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Research and Development Activity in Poland following the Accession to the European Union (in the years 2004-2017)

Adam SADŁOWSKI, Paweł STĘPKOWSKI

Abstract:

The purpose of the article: The basic purpose of the article is to describe and evaluate the scale, structure and dynamics of research and development activity in Poland in the period following the accession to the European Union, based on selected quantitative indicators, including financial ones. A further, secondary purpose of the article is to indicate financial instruments, which are potentially effective tools for the implementation of the national research and development policy.

The study method: The assessment of the process of changes in the scale and scope of research and development activity in Poland was based on the analysis of selected literature on the subject (the selection of which was determined by both the validity of the studies and their material value – hence slightly older studies, still of high informative value) and generally available statistical data from the Central Statistical Office, published both as traditional yearbooks and in an electronic form. In the analysis, selected methods of descriptive statistics were used, including tables and charts, as well as selected indicators of diachronic analysis (dynamics of changes) and the structure of the studied processes.

Conclusions: The study indicates a small and inappropriate structure of expenditures on research and development activity and too low involvement of enterprises in research works, which results in, among others, a low level of innovativeness of the national economy. The mechanism for transferring innovations shows the passive side of economic entities, who have little to no interest in acquiring these innovations themselves. However, the observed development trends indicate a certain improvement in the situation of the research and development sector in Poland, which has taken place in recent years. On the one hand, this was due to attempts to implement EU and national development strategies, as well as direct actions, including the introduction of financial (tax) incentives for enterprises carrying out research and development works. The article shows that appropriately selected financial instruments may increase the willingness of enterprises to undertake research and development works.

The original value of the article: The analysis carried out clearly shows a positive development trend in the level of expenditures on research and development activities in the Polish economy, as well as changes in the structure of these expenditures and the accompanying positive transformations of the structure of research and development sector entities. At the same time, it was shown that the implemented solutions aimed at reducing the distance between Poland and the European Union in the sphere of innovation, which is a derivative of the level of development of the research

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and development sector, may bring positive effects. In the authors' opinion, the article may contribute to further, extended research, including monographical research, as well as serve entrepreneurs whose previous attitude, not only in the area of financing research and development activities but also in the area of conducting research, has been too inactive.

Implications of the study: The article is primarily informative and analytical in nature, so it should be the basis for further research on the broadly understood issue of modernization of the economy and its structural changes stimulating economic development (which should not be confused with the notion of economic growth), but – in the opinion of the authors – may also contribute to an increase in the level of research and development activity in Poland.

Keywords: *B&D, innovativeness, Lisbon Strategy, Europe 2020 Strategy.*

JEL codes: O30, O32

1. Introduction

The following article aims to study and analyse, in qualitative and quantitative terms, the research and development activity in Poland in the period following the accession to the European Union, i.e. from 2004 to 2017, for which there is available statistical data. For this reason, the study refers primarily to the quantitative dimension of the whole process, which, however, in the case of the analysis of the structure, gives a perfect picture of the changes qualitative in nature. The literature and legal acts we used, including documents defining strategic objectives of social and economic development, of which the research and development policy is an immanent component, seem to be a perfect complement.

In the introduction, the macroeconomic conditions for the implementation of the research and development policy are presented, and the concepts of research and development activity are briefly defined and classified according to the adopted rules. The first part of the article shows the importance of R&D activity for the economic development of the country and indicates strategic documents concerning the progress in the field of European integration, which was also supposed to contribute to the acceleration and activation of R&D activity. The second part analyses the R&D sector in terms of changes in the number of entities, their structure and the size of employment, as well as expenditures on research and development. Selected methods of statistical analysis were used, especially the analysis of dynamics (in the form of indices of dynamics with a constant and variable basis), as well as the analysis of structure. The third part of the article draws attention to the necessity of further increase of expenditures on research and development activity, especially in the sector of enterprises, because without a radical growth, it will be impossible to achieve the assumed strategic objectives. At the same time, new perspectives for financing research and

development activities were pointed out, in particular by granting tax allowances to businesses to stimulate such risky undertakings.

At the present stage of the social and economic development of the world, often referred to as the knowledge-based economy, the research and development policy, i.e. the size and structure of R&D expenditures, both personal and financial, is becoming a factor of rapidly growing importance (Dyjach 2011: 219). Therefore, not only the development of knowledge, but also the ability to transform it into new technologies, play a key role in creating a competitive advantage of the economy that is qualitative in nature. The development of knowledge and the ability to transform it into new technologies play a key role in creating a qualitative competitive advantage of the economy, therefore one of the key factors, even determining the development of the economy, is the amount of expenditures on research and development (Broszkiewicz et al. 2018: 3).

Research and development activity is one of the most important factors of innovative activity in the strategy and development policy of not only the national economy as a whole, but also the sectors and individual business entities that comprise it. The competitiveness of individual economic entities and the entire national economy depends on the results of their work and the subsequent results of their application. Therefore, the purpose of research and development activity is to strive for continuous improvement of the already existing activity and to define its basic opportunities and threats in a perspective that may lead to a reformulation of the previously set purposes (Bieńkowski et al. 2010: 582).

The effect of social and economic transformations taking place in developed and developing countries is the creation of knowledge-based economies, which, among others, are characterized by striving to achieve competitive advantage by increasing research and development activity, which is the first stage of the innovation process; the next stages of this process are implementation and commercialization of the achieved results (Szymański 2017: 105).

