff and other staff. How-

[5] A higher level of education of the population is a factor of the adaptation new solutions, ideas and innovation. It promotes not only the creation of new solutions, but also the transfer, adoption and implementation of the solutions by new customers, facilitates the learning process companies and institutions, it becomes a condition to the transfer of hidden knowledge.

ever, the decrease in the number of support staff may have disadvantageous effects on work's results [Ibid, p. 24].

Technical equipment of the R&D work, more specifically the level and quality of technical background, of units conducting the R&D activities depend on investment expenditures. It probably has a minor significance for the R&D effectiveness than the quality of work resources, but at the present stage of science development, especially in some fields of technical and natural science, the quality of equipment in machines and devices may have a major significance to scientific development and implementations. The R&D equipment is classified as fixed assets and their value is shown in current prices. While conducting the analysis at the regional level we should take a look at the concentration of research equipment in each region as a percentage of the amount attributable to the country. It often happens that the extent of employment concentration in the R&D activity is lower than the expenditures on this activity.

It should not be concluded that the higher R&D potential of a region, the lower degree of research equipment's attrition in the R&D sector. There is no simple relation between technological equipment of work and a region's R&D potential. Advantage can be gained only by metropolitan regions over regions with very slight R&D potential. Regional differentiation of research equipment's value per worker in connection to the level of its usage allows to conclude about technical equipment of work in the R&D sector [Ibid, p. 29].

6. Description of the R&D sector in the Podlaskie Province

The Podlaskie Province is not characterised by significant research potential, the region does not possess highly developed cooperation with other R&D units in the country or abroad. The R&D potential of the region is characterised by the following structure:

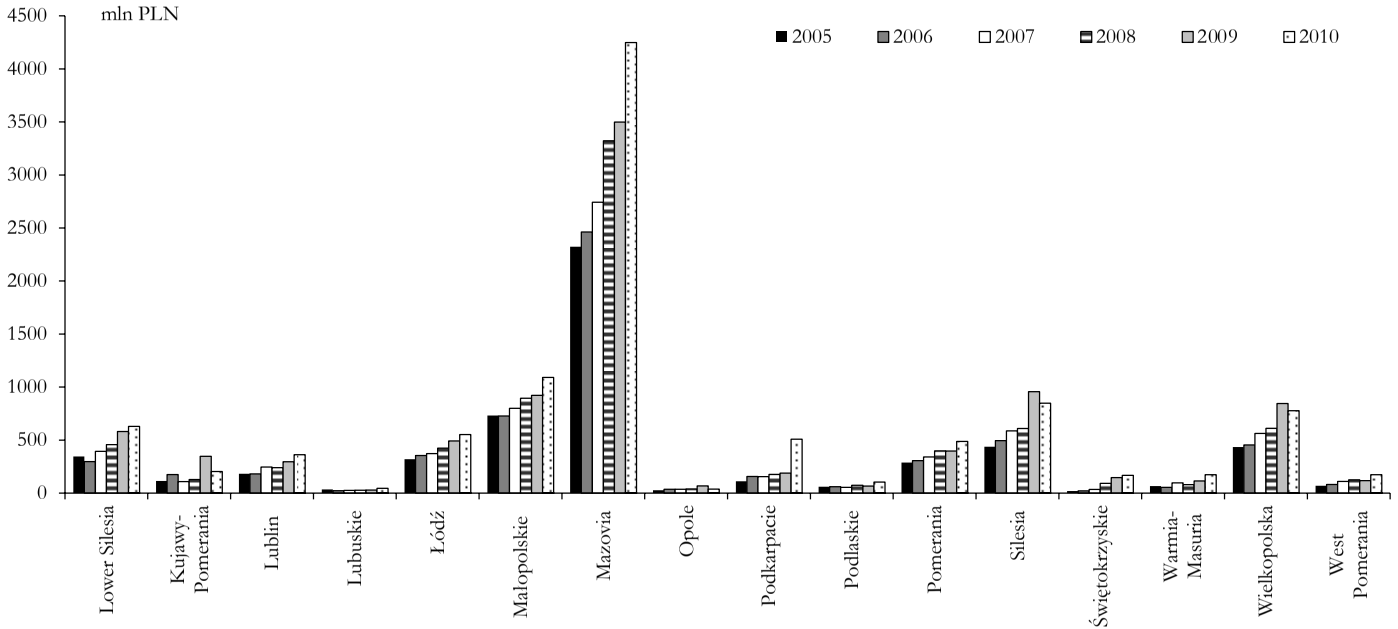
1. number of units conducting R&D activity in the province;
2. number of researchers;
3. amount of expenditure on R&D;
4. number of submitted inventions and obtained patents.

