ASSESSMENT OF THE EFFECTIVENESS OF INVESTMENT IN R&D BY EUROPEAN UNION COUNTRIES

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Abstract
Investment in R&D today is an essential condition for the economic development of companies, industry as a whole and countries and regions. On the other hand, the financial capacity of economic operators is limited and it is important to know the benefits of these investments. In this context, the problem of their effectiveness is of particular importance. An adequate picture is provided by the analysis of the overall R&D process and its components – the impact on the creation of new knowledge; the impact of the new knowledge expressed in patents on the investment; the impact of innovation on the country's economic development. The study highlighted the following patterns: The developed countries of the European Union are characterised by higher R&D investment compared to developing countries, a significantly higher number of patent applications and the higher Global innovation index values. A different picture is with the effectiveness of R&D investment. Both patents and the entire investment processes are more efficient in the developing countries. This is due to a significant increase in patent sales in developed countries, a more decentralized innovation policy, i.e. significantly higher exports to other countries. All this distorts the picture of the actual effectiveness of R&D investments.

Keywords: investment in R&D, efficiency, European Union countries.

JEL Classification: F63, F21, O11.

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Introduction

Analysis of literature sources shows that the economic development of countries, which is determined by scientific and technical progress, is analysed in various aspects. This is the impact of R&D investments expressed by the innovations, the impact of new knowledge on innovation activities (Kalapouti *et al*., 2020; Han *et al*., 2017); the impact of innovation on the competitiveness, which is an essential condition for the country's economic development in the era of globalisation (Grant and Porter, 1991; Porter, 1998; 2013) and so on.

The development of new knowledge, on which the level and scale of innovation depends, requires the favourable infrastructure for the development of innovative activities. It consists of the investments in R&D, their size, sufficient number and potential of researchers, research institutions, cooperation between universities and industry and the protection of intellectual property (Sternberg and Arndt, 2001; Mairesse and Mohnen, 2004). Among these factors, investment in R &D has always been highlighted as an essential condition for the economic development of companies, industries and countries and regions (Shefer and Frenkel, 2005; Kor, 2006; Pessoa, 2007; Sharma and Thomas, 2008). Two key aspects of the analysis of investments in R&D can be distinguished – their impact on the end goal – the economic development of the country, and on the individual parts of this process – the creation of new knowledge, innovation, etc. On the other hand, the importance of the effectiveness of these investments is emphasised in all cases. This aspect is relevant, in particular, because the financial capacity of economic operators is limited. And it is therefore important what benefit they provide (Dočekalová and Bočková, 2013; Gerybadze and Reger, 1999; Santiago and Vakili, 2005; Chen and Ali, 2004; Cullmann et al., 2012). In addition, it has been noted that increasing R&D investment does not always improve economic performance (Jaruzelski et al., 2011).

Analysis of literature sources shows that the focus of research is on the interaction or effectiveness of the individual parts of this process (investment in R&D and new knowledge, new knowledge and innovation, innovation and economic development). There is a lack of research that examines the efficiency of the whole process in a comprehensive way. The research is not linked to the level of economic development achieved in the countries and does not allow to reveal the trends in investment in R&D.

The aim of the article is to assess the effectiveness of the investments of the European Union countries in R&D in both the individual parts and the whole of this process, taking into account the level of economic development achieved.

In addition to the introduction, the article consists of literature review, research methodology, empirical results and discussion, and conclusions.

1. Review of literature

Almost all literature that explores the R&D investment process highlights their importance for the economic development of companies, industries and countries and regions. Investment in research and experimental development is understood as the search for better value creation methods (Nelson and Winter, 1982). This is considered to be a crucial factor, as it initiates creative activities that contribute to the development of knowledge that can be successfully used in the development of new products and services (Shefer and Frenkel,

2005; Kor, 2006; Pessoa, 2007; Jang et al., 2016). In terms of product life cycle, R&D is just as important as manufacturing itself (Jang et al., 2016).