Among the less developed countries of the EU Member States, with Poland still being one of them, we can observe two strategies for generating and using the role of expenditures on research and development. According to the first strategy, research and development is supposed to be the engine of future accelerated economic development and contribute to convergence at an international level; this leads to a constant increase in expenditures on this sphere of activity. The second strategy consists in treating research and development activity as any other area and

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financing its development according to the resources available and looking for other sources of development, such as in accepting foreign investments (Janasz 2004: 143). Poland is one of the countries trying to catch up with the world's leading economies by means of accelerated economic growth. The analysis of expenditures on research and development in Poland shows that, taking into account the approach to science, it implements the latter strategy.

Research and development activity is important not only on a national or international scale, but also becomes one of the important factors of regional development (Chojnicki 1989: 112). Basing the growth and development of the economy on the use of a new development factor, i.e. innovation, which is especially the result of research and development activity, means that the competitive advantage of countries and regions may depend on their capacity to produce, develop and spread innovation. Only those regions that are innovative can compete effectively (Przygocki 2007: 144).

Research and development activity was already defined in the first years of transformation, in the Polish tax law (PIT and CIT Acts), indicating that it is “a creative activity, including scientific research or development works, undertaken in a systematic manner in order to increase knowledge resources and use resources to create new applications” (Act of 26 July 1991 on personal income tax, Journal of Laws, 1991, No. 80, item 350, i.e. Journal of Laws, 2019, item 752; Act of 15 February 1992 on corporate income tax, Journal of Laws, 1992, No. 21, item 86 as amended, i.e. Journal of Laws, 2019, item 865). The same definition was given to this concept by the Act of 30 April 2010 on the principles of financing science (Ustawa z dnia 30 kwietnia 2010 r. o zasadach finansowania nauki). A similar definition was adopted by the Central Statistical Office, stating that research and development activity is a systematic creative work carried out in order to increase the amount of knowledge, including knowledge about man, culture, society, as well as attempts to find new ways of applying the discovered knowledge (*Nauka i technika*, 2017).

The definition of research and development activity, also contained in the international Frascati Manual 2002 and Frascati Manual 2015, indicates that research and development includes creative works undertaken in a systematic manner to increase knowledge, including knowledge of man, culture and society, and to use this knowledge to create new applications. These manuals distinguish between three types of research and development (R&D), i.e. basic research, applied research and experimental development, whereby basic research is divided into pure basic research

and oriented basic research (Žuk et al. 2018: 288). The results of basic research are used in applied research, undertaken in order to acquire knowledge tied to a specific practical application. The results obtained in the process of applied research may be useful for economic practice, and thus constitute a starting point for the implementation of further phases of the research and development cycle, i.e. experimental development consisting in the application of the existing knowledge to the development of a new or significant improvement of existing products, processes or services (Mosionek-Schweda 2011: 78).

For this reason, R&D should not be synonymous to the creation of innovations. Innovations may or may not result from research and development works. The effect of their implementation, as well as expenditures on R&D remain uncertain, which in both cases reveals the same market failures (Bukowski et al. 2012: 5). The purpose of research and development activity is not only to strive for a continuous improvement of the economic activity conducted in the enterprises forming the national economy, but also to search for and define basic opportunities and threats occurring in the environment, the final result of which may be, and even should be, a kind of continuous reformulation of economic activity purposes that would be conducive to meeting the requirements of a competitive market.

The research and development sector is created by institutions and individuals engaged in activities aimed at increasing knowledge resources and finding new applications for that knowledge. This sector's activity results in various types of innovations – product, process or technological, which are crucial for rapid economic development (Leśniewski 2010: 1). Thanks to these innovations, the national economy should not only grow, but also develop by means of structural changes considered beneficial in the strategic context.

2. The importance of research and development activity for economic development

Poland seems to be a potentially excellent place to conduct research and development activity. The so-called social and economic transformation, initiated at the beginning of the 1990s, gave rise to political changes which made Poland a modern, socially and economically stable country with a relatively high investment potential (*Raport "Inwestycje zagraniczne w Polsce przez 25 lat przekroczyły 712 mld zł"*, 2017). Throughout the transformation period, the Polish economy grew slightly faster than the entire global economy, and much faster than developed countries on the whole (Kotyński 2017: 14). Poland's greatest asset, however, is its well-educated and competent

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engineering staff, which is already a magnet for many foreign investors operating in several business sectors (*Prężny napływ bezpośrednich inwestycji zagranicznych do Polski*, 2017). High qualifications and a fairly good knowledge of foreign languages are therefore an excellent basis for the development of R&D centres. The Polish world of science consists of several hundred universities, many research and development sites and tens of thousands of research and development employees. The scientific and research projects they undertake can expect financial support not only from the national budget, but also from EU funds.

Poland is no longer merely a supplier of cheap labour, but more and more often a hub of qualified staff for science and business, although relatively low labour costs are still one of the factors drawing foreign capital to Poland (Gromada et al. 2015: 9). Economic and political stability, highly-educated staff, scientific potential and financial support are almost everything business representatives need to develop their R&D activities. High economic potential and solidly established growth factors of the economy have been noticed by foreign investors who place production plants or shared services centres in Poland (*Inwestycje zagraniczne*, 2017). Unfortunately, it is still much less frequent to place science, research and development centres here.

