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EXPENDITURES ON RESEARCH AND DEVELOPMENT ACTIVITIES AS A FACTOR IN THE DEVELOPMENT OF INNOVATION

Abstract: The development of research and development is a key process leading to the growth of innovation in the economy, and its conduct is important in the development and improvement of the level of competitiveness. Innovative activity consists in improving the quality of products and services, applying various concepts in business management as well as anticipating the possibilities of satisfying future needs of clients or even creating them. The size and structure of these activities are very diverse and depend on the level of economic development of a given country. Among the European Union countries can be distinguished those that allocate huge amounts for investments in R & D, that is, developed countries, and countries such as Poland, which are still spending too little on research and development activities. In addition, the subjective structure of investments is an important issue. The purpose of this publication is to analyze the size and structure of expenditures on research and development in the European Union, in particular, paying attention to the condition and general causes of insufficient R & D activity in the Polish economy.

Key words: research and development activity, innovations, innovation.

INTRODUCTION

The importance of knowledge and, consequently, of innovation, is still growing, while the importance of traditional material factors is decreasing (Kaspierkiewicz 2012). It is pointed out that the IT revolution gave impetus to the transformation of the structure of the capitalist economy. The changes that are taking place have wider access and also reach the potential recipient more efficiently. The changes taking place consist in the fact that capitalism has moved from the industrial phase to the knowledge-based phas (Piekut 2013). In literature (Thurow 1999, Drucker 1992), it is pointed out that currently the main source of values are knowledge and innovation. Recent experiences of highly developed economies show that achieving a competitive advantage based on knowledge and innovation is a guarantee of sustainable economic development and civilization progress (The Global...2015-2016). At the same time, it should be remembered that the emergence of innovations depends primarily on the behavior, attitudes and motivations of entrepreneurs (Newell et al., 2009), because these factors determine the choice of the future investment. Expenditures made in research and development activities are one of the factors that may contribute to the development of a company, affect its innovation (Piekut 2012). Works related to research and development concern both the development of industrial products as well as the modernization and automation of production processes. The regions of Europe, where the position and dominating role of industry have been established in the past, are leaders in terms of employment in the R & D sector, hence the significant differences in the share of spending on R & D in GDP between individual EU countries. The smallest share of expenditures concern regions with a small share of modern industry, which is accompanied by direct facilities of R & D units. Expenditure on R & D activity is related to production investments that produce innovative products or technologies. In Central and Eastern Europe, there are a few investments of this type, which is

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due to lower outlays on R & D. Changes in the structure of investments may lead to a reduction of the gap between the European Union countries, because increased cooperation in R & D usually leads to mergers of enterprises (clusters) which may result in greater intensity of research and development activities (Prystrom, Wierzbicka 2015).

In the modern global economy, very important is attributed to innovation. The aim of many enterprises, regions and economies is to increase its level, which allows you to strengthen your position, and is often a source of success, but it should be noted that it is not easy, because it depends on many different factors. On the one hand, it is shaped by people, the institutional environment, and financial resources, in particular the financing of research and development activities. Drucker claimed: "a company that does not innovate inevitably grows old" (Drucker 1992), that is why it is indispensable to constantly search for funds to develop works aimed at strengthening the innovative position.

As it was mentioned before, knowledge plays a very important role in the modern economy and in socio-economic development. The ability to create and transform it into new technologies, products and services affects the market success of enterprises and promotes the development of the entire economy. An important role in this area is played by the development of research and development activities. The importance of research and development activity is extremely important, therefore, the purpose of this publication is to analyze the size and structure of expenditure on research and development in the European Union, in particular with regard to the condition and general causes of low R & D activity in the Polish economy. The proposed analyzes are an attempt to identify problems that occur in the structure and volume of R & D outlays that can have a major impact on the development of innovation in Poland. In connection with the goal formulated in this way, the thesis was adopted that the increase in expenditure on research and development in Poland, compared to expenditures in economically developed countries, is not sufficient to compensate for the differences in the level of innovation between Poland and these countries. Apart from insufficient expenditure on research and development, Poland is also characterized by its inadequate structure.