In all cases, investments in R&D are analysed and evaluated in the context of their effectiveness, emphasising that these are the quantitative and qualitative sides of one and the same process. It is understood as the result-to-cost ratio (Collins and Porras, 1996; (Gerybadze and Reger, 1999; Furman et al., 2002). The analysis is carried out in two aspects: the impact on the economic development of the parties and the effectiveness of the interaction between the components of the overall R&D process. The importance of investing in R&D is presupposed by several factors. In particular, the financial possibilities for the investments of economic operators are limited and it is therefore necessary to compare the input costs and the result obtained (Dočekalvá and Bočková, 2013; Gerybadze and Reger, 1999; Santiago and Vakili, 2005; Chen and Ali, 2004; Cullmann et al., 2012). This has a two-fold effect: it enables benchmarking and the identification of weaknesses in activities. Moreover, research has shown that increasing R&D investment does not always improve economic performance (Jaruzelski et al., 2011).

Literature sources analyse the following aspects of the assessment of the effectiveness of the R&D process: interaction of investments with economic growth and new knowledge; interaction of foreground expressed by certain indicators (patents, publications, etc.) with innovations expressed in high-tech weighting in the overall industrial structure, their exports, etc. and the impact of innovation on economic growth expressed in high-tech added value, sales volume of new products, etc. (Figure 1).

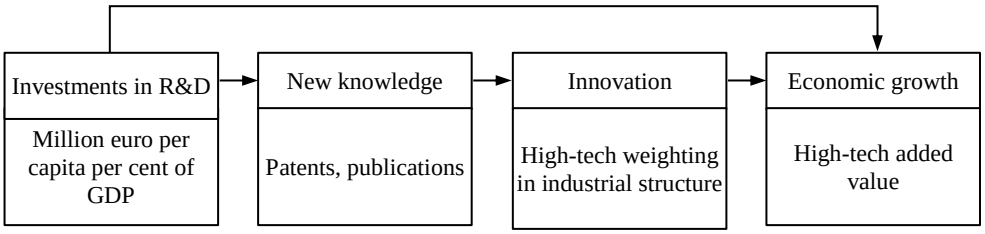

Figure no 1. Structure of the R&D investment process
Source: written by the author

The effectiveness of investment in R&D interactions with economic growth. Few studies have tried to assess the effectiveness of this interaction, although it is emphasised that the economic benefits with long-term effects are the main objective of investing in R&D (Camera et al., 2005; Katouros, 2005; Hashimoto and Haneda, 2008; Kontroumpis, 2009; Jang et al., 2016; Kalapouti et al., 2020). This concludes that a systematic quantitative assessment of the effectiveness of R&D investments is necessary (Jang et al., 2016; Meidute-Kavaliauskiene et al., 2021). However, such research is fragmented. For example, the effectiveness of the R&D in developed countries in Western Europe was analysed, where GDP was taken as one of its indicators (Rousseau, S. and Rousseau, R., 1998).

In another study, 18 countries were divided into 4 categories according to the R&D percentage of GDP and compared their average efficiency. A contradictory conclusion was reached that there was no sufficiently strong link (Rousseau, S. and Rousseau, R., 1997). A similar idea is highlighted in another study – increasing investment in R&D does not always drive innovation (Kaihua and Mingting, 2014; Zabala-Iturriagagoitia et al., 2007). Literature

shows that research on the effectiveness of the interaction between individual parts of the process predominates.

The effectiveness of investment in R&D and the interaction of new knowledge. As shown in Figure 1, the direct result of investment in R&D is new knowledge expressed through patents, publications (Griliches, 1990; Johansson *et al*., 2015). A 1 % increase in these costs is also estimated to increase the number of patents by 1 %. (Teitel, 1994). Investment in R&D is usually measured on the number of patents (Rousseau, S. and Rousseau, R., 1997). They are understood as an expression of creativity (Maclaurin, 1953). Studies have shown that differences in the intensity of patent applications can be explained by differences in investment in R&D (Furman et al., 2002; Goto and Suzuki, 1989; Johansson et al., 2015; Han et al., 2017; Thomas et al., 2011; Furman et al., 2002; Hollanders and Esser, 2010). On the other hand, a deeper analysis has revealed the contradictory nature of this interaction: increasing R&D investment does not always lead to an increase in the number of patents and the economic benefits derived from them (Zabala-Iturriagagoitia et al., 2007). This may have been because not all patents have commercial potential (Lee *et al*., 2009; Fritsch and Slavtchev, 2007). In addition, most patents are small, others include only improvements and few of them are original (Johansson *et al*., 2015). In this context, the assessment of the interaction effectiveness between R&D investment and patent applications is very important.