A characteristic feature of the spatial layout of the research and development activity of the European Union is the fact that regions with a traditionally large role of the industry in the past maintain the position of leaders in terms of the size of the R&D sector potential (Rachwał et al. 2009: 36). Indeed, the development of industry, which requires a significant share of R&D works, has become both a factor and a result of technological progress. Apart from highly industrialised regions, the regions that are characterised by a high value of this measure are the ones with the best developed central functions, which results from the location of numerous and large scientific and scientific-educational institutions in the largest cities of Europe.

The spatial diversity of the R&D potential indicates its significantly higher value in regions with developed central functions, as well as in those where many plants with highly advanced manufacturing processes have been located. On the other hand, peripheral regions in relation to a certain “centre” of the EU are characterised by a low R&D potential (Rachwał et al. 2009: 37). The EU's central area is characterised by the highest density of research and development centres and head offices of multinational concerns whose expenditures on research and product development

are allocated to these regions. Therefore, the differentiation in the share of R&D expenditures in GDP still shows a clear difference between the countries of the “old” and the “new” EU.

The European Union's R&TD policy is based on Title XVIII of Part Three of the Treaty establishing the European Community (Articles 163 to 173), replaced by the Treaty on the Functioning of the European Union (*Traktat o funkcjonowaniu Unii Europejskiej*). The provisions concerning support for scientific research were also included in earlier documents creating institutional European structures, i.e. the Treaty establishing the European Coal and Steel Community and the Euratom Treaty. The European Community's competence to support research and development was conferred on it by the Single European Act of 1986. (Barcz 2005: II-670).

The assumption behind later EU development strategies (especially the Lisbon Strategy implemented for 2000-2010, but also its continuation, i.e. the Europe 2020 Strategy) was to increase expenditures on R&D to 3% of GDP (Stankiewicz 2012: 274), however, in a direction that only 1/3 of expenditures on R&D would be financed from public expenditures of the Member States and 2/3 from private sources (*Ministerstwo Nauki i Szkolnictwa Wyższego*, 2006: 34).

The Lisbon Strategy, passed in 2000 and finally adopted in 2002, outlined a ten-year programme for the development of the European Union (Czerwińska 2004: 1), but – in the field of research and development policy – it was not carried out, therefore the new perspective included in the Europe 2020 Strategy maintained the objectives of the Lisbon Strategy as still valid (Żuk et al. 2018: 287). This strategy also indicated that expenditures on R&D in Europe do not exceed 2%, which is far behind the expenditures of economic powers such as the USA and Japan. The strategic objectives of the European Commission, set out in the Europe 2020 Strategy, were reflected in the Europe 2020: National Reform Programme of Poland, which assumed the achievement of total expenditures on research and development of up to 1.7% of GDP in 2020 (*Krajowy Program Reform 2020*), which, however, seems to be completely unrealistic from today's perspective.

Despite the fact that Poland is still clearly lagging behind, in recent years, however, there has been a significant increased interest on the part of management boards of various companies, and above all of large foreign corporations with branches in Poland, to open research and development sites in our country (Leśniewski 2010: 4). International concerns increasingly see Poland as a convenient place to make investments requiring advanced human capital resources and increasingly expand their existing production activities with research departments that are crucial for further operations. There are investments that are increasingly based on knowledge (KPO –

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Knowledge Process Outsourcing), especially in the outsourcing sector. The concerns most willingly open research centres, operating in the field of IT, telecommunications or electronics, but there are also great opportunities for development in medicine or biotechnology (Leśniewski 2010: 7).

Conducting research activities by international corporations is becoming a proof of the growing attractiveness of Poland (although the scale of this process is still far below the capabilities of Poland), which is connected with the relative ease of finding an appropriate number of well-educated scientific staff.

3. The analysis of the structure of the R&D sector and expenditures on R&D activity

Between 2004 and 2017 the R&D sector grew very fast, both in terms of the growth of the total number of entities and the number of entities comprising the enterprise sector, which ultimately was to play the most important role in it (see table 1).

Table 1. Number of entities comprising the R&D sector in Poland in the years 2004-2017

Year	Total number of entities	Including the enterprise sector	Share of the enterprise sector in the R&D structure (%)	Increase of the total number of entities y-o-y (%)	Increase of the number of enterprises y-o-y (%)
2004	957	587	61	-	-
2005	1,097	699	64	14.6	19.1
2006	1,085	676	62	-1.0	-3.3
2007	1,144	749	65	5.5	10.8
2008	1,157	745	64	1.1	-0.5
2009	1,298	842	65	12.2	13.0
2010	1,767	1,233	70	36.1	46.4
2011	2,220	1,663	75	25.6	34.9
2012	2,733	2,127	78	23.1	27.9
2013	3,122	2,467	79	14.2	16.0
2014	3,474	2,814	81	11.3	14.1
2015	4,427	3,735	84	27.4	32.7
2016	4,871	4,250	87	10.0	13.8
2017	5,102	4,474	88	4.7	5.3

Source: Local Data Bank of the Central Statistical Office, <https://bdl.stat.gov.pl/BDL/dane/podgrup/tablica>.

In the years 2004-2017, the total number of enterprises in the B&R sector grew by 433% (the average annual growth determined by the geometric mean method was 13.7%), while the number of enterprises belonging to this sector grew as much as by 662% (the average annual growth determined by the geometric mean method was 16.9%), thanks to which their share in the

total number of entities increased from 61% to 88%. In the whole period, the growth rate in the enterprise sector is much higher (the maximum growth by over 46% in 2010) than of the total entities (the maximum growth by over 36% also in 2010). Thus, despite minimal decreases (in 2006 and also in the enterprise sector in 2008), the growth of enterprises participating in R&D activity significantly outpaced the growth of the whole sector.