Despite the fact that the region of Podlasie does not belong to the leading ones in terms of innovative potential, statistical data show that the situation has improved in the recent years. Location of the region in the middle position in the country, in terms of the number of expenditures on R&D and the functioning of the R&D units may favour to development of the basis for the system of innovations in the future.

Total expenditure on the R&D activities expressed in current prices in 2010 for the Podlaskie Region reached the level of 103.9 million of PLN. Two regions in the country made lower expenses on that purpose: Opole and Lubuskie. The highest level of expenditures was noted in Mazowiecki Region-4248.7 million of PLN being over 40% of the value on the country level. Analysing the data of the years 2005-2010 these values in the country show an increasing tendency. The Podlasie Province, in spite of 70% increase of expenditure on R&D in the analysed period took the fifth in 2006, to the second in 2009 positions from the end, in the ranking [*Benchmarking regionalny czynników*…, 2012, p. 408] (Fig. 1.).

FIGURE 1.

Total expenditure on the R&D activity (current prices) for provinces during the period 2005-2010



Source: Own study based on: [*Rocznik Statystyczny*…, 2011, s. 56; *Rocznik Statystyczny*…, 2010, s. 52; *Rocznik Statystyczny*…, 2009, s. 51; *Rocznik Statystyczny*…, 2008, s. 51; *Rocznik Statystyczny*…, 2007, s. 107; *Rocznik Statystyczny*…, 2006, s. 105].

TABLE 1.

Expenditures on R&D activities per 1 inhabitant in PLN (current prices) during the period 2005-2010

Province	2005	2006	2007	2008	2009	2010
Polska	**178**	**155**	**175**	**202**	**238**	**273**
Dolnośląskie	145	103	137	159	202	219
Kujawsko-pomorskie	69	85	53	63	168	99
Lubelskie	96	83	114	111	137	168
Lubuskie	40	24	26	28	29	45
Łódzkie	131	138	146	166	194	218
Małopolskie	279	222	244	273	280	330
Mazowieckie	561	476	529	639	670	812
Opolskie	36	35	35	39	66	37
Podkarpackie	67	75	75	85	90	242
Podlaskie	**69**	**51**	**46**	**63**	**56**	**87**
Pomorskie	181	139	154	180	178	219
Śląskie	111	106	126	131	206	183
Świętokrzyskie	17	17	28	72	115	132
Warmińsko-mazurskie	57	39	68	56	81	122
Wielkopolskie	161	135	166	180	248	228
Zachodniopomorskie	53	48	66	74	70	103

Source: own study based on: [*Rocznik Statystyczny*…, 2011, p. 56; *Rocznik Statystyczny*…, 2010, p. 52; *Rocznik Statystyczny*…, 2009, p. 51; *Rocznik Statystyczny*…, 2008, p. 51; *Rocznik Statystyczny*…, 2007, p. 107; *Rocznik Statystyczny*…, 2006, p. 105].

TABLE 2

Expenditures on R&D activities to GDP in % (current prices) during the period 2005-2009

Province	2005	2006	2007	2008	2009
Poland	**0.57**	**0.56**	**0.57**	**0.60**	**0.68**
Dolnośląskie	0.45	0.35	0.41	0.44	0.53
Kujawsko-pomorskie	0.25	0.35	0.20	0.22	0.56
Lubelskie	0.48	0.44	0.54	0.48	0.58
Lubuskie	0.15	0.10	0.09	0.10	0.10
Łódzkie	0.52	0.54	0.51	0.54	0.60
Małopolskie	1.02	0.92	0.92	0.95	0.93
Mazowieckie	1.10	1.07	1.07	1.21	1.19
Opolskie	0.12	0.16	0.14	0.14	0.23
Podkarpackie	0.30	0.39	0.36	0.37	0.37
Podlaskie	**0.27**	**0.25**	**0.20**	**0.26**	**0.21**
Pomorskie	0.52	0.51	0.51	0.57	0.52
Śląskie	0.34	0.36	0.38	0.36	0.55
Świętokrzyskie	0.08	0.08	0.12	0.27	0.42
Warmińsko-mazurskie	0.24	0.18	0.29	0.23	0.31
Wielkopolskie	0.47	0.46	0.52	0.52	0.66
Zachodniopomorskie	0.17	0.19	0.24	0.24	0.22