The effectiveness of R&D and innovation investments in the scientific literature is analyzed in the *context of the interaction between patents and innovations*. Patents are considered to be an indicator of the innovation (Johansson et al., 2015). On the basis of the information on patents, the aim was to explain differences in innovation efficiency between countries (Furman et al., 2002; Gans and Stern, 2003; (Fu and Yang, 2009). Empirical studies have shown that the number of patents is highly correlated with the value of sales of new products (Comanor and Scherer, 1969; Cohen and Levinthal, 1989; Hall et al., 1986). Regions that have developed innovation activities on the basis of patents have shown greater innovation efficiency (Chen and Kou, 2014; Cullmann et al., 2012; Furman et al., 2002). In modern conditions characterised by constant change, it is considered difficult to achieve success in technology without the fostering of R&D (Johansson et al., 2015; Nelson and Winter, 1982).

Many studies focus on the *links between innovation and economic growth* (Jang *et al*., 2016). The economic benefits of innovative activities can be measured on the basis of a number of indicators. One of them is sales and revenues, of the new products (Comanor and Scherer, 1969; (Johansson *et al*., 2015). The importance of the new products is unconditionally recognized and the growth of high-tech industries has always been seen as one of the most important indicators of economic development (Cainelli et al., 2006; Grossman and Helpman, 1993; Rosegger, 1996. The country's innovative innovation activities are summarised by the Global Innovation Index (Global Innovation Index) provided by the World Intellectual Property Organisation.

The ability to innovate and successfully bring them to the market is a key factor in competitiveness (Rakauskienė, 2013). Long-term economic growth in both developed and developing countries can only be sustained through innovation. Less developed countries can still increase their productivity by adapting existing technologies, but this is not enough for developed countries. In order to maintain their competitiveness, companies need to develop and develop smart processes and introduce new products to the market (Kalapouti et al., 2020).

2. Research Methodology

The European Union is made up of countries that are very diverse in terms of economic development. For example, Luxembourg's GDP was 9 times higher in 2020 compared to Romania and 8 times higher for Croatia. Ireland – selected 6.5 and 6.0 times; Denmark is 4.7 and 4.4 times higher, etc. Investments in R&D were 21.8 and 7.3 times respectively in Luxembourg in the same year, 17.4 and 6.0 times in Ireland, 21.2 and 7.3 times higher in Denmark. There is a clear correlation between the level of economic development of the country and the size of the R&D investment. It follows that for an adequate assessment of their effectiveness, it is appropriate to divide all EU countries into groups depending on their GDP. Based on the number of EU countries, there are 2 groups. The size of the grouping range can be determined on the basis of the formula:

$$h = \frac{BVP^{\max} - BVP^{\min}}{2} \quad (1)$$

where *h* is the size of the grouping interval, EUR thousand per inhabitant; $BVP^{\max}$ – highest GDP in 2020 among all EU countries; $BVP^{\min}$ the same, the least.

Based on (1) the following ranges have been obtained (Table 1).

Table no 1. GDP ranges for EU countries, EUR thousand per inhabitant (source: written by the author)

Groups of countries	Limits of intervals		Number of countries in the group
	from	up to	
First (developed countries)	32.4	53.6*	10
Second (developing countries)	11.3	32.4	17

*Notes. * Two countries – Luxembourg and Ireland – have been switched out of the grouping because their GDP exceeds the GDP of all other countries, which would distort the picture of the grouping. They are automatically incorporated into the first group of countries.*

Figure 1 shows that in order to assess the effectiveness of the interoperability of both the R&D process as a whole and its parts, two challenges need to be addressed first. First, to determine the way in which its components – new knowledge, innovation and economic growth – will be expressed; secondly, determine how their efficiency will be calculated.