The employment growth in the research and development sector was almost equally dynamic (see table 2).

Table 2. Employment in the R&D sector in Poland in the years 2004-2017 by institutional sectors

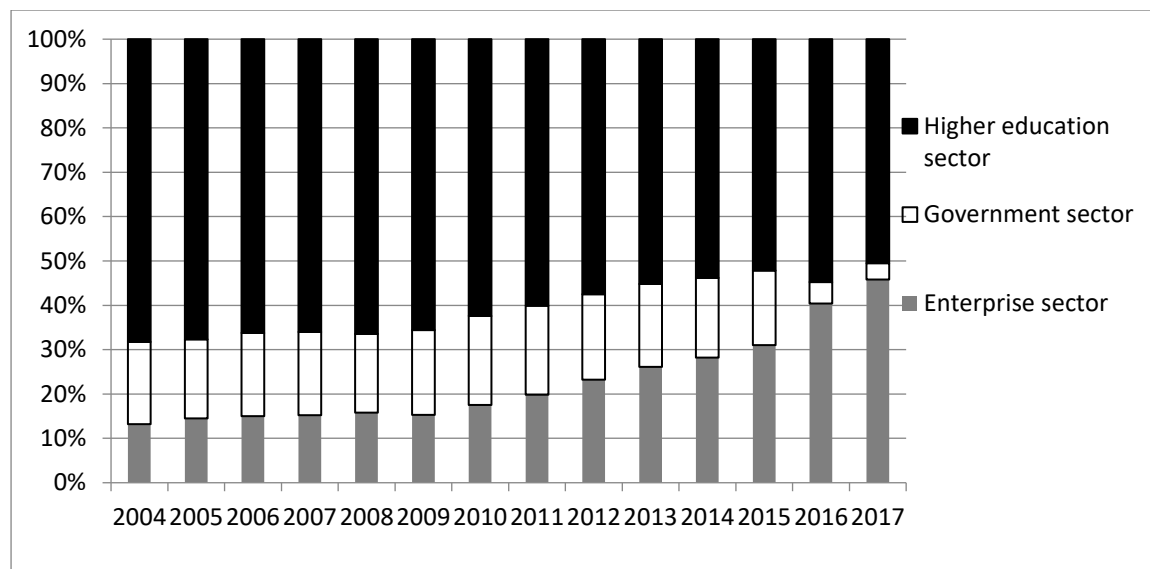
Year	Total employment	Including in		
		the enterprise sector	the government sector	the higher education sector
2004	127356	16846	23578	86823
2005	123431	17875	21966	83433
2006	121283	18194	22744	80162
2007	121623	18461	22840	80187
2008	119682	18889	21210	79523
2009	120923	18519	23115	79261
2010	129792	22710	26027	80918
2011	134551	26700	26953	80719
2012	139653	32381	26861	80130
2013	145635	37996	27176	80223
2014	153475	43185	27581	82463
2015	157921	48963	26459	82282
2016	171610	69315	8308	93987
2017	187583	85919	6878	94786

Source: Local Data Bank of the Central Statistical Office, <https://bdl.stat.gov.pl/BDL/dane/podgrup/tablica>.

The level of total employment in R&D in the years 2004-2017 increased only by 47% (the average annual growth determined by the geometric mean method was 3.0%), but the growth was very diversified in individual institutional sectors. The most stable in this respect was the higher education sector, where employment increased by only 9.2%. On the other hand, great changes took place in the enterprise sector, where employment increased by 410%, as well as in the government sector, where employment decreased by as much as 71.8%, which was, however, the result of decreases in 2016-2017, as in the years 2004-2015 the growth reached 12.2%. As a result, the structure of employment in individual sectors changed significantly, as shown in figure 1.

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Figure 1. Employment in the R&D sector in Poland in the years 2004-2017 by institutional sectors



Source: Local Data Bank of the Central Statistical Office, <https://bdl.stat.gov.pl/BDL/dane/podgrup/tablica>.

There is also a close statistical correlation between the number of research and development units and the size of employment in the R&D sector; the linear correlation coefficient of 0.97 indicates a very important correlation between these values – each change in the number of entities was positively correlated with changes in the size of employment.

There were also significant changes in the structure of employment by position in the research and development sector (see table 3).

Table 3. Employment in the R&D sector in Poland in the years 2004-2017 by institutional sectors

Year	Total employment	Including		
		science and research employees	technicians and equivalent employees	others
2004	127,356	96,531	15,686	15,139
2005	123,431	97,875	13,989	11,567
2006	121,283	96,374	13,533	11,376
2007	121,623	97,289	13,500	10,834
2008	119,682	97,445	11,645	10,592
2009	120,923	98,165	12,314	10,444
2010	129,792	100,934	17,074	11,784
2011	134,551	100,723	21,386	12,442
2012	139,653	103,627	23,160	12,866
2013	145,635	109,611	22,400	13,624
2014	153,475	115,375	23,703	14,397
2015	157,921	118,494	23,459	15,968
2016	171,610	132,547	23,847	15,216
2017	187,583	146,643	24,363	16,577

Source: Local Data Bank of the Central Statistical Office, <https://bdl.stat.gov.pl/BDL/dane/podgrup/tablica>.