Source: own study based on: [*Rocznik Statystyczny*…, 2011, p. 56; *Rocznik Statystyczny*…, 2010, p. 52; *Rocznik Statystyczny*…, 2009, p. 51; *Rocznik Statystyczny*…, 2008, p. 51; *Rocznik Statystyczny*…, 2007, p. 107].

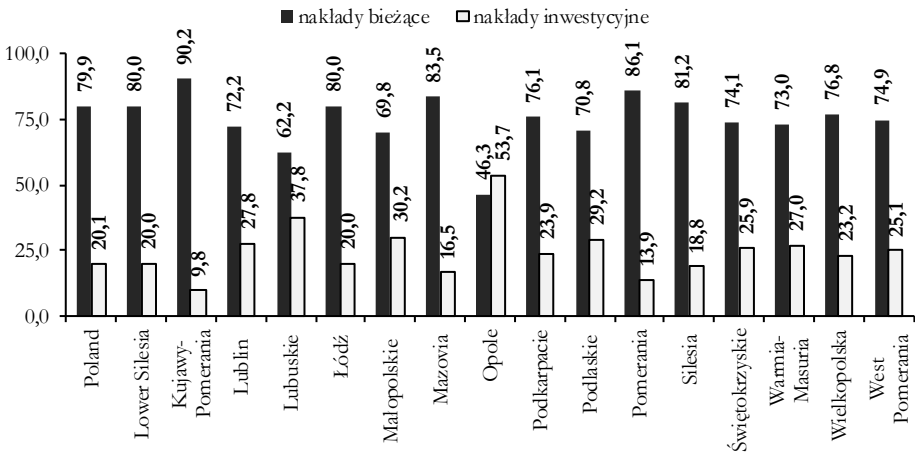
R&D potential characterised, among the others by the amount of expenditures on R&D per an inhabitant (69 PLN in 2005) classifies the region in the last positions in the country. The leading position was taken by Mazowieckie Province and Małopolskie Province. It should be emphasised that expenditures on the R&D per an inhabitant during the period 2005-2010 increased by over 26% in 2010, compared to 2005. Podlaskie Province in 2010 was placed in the third position from the end before Lubuskie Province and Opolskie Province. The biggest increase in the value of expenditure on the R&D activity per an inhabitant in the years 2005-2010 in Podlasie Region was noted between 2009 and 2010 [*Benchmarking regionalny czynników*…, 2012, p. 409] (Table 1).

In 2005, the relation between expenditures on the R&D activities in Podlaskie Province to GDP amounted to 0.27 %, in Poland it was 0.57%. Taking into consideration this indicator Podlasie was placed on the tenth place, the leading position was taken by Mazowieckie Province and Małopolskie Province. In the following periods the indicator showed a decreasing tendency. However, in 2008 compared to the previous year the indicator increased by 0.06 of percentage point. In the same period, the indicator of expenditures on the R&D to GDP in the country amounted to 0.60%. Podlaskie Province took the eleventh place in the country proceeded by the following provinces: Pomorze Zachodnie, Warmia-Mazury, Kujawy-Pomorze, Opolskie and Lubuskie. In the following year the region took the second place from the end, being ahead of Lubuskie Province (Table 2).

While analysing the structure of expenditures on the R&D, it should be noted that in the country, most of them are dedicated to current expenses in comparison to the investments. In 2009, the relation was 80% to 20 % for the country. The biggest participation of investment expenditures in the analysed year took place in the Opole Region, where they exceeded the values of current expenditures. The lowest percentage was noted in the Kujawsko-Pomorski Region [*Benchmarking regionalny czynników*…, 2012 p. 410] (Figure 2.).