Both new knowledge, innovation and economic growth by nature are complex phenomena that can only be characterised by a limited number of indicators. It can be seen from literature sources that new knowledge is expressed in patents, publications, inventions, etc.; innovation as a high-tech part of the overall industrial structure, its exports, imports, etc.; economic growth – high-tech added value, sales value of new products, etc. The more diverse and comprehensive the set of indicators will be, the more adequately reflect the phenomenon in question. On the other hand, as the number of indicators increases, the assessment of the status of the phenomenon is becoming increasingly complex. This is due to a variety of reasons – the lack of information on the values of some indicators, diverging views on the generally accepted set of indicators system, complex methods of aggregation, etc. Furthermore, the different structure of the indicator system makes it impossible to compare countries.

A way out of this situation can be found by selecting an indicator that integrates in itself the characteristics of all other, or at least most indicators, and is therefore is representative. This is

the case today, for example, with an assessment of the state of economic development of countries, which reflects the gross domestic product (GDP) per one inhabitant. It is no coincidence that this path has been taken in terms of the efficiency of the R&D process. New knowledge indicators include patents, innovations and economic growth. In this way, the framework for the analysis of the efficiency of the R&D process will look like this (Figure 2).

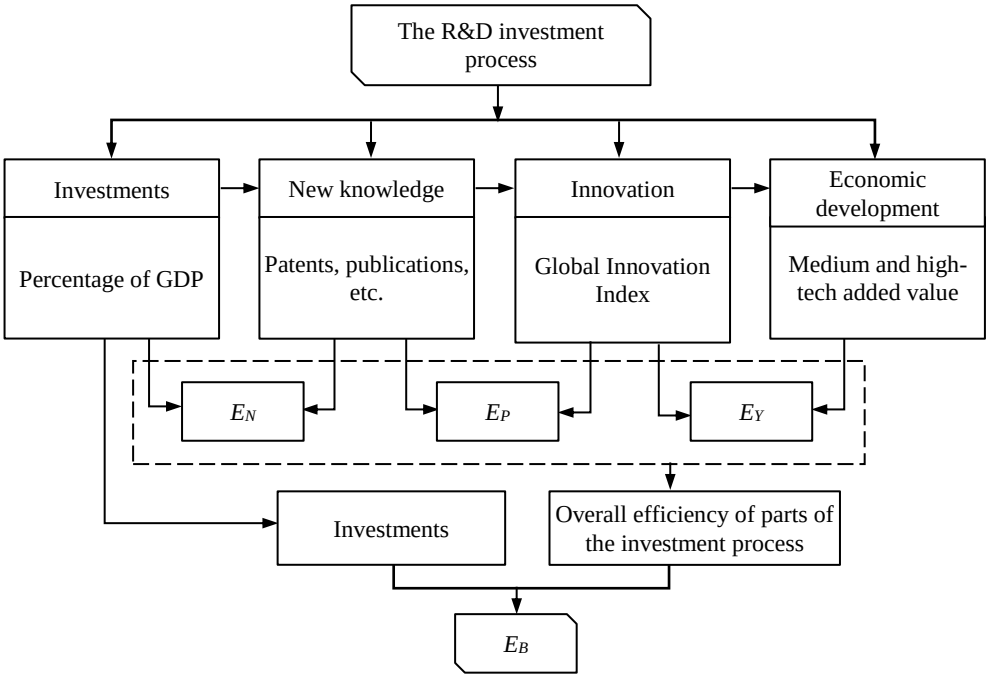

Figure 2. R&D investment efficiency analysis scheme

An understanding of the efficiency of the R&D investment (result-to-cost ratio) can be determined as follows:

a) the efficiency of new knowledge E_N:

$$E_{Nj} = \frac{P_j}{R_{Dj}} \quad (2)$$

b) the efficiency of patents in E_P:

$$E_{Pj} = \frac{G_j}{P_j} \quad (3)$$

c) the efficiency of innovation E_Y:

$$E_{Yj} = \frac{G_j}{I_j} \quad (4)$$

d) the efficiency of the R&D investment process as a whole E_B:

$$E_{Bj} = \frac{BVP}{R_{Dj}} \quad (5)$$

this R_{Dj} is j - country's investment in R&D, million euros per capita; P_j – number of country j patents per million inhabitants; I_j– *high*-tech added value of country j , % of total value added in manufacturing.