With a general increase of employment in the sector by 47.3%, the employment of science and research employees increased by 51.2%, that of technicians and equivalent employees by 55.3%, and that of other employees by only 9.5%. However, this was the effect of the decrease in employment in this category, which was the largest (only in the years 2004-2005 it amounted to 33.6%) and the longest (it lasted until 2009, while in the group of science and research employees it ended in 2006, and in the group of technicians in 2008).

One of the key factors enabling the development of business entities, as well as the entire national economy, is the size of expenditures on research and development activity. The importance of research and development works is confirmed by the financial commitment of economic entities to conduct them, and a quantifiable and measurable indicator of the intensity of R&D works are expenditures incurred on their implementation (Turek 2015: 215). R&D expenditures in the period 2004-2017 increased significantly, while the share of the budget sector in their financing decreased (see table 4).

Table 4. Expenditures on research and development activity in Poland in the years 2004-2017 (in PLN million)

Year	Total expenditures	Including the budget sector	Share of the budget sector in R&D financing (in %)
2004	5155.4	3178.9	61.7
2005	5574.6	3217.0	57.7
2006	5892.8	3385.6	57.5
2007	6673.0	3905.0	58.5
2008	7706.2	4321.1	56.0
2009	9070.0	5482.3	60.4
2010	10416.2	6347.1	60.9
2011	11686.7	6521.5	55.8
2012	14352.9	7367.5	51.3
2013	14423.8	6814.5	47.2
2014	16168.2	7310.2	45.2
2015	18060.7	7553.7	41.8
2016	17943.0	6972.7	38.9
2017	20578.5	7877.7	38.3

Source: Research and development activity in Poland. The latest statistical news for the years 2010-2017 by CSO, Warsaw 2011-2018, Nauka i technika [Science and technology] by CSO for the years 2004-2016, Warsaw 2005-2017.

The amount of expenditures on R&D activity increased in the years 2004-2017 by 299% (the average annual growth determined by the geometric mean method was 11.2%), while the amount of expenditures coming from the budget sector only by 148% (the average annual growth determined by the geometric mean method was 7.2%). As a result, the share of the budget sector decreased from almost 62% to slightly over 38%, which shows changes in the right direction – i.e.

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increasing the share of other sectors in the expenditures, including the commercial sector (businesses).

A close statistical correlation can be observed between the size of employment in the R&D sector and the size of expenditures on R&D; the linear correlation coefficient of 0.92 proves a very important correlation between these values, while the rate of growth of expenditures was ahead of the rate of growth of employment.

Also the structure of R&D expenditures by executive sectors showed far-reaching changes (see table 5).

Table 5. Internal expenditures on research and development activity in Poland in the years 2004-2017 (in PLN million)

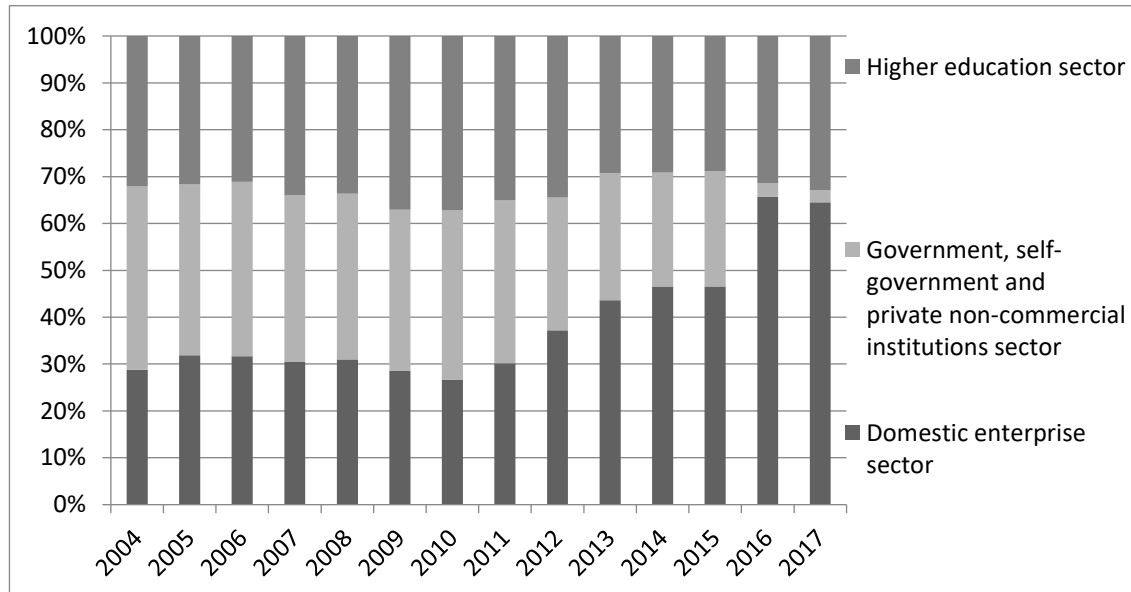
Year	Total expenditures	Including		
		domestic companies' sector	government and private non-profit institutions sector	the higher education sector
2004	5155.4	1478.7	2011.2	1647.3
2005	5574.6	1770.2	2026.8	1760.3
2006	5892.8	1858.3	2182.2	1826.9
2007	6673.0	2025.7	2364.5	2262.6
2008	7706.2	2383.7	2723.1	2592.6
2009	9070.0	2584.7	3123.5	3361.8
2010	10416.2	2773.5	3768.5	3874.1
2011	11686.7	3521.6	4062.8	4102.3
2012	14352.9	5341.1	4069.6	4942.2
2013	14423.8	6291.2	3912.2	4220.3
2014	16168.2	7532.1	3921.3	4714.8
2015	18060.7	8411.4	4434.2	5215.2
2016	17943.0	11782.5	530.2	5630.4
2017	20578.5	13271.9	541.6	6764.9

Source: Research and development activity in Poland. The latest statistical news for the years 2010-2017 by CSO, Warsaw 2011-2018, Nauka i technika [Science and technology] by CSO for the years 2004-2016, Warsaw 2005-2017.