RESEARCH AND DEVELOPMENT ACTIVITY, ESSENCE AND DEFINITIONE

The term research and development is understood as systematically carried out creative work, carried out in order to increase the knowledge base, including knowledge about man, culture and society, as well as - finding new ways of applying the discovered knowledge (Nauka i technika…2015). The systematics of scientific research distinguishes different concepts of divisions of research and development activities. In the research conducted by the R & D sphere, the following types can generally be distinguished:

1. income research (incremental), which consists of small B (basic research, theoretical research) and large R (development and implementation works),
2. radical research (radical), covering both large B and large R,
3. fundamental (fundamental) research - large B and small R (Roussel, Saad, Erickson 1991, Walas-Trębacz 2010).

Basic research is of a theoretical nature or may bear the characteristics of an experiment, and is undertaken mainly due to the desire to expand current knowledge on a given topic. Their goal is to explore certain areas of science not to use new truths in practice. Industrial research, in turn, is focused on using the results of basic research in order to create or introduce new products, processes and services or to improve existing ones, which may contribute to the emergence of innovations. In the process of conducting applied research, the developed effects are checked in the laboratories in terms of assessing the effectiveness of the achieved results, which is the starting point for development works. The development work combines the results of research work with the technical knowledge used for production planning and the creation and design of new, changed or

improved products, processes or services. They do not include routine activities, but by compiling the effects of research activities and practical experience, they form the basis for initiating new and significant improvements to already existing processes, systems and services (Ostraszewska, Tylec 2016).

The main source of the commonly adopted methodology for the use of data on research and development is the Frascati Manual, which states that "research and development activities, in short R & D, cover creative work undertaken in a systematic manner in order to increase knowledge resources, including knowledge about people, culture and society, and use these knowledge resources to create new applications" (OECD 2015). Innovation and R & D are to a certain extent synonymous terms. The research and development activity carried out by enterprises is almost always an innovative activity. In fact, the largest part of expenditure on innovation in many industries consists of research and development (Dachs 2009).

EXPENDITURE ON RESEARCH AND DEVELOPMENT ACTIVITIES

International research on expenditures earmarked for research and development activity is based on the classification of sources of funds for expenditure proposed in the Frascati Manual. The typology is as follows:

1. Budgetary resources designated by the government for R & D, ie the amount of expenditure allocated by the government for R & D works in the country, allocated from the budget in the form of all items related to research and development works, and then estimated in terms of financial resources,
2. Internal expenditure on R & D activities Expenditure incurred in the reporting year on R & D works performed in the reporting unit, regardless of the source of funds; they include current outlays as well as capital expenditures on fixed assets related to R & D, but do not include depreciation of these funds,
3. Scientific-research apparatus. Sets of research, measuring or laboratory devices with a low degree of universality and high technical parameters; the research equipment does not include computer equipment and other devices not used directly for the implementation of R & D works,
4. External expenditure on R & D. Expenditure on R & D works acquired from other contractors (subcontractors), domestic and foreign, including contributions and other funds - in the part concerning R & D activity - transferred to international scientific organizations and associations (Ostraszewska, Tylec 2016).

The basic measure allowing to assess and compare the size of R & D activity is the sum of internal expenditures on research and development activities carried out within a given country. It creates an indicator covering total gross national expenditure on research and development (GERD - Gross Expenditure on Research and Development). In publications concerning statistical analysis of R & D, the most frequently analyzed is the level of these expenditures in relation to the GDP of a given country (GERD / GDP), illustrating the ratio of total expenditure on research and development of four institutional sectors: enterprises, government and self-government, higher education and private non-commercial institutions to the country's GDP (Działalność badawcza… 2013). The value of this relationship is usually positively correlated with the value of GDP per capita (Dworak, Grzelak 2010). Data on external R & D expenditure in statistical units are not included in the GERD index, but they are a practical complement to information collected on internal inputs (GUS 2015a).

Domestic expenditure on research and development (GERD) in 2015 amounted to EUR 299 billion in the EU-28, an increase of 4.4% compared to the previous year by 47.8% and was higher than 10 years earlier (in 2005 r.). It is worth noting that rates of change are in current prices, and thus reflect changes in prices, as well as real changes in the level of expenditure. In 2013, the level

of spending on R & D in the EU-28 was equal to 80% of the United States, which is the best in the world.