Data for the calculation of the values E_Y, E_P *and* E_N can be obtained from statistical information sources. More complex is the assessment of the efficiency of the overall process of the R&D investment parameter E_B. For this reason, as mentioned before, there are only a few studies that have attempted to implement this. The situation here is complicated by the fact that the efficiency of the individual parts of the R&D process varies from country to country – one for new knowledge, another for patents, and a third for innovation. In the meantime, the overall assessment is relevant as the increase in R&D investment, as noted above, does not always improve economic performance. This happens for various reasons. For example, the increase in R&D investment does not always stimulate innovation (Zabala-Iturriagagoitia et al., 2007; Cullmann et al., 2012).

Patent efficiency may be undermined by the fact that some of them are non-commercial (Fritsch and Slavtchev, 2007; Chen and Kou, 2014; Kalapouti *et al*., 2020; Kaihua and Mingting, 2014). Moreover, due to shortcomings in the use of patent statistics, not all new knowledge (e.g. inventions) is patented (Johansson et al., 2015). Innovation efficiency is also influenced by various factors. Studies show that countries with high innovation efficiency often follow a highly decentralised policy, i.e. the results of the high-tech industry are exported, making it difficult to assess the impact of innovation on economic growth. For example, many German multi-branch companies concentrate their R&D activities in the country's headquarters, but the results also apply to the branches in other countries. These activities are often subsidised, making it difficult to determine the impact of R&D investments on economic growth (Kvedarienė, 2022).

The question arises how to assess the effectiveness of the entire R&D investment process in this controversial situation. One way forward is to find a variable that gives an overall picture of the different situations in each country. Such a challenge can be solved by applying the principles of multi-criteria evaluation. The essence of these methods is that they can combine into a single sum indicators of different importance and based on different dimensions and variables can change in the opposite directions (Cinelli et al., 2020; Kumar and Thakkar, 2017; Chandra and Kumar, 2020).

They presume that each indicator must be reflected in the value and importance, which is usually different. In the present case, a single component of the R&D investment process cannot take place without the other, and it is therefore conceivable that both new knowledge, patents and investments are equally important. In this case, the amount E_B will be determined as follows:

$$E_{Bj} = \tilde{E}_{Nj} + \tilde{E}_{Pj} + \tilde{E}_{Yj} \tag{6}$$

Here $\tilde{E}_{Nj}$, $\tilde{E}_{Pj}$ $\tilde{E}_{Yj}$ are the normalised values for new knowledge, patents, and innovation efficiency indicators. Normalisation of values is done as follows:

$$\tilde{E}_{Nj} = \frac{E_{Nj}}{\sum_{j=1}^{m} E_{Nj}} \tag{7}$$

$$\tilde{E}_{Pj} = \frac{E_{Pj}}{\sum_{j=1}^{m} E_{Pj}} \tag{8}$$

$$\tilde{E}_{Yj} = \frac{E_{Yj}}{\sum_{j=1}^{m} E_{Yj}} \quad (9)$$

where *m is the* number of countries ($m = 1, \overline{m}$).

Such a normalisation of the values of the indicators, despite the fact that they are already dimensionless and therefore comparable with each other, led to the fact that the purpose of this multi-criteria assessment is to compare the countries concerned. In this case, the values of one country's indicators must "exit" from the context of the values of all other countries.

3. Empirical research and results

In particular, based on formula (1), all EU countries were divided into two groups according to their economic development, i.e. GDP per capita. Statistics for the analysis of the effectiveness of investments in R&D, taken from Eurostat (2021) in Table no 2.