With the total increase in expenditures by 299% (as indicated above, the average annual growth determined by the geometric mean method was 11.2%), the government sector expenditures, including those of private non-profit institutions, decreased by 73% (the average annual decrease determined by the geometric mean method was 9.6%), while the greatest decrease was for the years 2016-2017, because in the years 2004-2015 there was an increase by 120%. However, this increase was still lower than in the entire R&D sector. At the same time, large increases in expenditures were observed in the higher education sector – by 311% (the average annual growth determined by the geometric mean method was 11.7%) and in the enterprise sector – by 798% (the average annual growth determined by the geometric mean method was 18.4%).

This was a manifestation of positive changes not only in the structure of financing, but also in the spending of funds allocated for R&D (see figure 2). A further increase in private expenditures on research and development, up to the level set as Poland's strategic objective, will be a major challenge for entrepreneurs (Kuskowski et al. 2013: 43).

Figure 2. Structure of expenditures on research and development activity in Poland in the years 2004-2017 by executive sectors



Source: Research and development activity in Poland. The latest statistical news for the years 2010-2017 by CSO, Warsaw 2011-2018, Nauka i technika [Science and technology] by CSO for the years 2004-2016, Warsaw 2005-2017.

The structure of expenditures of this shape corresponded to the directions adopted in the EU and national strategic programmes, according to which the role of the public sector should decrease and the role of commercial enterprises should increase.

As a result of the increase in R&D expenditures, their share in GDP has also increased (see table 6).

Table 6 Share of R&D expenditures in Poland in the years 2004-2017 in relation to GDP (in %)

Year	Expenditures on R&D in relation to GDP (%)
2004	0.56
2005	0.57
2006	0.56
2007	0.57
2008	0.60

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2009	0.67
2010	0.72
2011	0.75
2012	0.88
2013	0.87
2014	0.94
2015	1.00
2016	0.97
2017	1.03

Source: Research and development activity in Poland. The latest statistical news for the years 2010-2017 by CSO, Warsaw 2011-2018, Nauka i technika [Science and technology] by CSO for the years 2004-2016, Warsaw 2005-2017.

Despite a favourable trend of increasing the value of financing research and development works in Poland, which has been noticeable for years, and a relatively fast GDP growth, a very low share of these expenditures in relation to GDP still continues. Therefore, despite this favourable trend, Poland still has a lot of work to do in order to reach the European Union average.

4. New perspectives for financing research and development activity

According to the European Commission's forecasts, a significant level of investment in research and development will translate into creating new jobs and increasing the rate of GDP growth, which will allow the European economy to mitigate the negative effects of the recent financial and economic crisis and embark on a path of faster development (Bukowski et al. 2012: 21). Therefore, the European Union strives to increase the innovativeness of the Member States, and the objective for Poland, within the framework of the Europe 2020 Strategy, is – as already mentioned – to increase the total expenditures on research and development to 1.7% of GDP in 2020 (*Działalność badawcza i rozwojowa w Polsce w 2020 roku*). However, in order to meet this major challenge, it will be necessary to step up with research and development works, particularly in the business sector.

The impact of R&D on the innovativeness of the economy is, however, related not only to the amount of financial expenditures, but also to their structure by function and number. In order to strengthen the diffusional impact of R&D and innovations on the whole enterprise sector, time is needed. Therefore, it is necessary to increase internal expenditures systematically and to search for new sources of growth of innovative enterprises.

The analyses conducted by KPMG show that even if enterprises would increase their R&D expenditures almost threefold by 2020, the target would be reached at the earliest in 2021

(*Działalność badawcza i rozwojowa w Polsce w 2020 roku*). According to KPMG estimates, in 2020 the expenditures of enterprises on research and development will be too low by PLN 2.2 billion in order to reach the objective set out by EU and Polish authorities (the objective envisages total expenditures at the level of 1.7% of GDP, and the expenditures of enterprises at the level of 0.8% of GDP); the objective of 0.8% of GDP, i.e. PLN 17.8 billion, would therefore be reached in 2021 at the earliest (*Działalność badawcza i rozwojowa w Polsce w 2020 roku*). It is worth taking into account that if we want to compete technologically as a state in the future, the 1.7% GDP objective should be treated as a minimum to be achieved in the short term. However, further legislative changes are needed to increase the rate of growth of R&D expenditures; these changes would make it easier for companies to raise funds, as the tax incentives available in recent years have been used very rarely.

Increasingly, attention is also drawn to the fact that maintaining the current growth trends in the economy in the long term will require to base this growth on own new technologies and transfer them through closer cooperation between business and organisations dedicated to creating innovations within national R&D actions. To this end, it will be necessary to increase not only the value but also the efficiency of public spending on R&D (which is one of the lowest in the EU) and to create systemic conditions for raising private spending in this area. The changes in the law, especially subsequent versions of the so-called innovation acts, introducing in particular the possibility of obtaining tax allowances (deduction of costs for R&D works), as well as a greater concentration of EU funds on activities in the R&D area can give this opportunity.