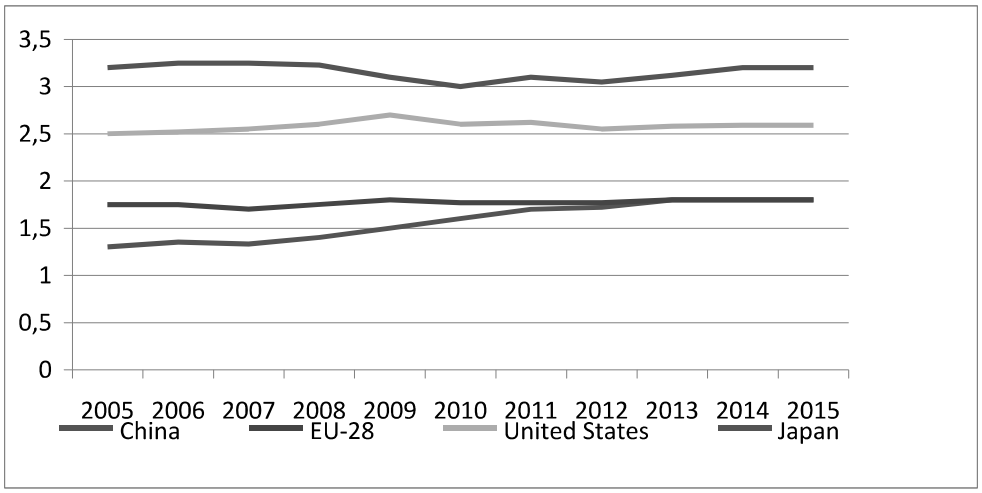

Figure 1. Gross domestic expenditure on R&D, 2005-20015 as % of GDP

Source: (Eurostat, R&D... 2017)

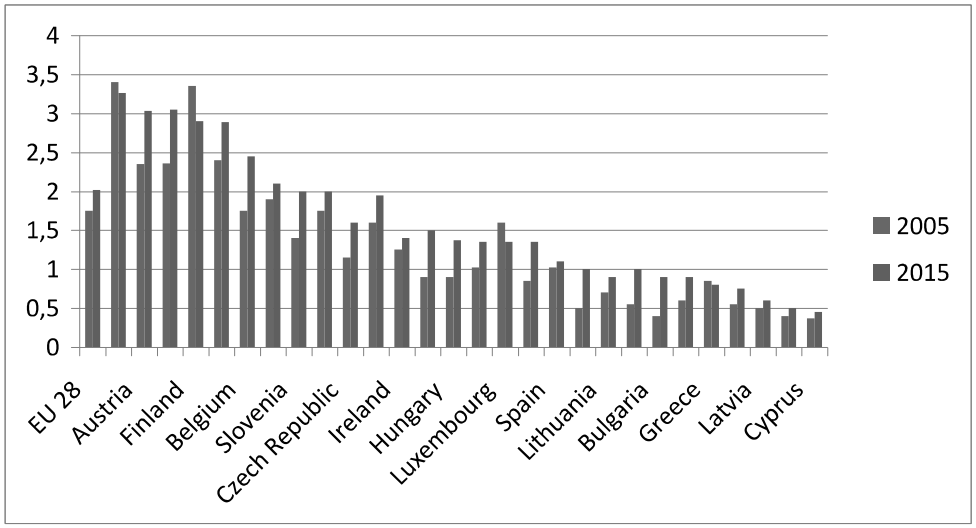

Figure 2. Gross dometic expenditure on R&D intensity, 2005-2015 as % GDP.

Source: (Eurostat, R&D... 2017)

For the results to be more comparable, GERD is often expressed in relation to GDP (Figure 1) - or in relation to the population. The ratio of GERD to GDP, one of the five key indicators of the Europe 2020 strategy, is also referred to as research and development intensity. This index increased slightly in the EU-28 in the period 2005-2007, from 1.74% to 1.77%. In the period from

2007 to 2012, it increased faster, reaching the level of 2.01%, despite the period of stagnation in 2010. The intensity of research and development increased slightly to 2.03% in 2013 and remained almost unchanged in 2014 and 2015.