Table 2. Efficiency of the European Union's R&D investment process in 2020

Group of countries	No	Country	The R&D investment process			
			GDP in euros 1 live	Investments to R&D, in euros per inhabitant	Patents, 1 million inhabitants	Global Innovation Index
I	1	Ireland	73.59	925.6	195.8	53.05
	2	Belgium	39.4	1378.8	208.2	49.13
	3	Denmark	53.60	1624.8	414.4	57.53
	4	Austria	42.30	1364.2	258.2	50.13
	5	Luxembourg	101.64	1157.6	633.3	50.84
	6	France	34.04	805.6	156.9	53.66
	7	The Netherlands	45.87	1054.5	365.4	58.76
	8	Finland	42.94	1254.7	343.2	57.02
	9	Sweden	45.85	1623.8	428.2	62.47
	10	Germany	40.12	1273.2	311.2	56.55
II	1	Bulgaria	8.75	74.3	7.8	39.98
	2	Czechia	20.12	400.8	19.6	48.34
	3	Estonia	20.44	361.9	42.9	48.28
	4	Greece	15.49	230.8	12.6	36.79
	5	Italy	27.78	425.3	78.0	45.74
	6	Latvia	15.43	109.1	15.8	41.11
	7	Poland	13.64	192.1	12.6	39.95
	8	Lithuania	17.51	201.7	17.9	39.18
	9	Malta	24.63	169.4	122.1	46.39
	10	Hungary	13.94	224.8	11.2	41.53
	11	Croatia	12.17	154.4	5.7	37.27
	12	Cyprus	23.40	199.5	72.5	46.67
	13	Romania	11.29	53.1	2.9	36.95
	14	Portugal	19.66	314.3	24.4	43.51
	15	Spain	23.69	333.1	37.8	45.60
	16	Slovakia	16.77	153.7	9.9	39.70
	17	Slovenia	22.01	480.7	78.7	42.91

Source: drawn up by the author based on Eurostat, 2021.

Group of countries	No	Country	Effectiveness of R&D investments							
			Medium and high-tech added value	E_{NJ}	E_{PJ}	E_{SJ}	$\widetilde{E}_{Nj}$	$\widetilde{E}_{Pj}$	$\widetilde{E}_{Sj}$	$\widetilde{E}_{Bj}$
I	1	Ireland	54.5	0.212	0.271	1.028	0.080	0.142	0.116	0.338
	2	Belgium	50.9	0.151	0.236	1.036	0.057	0.124	0.117	0.298
	3	Denmark	51.5	0.255	0.132	1.013	0.096	0.069	0.114	0.279
	4	Austria	45.4	0.190	0.195	0.905	0.071	0.102	0.102	0.275
	5	Luxembourg	20.8	0.547	0.081	0.409	0.205	0.043	0.046	0.294
	6	France	50.4	0.195	0.342	0.940	0.073	0.179	0.106	0.358
	7	The Netherlands	51.5	0.347	0.161	0.877	0.130	0.085	0.099	0.314
	8	Finland	45.6	0.274	0.167	0.801	0.103	0.088	0.090	0.281
	9	Sweden	52.4	0.264	0.146	0.839	0.099	0.077	0.094	0.270
	10	Germany	60.7	0.245	0.182	1.073	0.092	0.096	0.121	0.309
II	1	Bulgaria	32.4	0.104	5.126	0.811	0.042	0.100	0.057	0.199
	2	Czechia	52.1	0.049	2.467	1.078	0.020	0.048	0.075	0.143
	3	Estonia	29.6	0.119	1.126	0.614	0.048	0.022	0.043	0.113
	4	Greece	19.6	0.055	2.920	0.534	0.022	0.057	0.038	0.117
	5	Italy	43.2	0.184	0.587	0.945	0.074	0.012	0.066	0.152
	6	Latvia	21.9	0.145	2.602	0.533	0.058	0.051	0.037	0.146
	7	Poland	33.1	0.066	3.171	0.828	0.027	0.062	0,058	0.147
	8	Lithuania	27.6	0.135	2.189	0.706	0.054	0.043	0.049	0.146
	9	Malta	36.6	0.721	0.380	0.789	0.288	0.008	0.055	0.351
	10	Hungary	53.5	0.050	3.708	1.290	0.020	0.073	0.090	0.183
	11	Croatia	28.7	0.037	6.539	0.770	0.015	0.128	0.054	0.197
	12	Cyprus	27.3	0.364	0.630	0.599	0.146	0.013	0.042	0.201
	13	Romania	46.1	0.055	12.397	1.283	0.022	0.0242	0.090	0.354
	14	Portugal	25.5	0.078	1.784	0.587	0.032	0.035	0.041	0.108
	15	Spain	39.5	0.114	1.207	0.869	0.046	0.024	0.061	0.131
	16	Slovakia	50.7	0.065	4.011	1.278	0.026	0.078	0.089	0.193
	17	Slovenia	37.2	0.164	0.546	0.869	0.066	0.031	0.061	0.158