One of the first financial changes introduced within the R&D activity stimulation of enterprises, and at the same time the first step towards the reconstruction of the support model for the innovative activity of enterprises in Poland, was the introduction of the so-called allowance for research and development activity into the income tax system (Łukaszewska 2018: 182). The R&D allowance replaced the allowance for the acquisition of new technologies, which functioned in the previous legal environment, and which was recognized as a tool not effective enough to support independent R&D activity.

The allowance for the acquisition of new technologies had been in place since 2006 and provided for the possibility to deduct 50% of the costs incurred from the tax base. However, this possibility was limited by a number of conditions, often difficult to meet. From an economic point of view, the main disadvantage of the allowance for the acquisition of new technologies was,

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however, the mechanism encouraging the purchase of new technologies instead of undertaking own activities by enterprises in the field of production and development of new technologies. As a result, this allowance contributed primarily to the import of new technologies from abroad, and not to the creation of innovations in Poland. Additionally, the allowance for the acquisition of new technologies was applied only to the acquisition of fixed assets and did not allow for the deduction of the acquisition of intangible assets. Due to serious shortcomings, this allowance was considered ineffective in terms of its impact on the improvement of the innovativeness of enterprises.

Therefore, the objective of the new allowance was to improve conditions for the development of innovative activities, especially in the sector of private enterprises and to strengthen the cooperation between scientific and research institutions and enterprises (Zieliński 2017: 526).

On 1 January 2016, the Act of 25 September 2015 on the amendment of certain acts in relation to supporting innovation, that is the so-called small act on innovation entered into force, providing for the possibility for entrepreneurs to deduct costs incurred on research and development activity, i.e. the so-called R&D allowance. It replaced the previously binding legal solutions contained in the acts on income taxes in the form of allowances for the acquisition of new technologies (Ustawa z 26 lipca 1991 r. o podatku dochodowym od osób fizycznych, art. 26 c and Ustawa z 15 lutego 1992 r. o podatku dochodowym od osób prawnych, art. 18 b) (Gargul 2018). This allowance was supposed to be a stimulus encouraging entrepreneurs to undertake innovative activity, but it was not sufficiently widely applied, because it allowed to achieve real financial benefits for all entrepreneurs conducting research activity, regardless of the industry in which they operate (*Ulga na działalność badawczo-rozwojową (B+R). Nowe, atrakcyjniejsze zasady od 2018 r.*).

On 1 January 2017, the last provisions of the Act on the amendment of certain acts determining the conditions for conducting innovative activity entered into force (Ustawa z dnia 4 listopada 2016 r. o zmianie niektórych ustaw określających warunki prowadzenia działalności innowacyjnej). Their purpose was to encourage both entrepreneurs and scientists to undertake research and development actions which were not particularly popular in Poland before. The R&D allowance which it introduced made it possible to deduct part of the R&D costs (so-called eligible costs) from the tax base and extended the period for deducting them from three to six years.

On 24 November 2017, the President signed the amendment to the regulations on the R&D allowance, which came into force at the beginning of 2018. (*Ulga na działalność badawczo-rozwojową* (B+R)). Nowe, atrakcyjniejsze zasady od 2018 r.). In accordance with the introduced changes the limits of write-offs have increased, among others; under the amendment, in certain conditions, entities operating in special economic zones on the basis of a permit will be able to benefit from R&D allowances. However, particularly favourable changes were observed in research and development centres (R&D centres), where, among others, higher tax deductions replaced the previously functioning innovation fund.

The Act of 9 November 2017 amending certain acts in order to improve the legal environment for innovative activity (Ustawa z dnia 9 listopada 2017 r. o zmianie niektórych ustaw w celu poprawy otoczenia prawnego działalności innowacyjnej), i.e. the so-called large act on innovation, which is another legal act aimed at stimulating the increase of expenditures on R&D, mainly in the enterprise sector, brought more serious and far-reaching changes.

The Act, apart from increasing the amount of tax allowance for research and development activity, introduced a number of other allowances and facilitations, in particular by extending and clarifying the catalogue of eligible costs for the R&D allowance, extending at the same time the exclusion of the so-called double taxation of capital companies and limited joint-stock partnerships engaged in R&D activity. It also allowed to increase the scope of activities of special purpose vehicles, established by universities and scientific institutes of the Polish Academy of Sciences, to economic activity. The main point of the introduced changes was the removal of barriers related to innovative activity and the creation of effective mechanisms to support (especially through the tax system) innovative solutions in economic practice.

The large innovation act (*„Duża” ustawa o innowacyjności i jej główne założenia*) clearly shows the areas of new facilitations. First and foremost, it:

- allowed to increase the amount of tax allowance for research and development activity to 100% and for R&D centres to 150%,
- clarified and extended the catalogue of eligible costs for the R&D allowance (by assets other than fixed assets and by forms of employment other than employment contract. R&D centres received an even wider catalogue of costs related to real estate, among other things),
- allowed some enterprises operating outside the Special Economic Zones to take advantage of the R&D allowance,

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- extended the exclusion of the so-called double taxation of capital companies and limited joint-stock partnerships engaged in R&D activity until 2023,
- facilitated the financing of start-ups by clarifying the tax treatment of loans converted into shares or stocks,
- introduced the possibility for the Polish Agency for Enterprise Development and the National Centre for Research and Development to use financial instruments and to grant financial support of a repayable nature (such as guarantees and capital support); previously only the Polish Agency for Enterprise Development could grant financial support in non-repayable forms and as loans, while the National Centre for Research and Development had only a limited possibility to establish companies,
- increased the scope of activities of special purpose vehicles, established by universities and scientific institutes of the Polish Academy of Sciences, to economic activity,
- enabled universities and scientific institutes of the Polish Academy of Sciences to establish companies for the management of research infrastructure (also jointly with research institutes).