Figure 2 shows that among EU Member States the highest intensity of research and development in 2015 was recorded in Sweden (3.26%), Austria (3.07%) and Denmark (3.03%). These are the only Member States that reported R & D intensity exceeding 3,00% in 2015; it should be noted that this indicator fell from less than 3.00% in Finland in 2005-2015. In 2015, seven Member States reported R & D spending below 1.00% of GDP. Together with Greece, Member States with the lowest intensity of R & D are countries that joined the EU in 2004 or later, although it should be noted that Slovenia (2.21%) reported the intensity of R & D over EU-28 on average, while when the Czech Republic (1.95%), Estonia (1.50%), Hungary (1.38%), Slovakia (1.18%), Lithuania (1.04%) and Poland (1.00%) reported intensity at least 1.00%.

Almost all EU Member States reported greater intensity of R & D in 2015 than in 2005. The exceptions are two Member States with the highest intensity in 2005, Finland (-0.43 percentage points) and Sweden (-0.13 point), as well as Luxembourg (-0.28 points), while the intensity of research and development in Croatia hardly changed in the period under consideration. At the other end of the scope of the largest increase in research and development intensity (in percentage points) between 2005 and 2015 was recorded in Slovenia, the Czech Republic, Austria, Slovakia and Belgium.

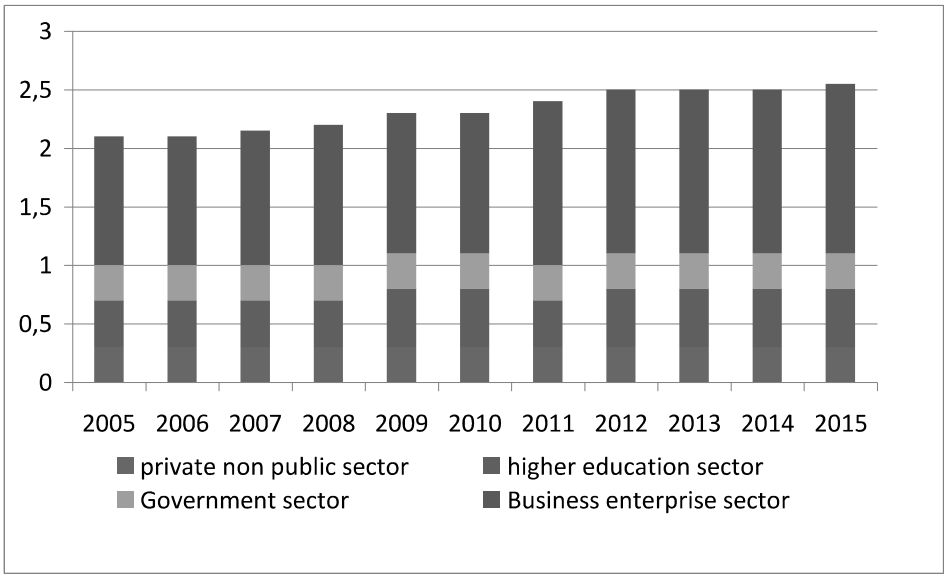

Figure 3. Gross domestic expenditure on R & D by sector, EU-28, 2005–2015 (% of GDP)

Source: (Eurostat, R&D… 2017)

Figure 3 shows how the intensity of R & D in the EU-28 increased between 2005 and 2014 - the determination of the R & D share in each of the four sectors - followed by a slight decrease in intensity in 2015. Over the entire period taking into account (2005 -2015), most R & D expenditure related to the enterprise sector, and research and development intensity increased from 1.10% of GDP in 2005 to 1.30% in 2014 and 2015, an increase of 18, 2%. The second largest research and development sector was the higher education sector, whose research and development intensity

increased by 23.1% in 2005-2014 to reach 0.48% of GDP before falling slightly in 2015. Intensity Research and development in the other two sectors have changed little during the period considered, and in 2015 the intensity of research and development in the government sector was 0.24% of GDP, while the non-profit private sector value was 0.02%.