The values E_{Nj}, E_{Pj}, E_{Yj} *and* E_{Bj} (Table 2) are determined based on Figure 1 and formulas (2) to (4). These calculations showed some trends. For the first group of countries compared to the second group, the R&D investment rate, measured as a percentage of GDP, is more than twice on average; the extent of new knowledge expressed in patent applications – almost 10 times; innovations denominated in the Global Innovation Index – 1.3 times (Table 3).

A different picture is with the effectiveness of investing in R&D. Here, only the efficiency of new knowledge is increased by the first group of countries (1.8 times). Meanwhile, the efficiency of patents and the efficiency of the entire investment process are significantly lower. Innovation efficiency is the same (Table 3).

Table 3. Differences in the effectiveness of EU R&D investments between the first and second group countries (source: written by the author)

Ratio of the average value of the first group to the average value of the second group	The R&D investment process			R&D investment efficiency indicators			
	Investments in R&D	Patent applications, 1 million inhabitants	Global Innovation Index	E_N	E_P	E_Y	E_B
Value	5.19	9.84	1.30	1.80	0.06	1.05	0.34

The seemingly paradoxical situation in Table 3 can be explained. The lower efficiency of the patents of the first group of countries is due to the fact that, although on the one hand, economically developed countries are better placed to apply for patents from a wide range of fields, on the other hand, as mentioned above, not all of them have commercial value, i.e. only part of them are transformed into technological innovations. The lower innovation efficiency of these countries was due to their more decentralised policies, i.e. their exports to other countries, patent sales, etc. The low efficiency of the overall R&D process compared to the second group was caused by as much as 16 times the efficiency of patents. This is because a small number of patents have been sold within these countries.

The aggregated picture is given by the value of indicator E_{Bj} (Table 2). It shows that the efficiency of the overall R&D investment process of the first group is over 1.75 times higher than for the second group. The new opportunities opened up in the European Union are likely to bridge the gap between these countries.

Conclusions

Investment in R&D today is an essential condition for the development of countries. On the other hand, the financial possibilities of economic subjects are limited, which makes the effectiveness of these investments very important. Research on the interaction between the individual parts of the R&D investment – investment and the creation of new knowledge predominates in literature; the impact on innovation of new knowledge because of patents; the impact of innovation on the economic development of the country. There are few studies that would look at the efficiency of the entire R&D process in a comprehensive way. Moreover, it is not linked to the level of economic development achieved by the countries. Individual countries, groups of countries, but not the European Union as a whole, are examined. This does not make it possible both to obtain an overall picture and to compare countries with each other.

Studies have shown that developed countries in the EU are characterised by higher R&D investments compared to other Community members, a significantly higher number of patents registered based on new knowledge and a higher value of the Global Innovation Index. This is the case with R&D investment efficiency. Both patents and innovations are more efficient in developed EU countries. At first glance, this paradoxical situation is due to the fact that not all patents in developed EU countries have commercial value, i.e. not all of them become technological innovations. In addition, the innovative policies of the first and second groups of countries differ, which are more decentralised in developed countries, i.e. many innovative innovations are realised abroad and therefore do not fall into account. Meanwhile, in most developing countries patents are realised domestically and thus fall into account. This is illustrated by the fact that the patent efficiency of these countries is as high as 16 times that of developed EU countries.

A summary view is given by the value of the total R&D investment process efficiency indicator E_{Bj}. It is more than 1.7 times higher for developed EU countries. Developing countries in the EU are likely to take advantage of the new opportunities opened and bridge this gap. In any case, in order to obtain an adequate picture of the effectiveness of the investment in R&D, the first step is to improve its accounting system.

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