Current expenditures on the R&D activity are dedicated for basic and applied research as well as for developmental works. In this respect, the biggest participation in the country's scale is that on developmental works. Applied research is done half as much and basic research participation is lower than developmental works by about 2 percentage points. In territorial division, the biggest percentage of developmental works and applied research (with the lowest of basic research) characterises the following regions: Lower Silesia, Lubuskie and Pomorskie. The reverse situation applies to Podlaskie, Świętokrzyskie and Podkarpackie Provinces. It should be noted that the domination of basic research is characteristic of underdeveloped economies, while in developed countries development and applied research play a leading role. That is this kind of works and research which have the biggest influence on increasing innovativeness of economy. Moreover, the participation of expenditures directed at development works funding, accounts for the proximity of the R&D activity and the market. The desired relationship of three types of studies is the ratio of 1:2:3, starting from basic research, and ending with the development work. In Poland, there is still far too high proportion of basic research and too little development and applied research [*Benchmarking regionalny czynników*…, 2012 p. 411] (Fig. 3.).

FIGURE 2.
The structure of expenditures on the R&D according to main categories in provinces in 2009 (in %)



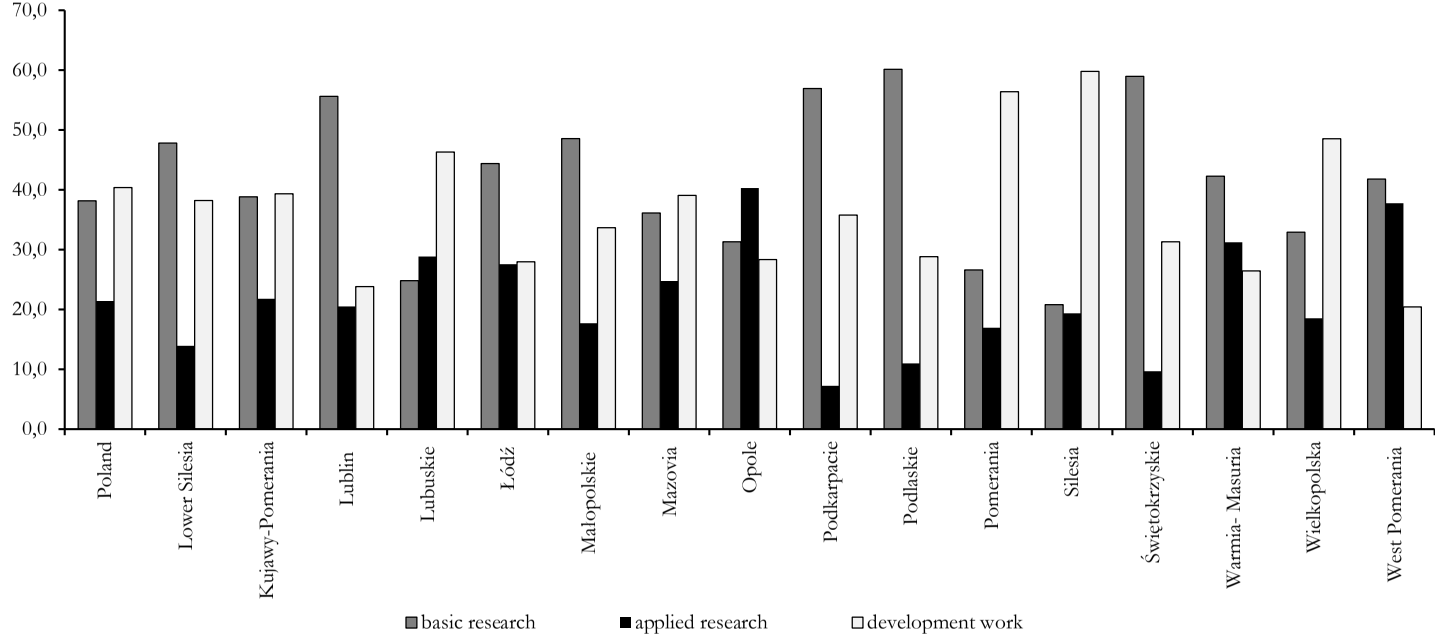
Source: own study based on: [*Nauka i technika*…, 2011, p. 192].

The indicator of researchers per 1000 economically active people, in 2005 amounted to 2.6, in connection to that the region took the eleventh place in the country (about 4.5% of employed in Poland). In the following year the number of the employed in this activity increased, then a slight decrease in the next year was noted and in 2009 the region was on the eighth position in the country with the indicator of 2.9 (Poland had the indicator of 4.3) of the employed researchers. In 2010 there was a slight drop of the indicator to the level of 2.8, with the increase for the country to 4.6 [*Benchmarking regionalny czynników*…, 2012, p. 412-413] (Table 3.).