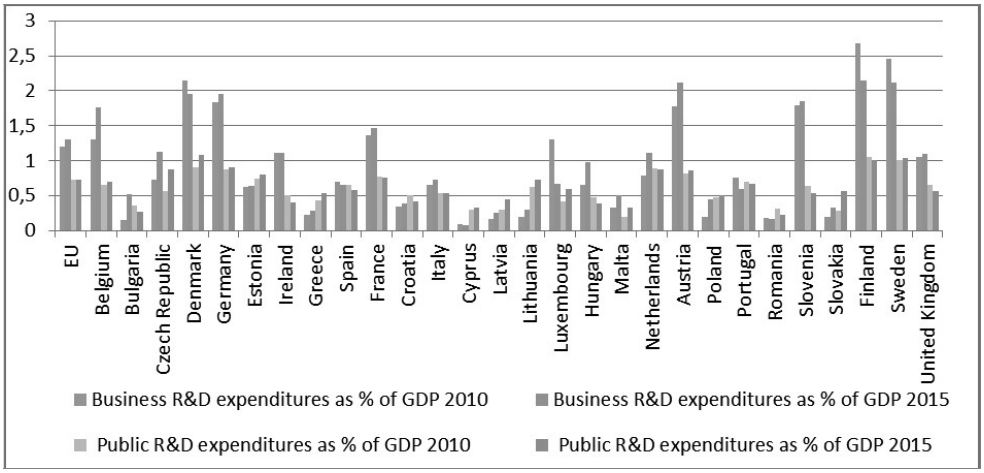

Figure 4. Business and public expenditures on R&D as % of GDP in UE-28, 2010-2015

Source: study based on (European Private Equity 2015)

Data evaluation for EU Member States also confirms that countries with relatively high R & D expenditure on enterprises in relation to GDP - namely Sweden (2.27%), Austria (2.18%), Germany (1.95%) Finland (1.94%) and Denmark (1.87%) also reported a relatively high overall level of research and development intensity (2.87% or more). Government spending on R & D in relation to GDP was highest in Germany, Luxembourg and the Czech Republic, while private sector non-profit sector expenditure in relation to GDP was very low in each Member State, reaching 0.07% in Cyprus.

Analysis of R & D expenditure by fund sources shows that more than half (55.3%) of total expenditure in 2014. Within the EU-28 it was financed by enterprises, while almost one-third (32.3%) was financed by government, and another 10.0% from abroad (foreign funds). Financing by higher education and private non-profit sectors was relatively small, 0.8% and 1.6% respectively. The main events in 2004-2014 were the reduction in the share of financing by the government sector, the lack of changes in participation in the private non-profit sector, and increases for three other sectors, in particular (in relative terms) for financing research and development from abroad (its share increased by 19.0% in total) (Eurostat, R&D 2017).

Among EU Member States in 2015. R & D-financed companies accounted for over three-fifths of total R & D spending in Slovenia (69.2%), Germany (65.8%, 2014 data) and Sweden (61 , 0%). However, the majority of research and development expenditures made in Cyprus (56.5%, data from 2014) and Greece (52.7%) were financed by the government sector. There were also significant differences in the relative importance of research and development funding from abroad, with relatively high shares - exceeding 30.0% in 2015 - reported in Bulgaria (50.9%, data from 2014), In Latvia (45, 0%), Slovakia (39.4%), Lithuania (34.6%), the Czech Republic (32.5%) and Luxembourg (32.3%, data for 2013). The higher education sector played a relatively small role in financing R & D expenditure in most Member States, exceeding 4.0% only in the southern Member States of Cyprus (5.6%, data from 2014), Portugal (4.2%, data from 2014) and Spain (4.1%, data

from 2014). Similarly, the role of the private non-profit sector was also generally small, exceeding 3.0% of expenditure on research and development in the United Kingdom (4.8%), Denmark (4.5%) and Sweden (3.1%, data from 2013).(Eurostat, R&D 2017)

POLAND AGAINST THE EUROPEAN UNION COUNTRIES

It is worth emphasizing that the increase in innovativeness of economies depends mainly on the constant development of research and development activities. With this in mind, the European Union and national governments constantly emphasize research and development work, which was reflected in the Lisbon strategy implemented in the years 2000-2010 and in its continuation in the form of the Europe 2020 strategy. One of the objectives specified in the Strategy is the increase of investments for research and development (R & D) to 3% of GDP (Stankiewicz 2012, Activity Report... 2013). In addition, the new perspective included in the Europe 2020 strategy includes three priorities, including the increase in the level of R & D spending in the amount of 3% of GDP (Piersiala 2014). It should also be mentioned that the strategic objectives of the European Commission translate into national goals, updated on an ongoing basis in the National Reform Program Europe 2020, which specify that Poland has, among others, the challenge of achieving a total R & D investment of 1, 7% of GDP in 2020 (National Reform Program Europe 2020). At the same time, it should be noted that Poland belongs to the countries that belong to the group of moderate innovators, that is countries that implement innovations, but usually belong to the group of followers.