Pursuant to statutory provisions, the Innovation Council responsible for the creation of the White Book of Innovation became an auxiliary body of the Council of Ministers – it consists of the heads of the Ministry of Science and Higher Education, the Ministry of Investment and Economic Development, as well as the Ministry of Administration and Digitization (*„Duża” ustawa o innowacyjności i jej główne założenia*). The new regulations, which are more favourable than all previous ones, are intended not only to encourage, but even motivate, entrepreneurs to conduct research and development activity on a larger scale and to implement its effects in their business activities.

5. Conclusions

Research and development activity is one of the most important aspects of innovative activity of enterprises, and its divisions, related to research and development, as well as organisationally separated (or legally and organisationally separated) research and development units, determine the competitiveness of the economy. In the period following the accession to the European Union, research and development activity of enterprises in Poland significantly

expanded. More and more expenditures on R&D activity are also expected in the future, but their scale is still far from sufficient.

The innovativeness of the economies of the EU Member States is one of the main objectives of the Europe 2020 Strategy, which replaced the Lisbon Strategy. Its implementation, however, requires actions aimed at increasing total expenditures on R&D to 3% of GDP by 2020. Poland, as a country with still too low a level and potential of the innovativeness of the economy in comparison to Western European countries, will probably have great difficulties to achieve the assumed much lower level since it reaches only 1.7% of GDP. The structure of financing also deviates from the assumptions. The reasons for this low level of expenditures on R&D in Poland are only partly due to the low level of economic development. However, they are also a result of other premises to a large extent, in particular of the structure of the economy shaped in recent years, which is characterised by a still low share of highly- and medium-advanced technology products and low involvement of foreign investors in conducting research and development activity in Poland.

By analysing the structure of Polish expenditures on research and development, one can notice that, due to the origin of these funds, it is practically a reversal of the proportions assumed in the Lisbon Strategy and the Europe 2020 Strategy. For many years, the state budget has been overburdened with financing the development of the Polish research and development sector (Heller, Bogdański 2005: 67). Therefore, one should only hope that in the period of still relatively good economic conditions, this trend will be reversed and the increase in the activity of private entrepreneurs will be even greater than before, although drawing far-reaching conclusions for the future seems to be very risky. The problem is definitely that many Polish enterprises are subsidiaries or branches of large foreign and international corporations that conduct their own research and development works, but usually in centres located in their country of origin, which is another reason for the low share of Polish enterprises in financing R&D activity (Janasz 2004: 150). These corporations implement specialized research and development works in our country very slowly, although the process is becoming more and more distinct.

Another weakness of the R&D sector is also its insufficient connection with the national economy and its entities, as well as too low a level of R&D expenditures from the private capital (Dyjach 2011: 223). Not only is this problem of the Polish R&D policy caused by the small size of

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expenditures, but also their structure, dominated for many years by the public sector, i.e. the opposite of the one assumed in the EU strategic documents (Boni 2009: 212).

The situation of financing R&D activity in Poland can be assessed as still not good enough, despite positive tendencies. In relation to the EU, the progress in this respect is still not dynamic enough. First of all, this is due to the fact that the amount of R&D expenditures is much too low, and it does not meet the needs, aspirations and capabilities of our economy. Achieving the strategic objective (1.7% of GDP) by 2020 requires a radical increase in funding.

The growth of R&D expenditures in the analysed period should, of course, be assessed positively, unlike its pace. The lack of significant acceleration of the growth in the coming years will result in the fixation or even increase of the distance between Poland and the European Union in the sphere of innovation.

Further changes are also needed in the structure of financing by function and using funds for research and development, because the state still remains too strong and the private sector too weak. What is particularly worrying is the passive attitude of enterprises, both in the area of financing R&D and conducting research. Perhaps the changes made in the legal system in recent years will become a development factor in this respect, allowing enterprises to finance an independent implementation of R&D results in a more advantageous way than before, so that economic entities, which previously avoided taking risks, more often choose developing their own solutions to purchasing ready-made ones.

Unfortunately, the system of research and development works that has shaped so far in Poland still mostly favours traditional, one-way transfer of technological knowledge, creating a mechanism that directs innovations from scientific and research units to enterprises, however, without launching mechanisms for obtaining innovations by entrepreneurs (Sosnowska et al. 2003: 48). The lack of interest on the part of economic entities leads to a situation in which research and development programmes of research and development units are in large part focused exclusively on the scientific ambitions of institutions, and much less on creating practical solutions in accordance with market expectations.

Increasing the expenditures of the enterprise sector on financing R&D activity is extremely important for the further development of the economy, because it is economic entities that should be responsible for adapting the effects of basic research and inventions and transforming them into

new technologies of major market importance. Increasing the competitiveness and attractiveness of products, and thus also the market importance of enterprises, should translate directly into the level and pace of GDP growth.

Financing research and development activity is, however, only one of many factors determining long-term economic effects of the research and development works carried out, and achieving a high level of innovativeness and competitiveness of the economy is connected with a long-term reconstruction of its structure.

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