Development of the R&D activity, apart from the level of funding and human resources also depends on the level of equipment. The rate of equipment classified as fixed assets expressed in current prices as at the last day of the year, and the meter indicating the level of consumption given in % is used to determinate this factor. The value of equipment in Poland during the period 2007-2009 was systematically growing from the level of 5 878 million PLN to 6 956 million PLN (18% increase). The degree of its usage was at the level of 74-78%. The highest value of R&D units equipment was noted in Mazowieckie and Małopolskie Provinces (from PLN 2 496 m in 2007 to PLN 2 807 m in 2009 in Mazowieckie Province and from PLN 745 m in 2007 to PLN 758 m in 2009 in the Małopolskie Province. The lowest value of equipment was characteristic for Lubuskie and Swiętokrzyskie Provinces (PLN 6.6-13 m for the Lubuskie Province and PLN 9.2 – 23.9 m for the Świętokrzyskie Province). In 2009 the most tattered equipment was in the Podlaskie Province (in 95.5%), and the least tattered in Lubelskie Province (53.5%). During the period 2008-2009 the Region of Podlasie was placed in the third position from the end, and in 2008 together with Kujawsko-Pomorskie, being ahead of Lubuskie and Opolskie (Fig. 4 and 5).

FIGURE 3.

The structure of the current expenditure on the R&D by type of activity in the provinces – the average during the period 2007-2009 (in millions PLN)



Source: own study based on: [*Nauka i technika*…, 2011, s. 193-194; *Nauka i technika*…, 2010, s. 122-123; *Rocznik Statystyczny*…, 2010, http://www.stat.gov.pl/bialystok/69_797_PLK_HTML. htm; *Nauka i technika*…, 2009, s. 111].

TABLE 3.

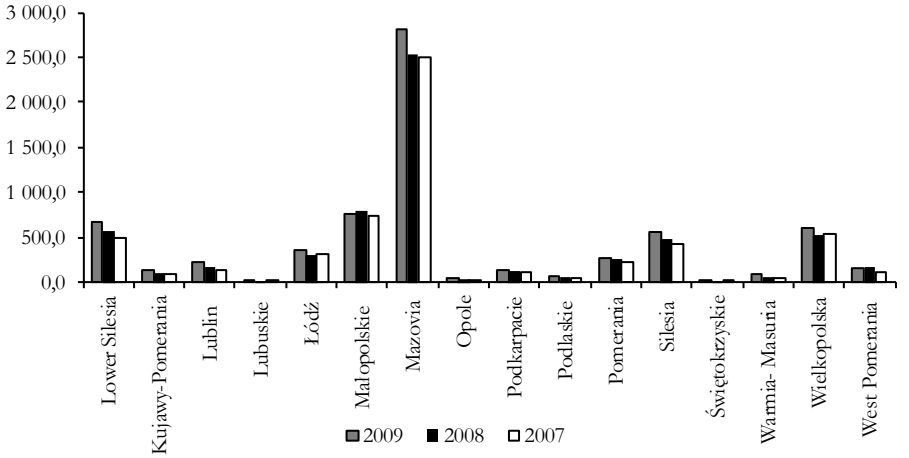
The employment in the R&D per 1000 economically active people during the period 2005-2010

Province	2005	2006	2007	2008	2009	2010
Poland	4.5	4.3	4.4	4.3	4.3	4.6
Dolnośląskie	4.0	3.8	4.6	4.7	4.7	4.2
Kujawsko-pomorskie	3.1	3.4	3.7	3.6	2.9	3.0
Lubelskie	3.2	3.3	3.1	3.1	2.8	3.0
Lubuskie	1.9	1.6	1.7	1.8	1.5	—
Łódzkie	3.2	3.4	3.2	2.9	3.2	3.2
Małopolskie	6.9	5.4	5.8	5.3	5.1	6.2
Mazowieckie	10.7	9.8	9.6	9.2	9.3	10.4
Opolskie	2.3	2.4	2.4	2.1	2.2	2.3
Podkarpackie	1.6	1.7	1.6	1.6	1.6	4.2
Podlaskie	**2.6**	**2.8**	**2.4**	**2.8**	**2.9**	**2.8**
Pomorskie	5.5	5.4	5.0	4.2	5.0	4.8
Śląskie	3.4	3.5	3.3	3.7	3.5	3.5
Świętokrzyskie	1.3	1.2	1.2	1.3	1.7	1.7
Warmińsko-mazurskie	2.0	2.0	2.0	2.1	2.0	2.2
Wielkopolskie	3.6	3.5	4.6	4.7	4.1	4.3
Zachodniopomorskie	2.8	3.4	3.2	3.1	2.5	—