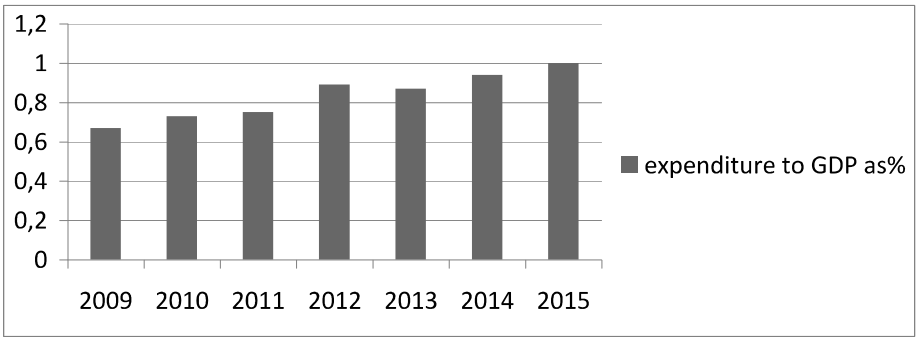

Figure 5. Relation of internal expenditures on R & D to GDP in Poland in 2009-2015

Source: study based on: (Działalność badawcza... 2013,2015)

The subjective structure of expenditure on research and development is also a very important issue. In the European Union countries, the financing of the business sphere and enterprises prevails, while in Poland the dominance of government financing prevails.

Comparing the situation in Poland to other developed countries of the European Union, where the main burden of financing R & D activities lies precisely on entrepreneurs, which should be assessed positively, in Poland the picture is shaped differently. The structure of R & D expenditures is considered desirable, in which the business sector plays a dominant role. A favorable situation is when the financial resources of enterprises for this purpose are twice as high as public expenditures, because entrepreneurs financially support mainly those studies whose effects in a short time can be used and earn on them. This, in turn, directly translates into an increase in the level of innovation. In the case of research financed from public funds, their commercialization is less frequent (Weresa 2006).

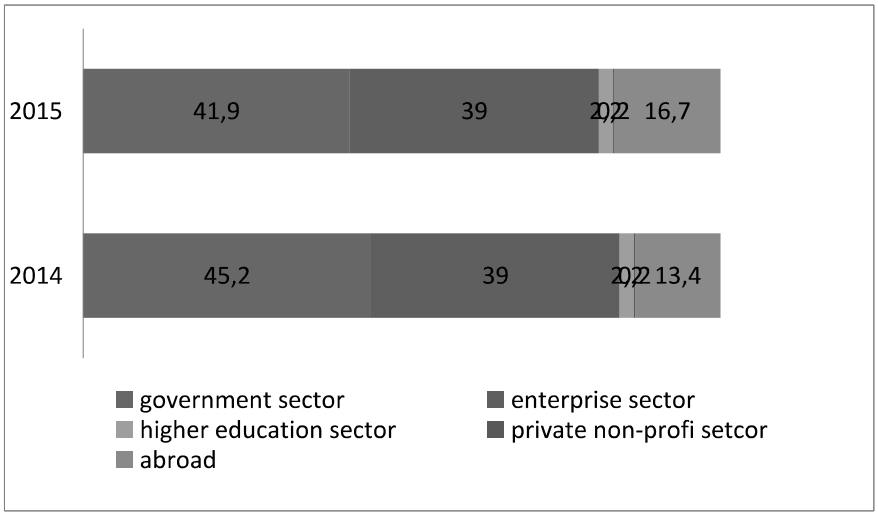

Figure 6. Structure of internal expenditure on R & D by sources of financing

Source: study based on: (Działalność badawcza… 2015)