Source: Own study based on: [*Rocznik Statystyczny*…, 2010, p. 53; *Rocznik Statystyczny*…, 2009, p. 52; *Rocznik Statystyczny*…, 2008, p. 52; *Rocznik Statystyczny*…, 2007, p. 108; *Rocznik Statystyczny*…, 2006, p. 106].

FIGURE 4.

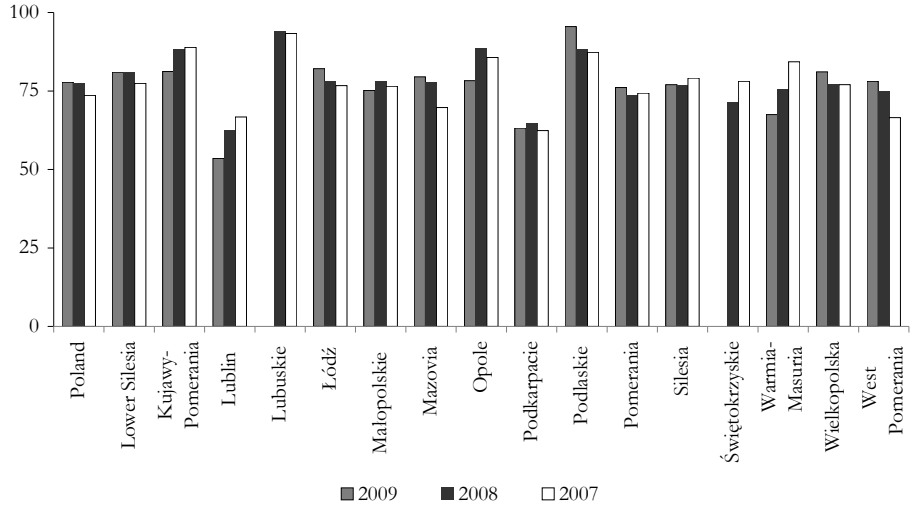
The value of the R&D equipment classified as fixed assets in Poland, in the provinces during the period 2007-2009 (current prices in millions of PLN)



Source: own study based on: [*Nauka i technika*…, 2011, p. 199-200; *Nauka i technika*…, 2010, p. 124; *Nauka i technika*…, 2009, p. 112].

FIGURE 5.

Degree of the R&D equipment attrition in Poland in the provinces (current prices in millions PLN) during the period 2007-2009



Source: Own study based on: [*Nauka i technika*…, 2011, p. 199-200; *Nauka i technika*…, 2010, p. 124; *Nauka i technika*…, 2009, p. 112].

TABLE 4.

Submitted inventions during the period 2007-2010

Province	2007	2008	2009	2010
Poland	**2392**	**2488**	**2899**	**3203**
Dolnośląskie	323	280	287	320
Kujawsko-pomorskie	94	82	115	124
Lubelskie	104	127	137	124
Lubuskie	14	28	23	28
Łódzkie	153	157	177	212
Małopolskie	186	204	258	310
Mazowieckie	474	499	644	701
Opolskie	45	65	75	70
Podkarpackie	55	85	70	82
Podlaskie	**34**	**48**	**50**	**56**
Pomorskie	130	140	216	201
Śląskie	406	383	374	436
Świętokrzyskie	53	48	47	49
Warmińsko-mazurskie	46	30	35	60
Wielkopolskie	189	218	282	314
Zachodniopomorskie	86	94	109	116

Source: Own study based on: [*Rocznik Statystyczny*…, 2010, p. 51; *Rocznik Statystyczny*…, 2009, p. 51; *Rocznik Statystyczny*…, 2008, p. 51].