In Poland, the situation looks a bit different. According to a report prepared by Deloitte (2015), as much as 44 percent. companies declare that they have not yet implemented the research and development strategy, and all related activities are undertaken ad hoc, if such is the decision of the management board. And although it is possible to look at this result optimistically, because in this year's innovation policy, as many as 2/3 companies operating in Poland admitted in the last year's survey, the situation is still worrying - almost half of entrepreneurs do not see business benefits from research and development activities. The basic source of financing R & D works are own funds of enterprises, which are used by as many as 98% of companies running or commissioning research and development projects. Most medium-sized and large enterprises that run or outsource R & D spend between 1 and 5% of their revenues on this activity. The second most frequently used source of financing is state aid - it is used by 48% of companies engaging in R & D. Enterprises receive mainly subsidies for investments and for research and development activities. Relatively often loans and equipment leasing are also used to finance R & D works (investment part) (Działalność badawcza… 2013).

In the European Innovation Scoreboard 2015 report, Poland took 24th place (out of 28 EU countries). In the next positions were Croatia, Bulgaria and Romania. Poland has been qualified for the so-called moderate innovators. According to GUS (Research Report 2015), the value of gross national R & D expenditures in Poland in 2008-2015 increased from PLN 7 billion 706 million (0.6 percent of GDP) to 18 billion 61 million zlotys (1% of GDP). As for R & D enterprises' expenditure in Poland, in 2008 they amounted to PLN 2 billion 480 million, and in 2015 to PLN 8 billion 411 million (Muszyński 2016).

In Global Innovation Index 2015, Poland took 46th place among 141 countries. Poland was on the 24th position - fourth from the end on the In Innovation Union Scoreboard 2015. In the summary available on the OECD website, which compared incentives for R & D activities through tax systems, Poland in all categories achieved zero-level indicators.

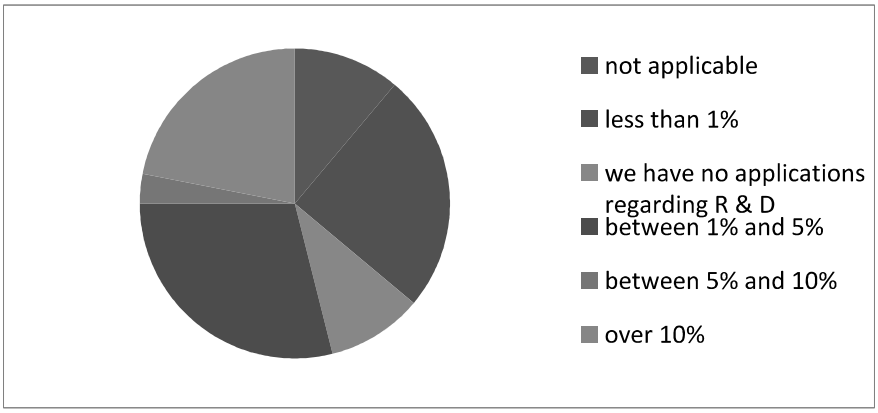

Figure 7. What percentage of your investment expenditures has been spent on research and development in 2015

Source: (Report 2016, Polska ... 2016)

CONCLUSIONS

Undoubtedly in Poland there is awareness of low innovativeness of the economy and threats resulting from such standing of things. In connection with the above, it is necessary to intensively increase expenditures on research and development activities, achieved mainly by intensifying work in this field.

Currently, the situation in financing research and development in Poland can be assessed as insufficiently good for the proper development of research on innovations, and it should be said that it is bad. At the same time, it should be admitted that the country improves both the level and the structure of financing, however, compared to the EU countries, progress in this respect shows little dynamism. In Poland, there is still too low level of expenditure on R & D, which puts Poland at a disadvantage in the international arena. Achieving the goals set by the European Commission (3% of GDP) requires a significant increase in funds. In connection with the above considerations, it is indispensable, above all, to change the subject structure of financing the funds for research and development activities. Currently, more funds are allocated by the state, with a smaller share of the enterprise sector, which is a different situation for economically developed countries. Companies avoid risk and more often than choosing their own solutions, they choose ready-made products. It is therefore necessary to increase the involvement of companies in our country in research and development. This may be favored by many factors, such as the improvement of cooperation between enterprises and the science sector, or an increase in the inflow of foreign direct investment, which will be possible thanks to the development of a new incentive system (a tax system that would guarantee reductions and exemptions)[64].

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