In terms of the number of inventions submitted, the Podlaskie Region does not fall quite well in comparison with other Polish regions. There has been a reported increase

in the number of inventions, but in 2009 Podlaskie came in the thirteenth place among the 16 provinces. Compared to 2007, this is unmistakable advancement as the region was in the fifteenth place, and a year later – in the thirteenth. In 2009, a smaller number of inventions was submitted only from the provinces: Świętokrzyskie, Warmińsko-mazurskie and Lubuskie, which are the regions with one of the lowest GDP and lower growth potential in the country. The frequency of patent applications in the Podlaskie Region in 2009 compared to 2008 (104.2) was smaller than the national average (116.5%). This was the case also in the year 2010. The increase in the number of submitted inventions by 12% compared to 2009, did not lead to a change in the ranking position of the region as the region still took third from the end [*Benchmarking regionalny czynników*…, 2012, p. 416] (Table 4.).

TABLE 5.

Granted patents in the years 2007-2010

Province	2007	2008	2009	2010
Poland	1575	1451	1536	1385
Dolnosląskie	219	153	170	146
Kujawsko-pomorskie	42	49	53	35
Lubelskie	79	73	60	55
Lubuskie	12	10	18	7
Łódzkie	107	99	115	94
Małopolskie	154	140	141	164
Mazowieckie	391	377	339	326
Opolskie	42	43	34	28
Podkarpackie	44	48	45	32
Podlaskie	**14**	**11**	**15**	**11**
Pomorskie	62	49	78	81
Ślaskie	236	240	274	233
Świętokrzyskie	22	27	37	25
Warmińsko-mazurskie	22	13	9	18
Wielkopolskie	92	87	105	95
Zachodniopomorskie	37	32	43	35

Source: Own study based on: [*Rocznik Statystyczny*…, 2011, p. 55; *Rocznik Statystyczny*…, 2010, p. 51; *Rocznik Statystyczny*…, 2009, p. 51; *Rocznik Statystyczny*…, 2008, p. 51].

In terms of patents granted during the period 2007-2010, the Region of Podlasie was on the penultimate place in Poland. Lubuskie and Warmińsko-mazurskie Provinces gained weaker results. The Region of Podlasie in 2007 was awarded with 14 patents, in 2008 and 2010 with 11, and in 2009 with 15. Comparing the data to national data, patents granted to the Region of Podlasie are 0.98% of all patents in Poland, which is evidence of the low level of innovation in the region and on a number of shortcomings in this area [*Benchmarking regionalny czynników*…, 2012, p. 417] (Table 5.).

7. Conclusions

The level and method of financing the R&D sector in Poland is characterized by a relatively low share of expenditure on the R&D activities, the domination of the public sector financed and a low spending on applied research and development work. Poland is among the group of countries with the highest share of basic research in the overall structure of research.

The Podlaskie Province is characterized by a slight potential of research and insufficiently well-developed scientific cooperation with other units in the R&D area in the country and abroad. The structure of the R&D potential of the region consists of a number of units engaged in researches in the R&D sector and the number of researchers, the amount of investment in the R&D activities, the number of inventions and patents.

The amount of expenditure on the R&D activities in spite of their growth in the region, during the period 2006-2010 did not contribute to occupy the leading position by Podlaskedie, a similar case was concerning the investment in the R&D activities per 1 inhabitant. In Poland, the most part of these expenditures is spent on current expenditure compared to investments. This still outweighs the percentage of basic research and too small applied research and development work.

The Podlaskie Province with a number of research employees takes the center position in the country, but in terms of abundance of equipment found takes the ending position in the country. According to the number of registered inventions, Podlaskie Province region is also not good in comparison with other Polish regions, the number of patents granted ranked the region in the next to last place in Poland.

It is possible to improve the situation that could contribute the cooperation between the R&D sector and local government institutions or cooperation in the innovation area between universities and companies. The low activity of the entities in the technology transfer would need to support of the companies through their involvement in the sale of a new technical solutions.

Poland should be the one of the most attractive place for the localization of the R&D centers, due to the large supply of highly qualified staff, or economic and technical fields. The investments in a of the R&D sector, in the innovation area it is the ability of creating more jobs. Furthermore, it is an opportunity for knowledge-based economy developing. Perhaps if there would not be the increasing the spending on the R&D centers, Poland will stay in the last places in the European Union. Therefore, it may lose the opportunity to develop the of R&D sector, which determines the whole economy development.

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