ASPECTS REGARDING THE CORRELATION BETWEEN THE LEVEL OF RESEARCH FUNDING AND THE INNOVATION INDEX IN THE EU

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Abstract:
This study aims to present the role and importance of innovation for the EU's economic development and to analyze the levels of innovation achieved by member states, as recorded by the Innovation Index – a complex and modern tool for quantifying innovation in the EU.
The analysis of the relationship between the Innovation Index and the percentage of GDP allocated to research and development in 2019 based on the Pearson coefficient led to the conclusion that, for most EU countries, there is a clear link between the percentage allocated to research and innovation and the value of the innovation index.
The scientific research methodology relies on the following methods used in conjunction: analysis, synthesis, induction, deduction, comparative data processing, time series analysis, tables and graphs method, abstraction and generalization, with the Pearson correlation coefficient calculated using SPSS for Windows

Key words: *innovation levels, research and development expenditure, competitiveness, European Union, GDP, Pearson coefficient*

JED Classification: O30, O52, O10

INTRODUCTION

In order to face the fierce international competition, the European Union has become aware of the need to implement innovation in the sectors of the creative economy and beyond. Thus, we can say that, in the European Union, innovation is considered the engine of economic growth and of future sustainable development, and is currently associated with all types of activities, not only with the industries known to promote the new, such as software development, electronics, biotechnology, and telecommunications. To expand research and innovation, the EU has implemented strategies through which its member states have focused their efforts on supporting, developing and promoting those activities meant to lead to sustainable development on an innovative basis.

The European Union has a number of significant achievements compared to the progress made by other member states that need a policy in terms of their competitiveness strategy. Most EU member states are trying to achieve good results in terms of innovation. However, according to the annual scoreboard for research and innovation, there are countries that have made no effort to innovate.

The member states of the European Union need help with innovation, growth and job creation methods. With this scoreboard, a comparison can be made between member states starting with the innovation and research levels, followed by other factors.

To compare and monitor the situation and the progress made throughout the European Union (European Commision, 2020), several tools have been implemented:

• with the help of the 27 indicators and the European knowledge market for licenses and patents, an innovation scoreboard in the EU was created. The European Innovation Scoreboard (EIS) is an important tool for a company's management, which has the role of collecting information about the evolution of economic phenomena that impact the company's fields of activity.

• based on the Regional Innovation Scoreboard (RIS), the European regions are divided, according to the Innovation Union, into four innovation performance groups: "Innovation Leaders" (38 regions), "Strong Innovators" (73 regions), "Moderate Innovators" (97 regions) and "Modest Innovators" (30 regions).

• the Innobarometer, an annual opinion poll conducted among units and the general public on attitudes and activities regarding innovation policies. The Innobarometer draws on multiple sources to compile relevant information regarding policies.

Research and education can be considered the pillars of innovation. It takes about one million researchers to be able to invest 3% of the European Union's GDP in Research and Development. The Innovation Union has recommended measures to complete the European Research Area (ERA). This means a stronger connection between European and national research policies, as well as the removal of obstacles to the mobility of researchers. In the field of education, the Commission supports projects aimed at creating new programs to fill the gaps in innovation skills.

Literature Review

One of the major features of the contemporary era is the continuous process of innovation. Nowadays, innovation manifests itself in all fields: art, medicine, society, as well as technology and economics.

Today, it is unanimously accepted that economic development, the improvement of the quality of life and the creation of a sustainable future for humanity are driven by innovation, in all its forms, as it is constantly present in all economic sectors.

Innovation, research and entrepreneurship are considered the main engines of economic development, with the first as the key factor for economic growth. Currently, the importance of innovation at both micro and macro levels is being strengthened by the economic crisis and international competition. Ensuring sustainable growth can only be achieved through continuous innovation processes. Entrepreneurs become the key players who turn ideas into new businesses, with new products / services for new markets. Starting new businesses is an effective tool for creating value from technology and research, which are based on creativity.

The following are mentioned as forms of creativity in the literature on inventions and innovations: discovery, invention and innovation.

In economics, the term "innovation" is approached by several authors from different perspectives. According to the Romanian Explanatory Dictionary, "innovation is novelty, change, transformation; solving a technical or work management problem in order to improve work (productivity), to improve technique or to streamline the activity". Innovation can be defined as: "the transformation of a new idea or concept into the final stage of a product, process or service activity accepted by the market, the result of which is to produce something else or to produce differently" (Rajnish Tiwari, 2012).

Depending on the object and subject of the research, innovation has been approached differently by foreign researchers. B. Twist, B. Santo and E. Mansfield treated innovation as a process: "... the global process of technological and commercial creativity, the transfer of a new idea or concept to the final stage of a new product, process or service accepted by the market" (Mansfield E., 1995).

From a technical and technological point of view, innovation is presented in F. Nixon's work and in the standards from the Oslo Handbook. Nixon believes that "innovation is a combination of technical, manufacturing and commercial activities that lead to the appearance on the market of new processes and equipment (OECD, 2005), and in the Oslo Handbook, innovation is "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (Baloiu L.& Frăsineanu I. & Frăsineanu C., 2001).

Another definition is found in the OECD Frascati Handbook, where innovation is defined as "the end result of innovation activity, represented by the set of scientific, technological, organizational, financial and commercial activities that involve investing in new knowledge meant to provide a new or improved product" (OECD, 2015).

In our opinion it is necessary to highlight the relationship between invention, innovation (activity) and innovation (result), and to highlight the differences between these concepts:

Invention is a discovery made for the first time, marking progress in a certain field (science, culture, economy, etc.). A creative solution to a technical or production-related problem, which introduces novelty or progress in relation to the known technological level worldwide. A solution or technological breakthrough in a field of knowledge, which introduces novelty and progress compared to the stage known until then (Baloiu L. & Frăsineanu I. & Frăsineanu C., 2001).

Innovation is the global process of technological and commercial creativity, the transfer of a new idea or concept to the final stage of a new product, process or service accepted by the market (Frăsineanu I., 2004).

Innovation can be defined as the result, the outcome of the innovation process, which aims at introducing the invention into social practice. This success is not only technological, but also economic, industrial, commercial, social and cultural (Mansfield E., 1995).

Therefore, innovation is a process of transforming invention or discoveries, which introduces novelty and progress in a field and results in new products or services usable in social practice (West, J.; Bogers, M.,2014). Innovation, in this context, can be defined as a new product, process or new / improved method, which has a practical usability and is the result of a creative process of transforming ideas into concrete things (Balland, P.A.; Boschma, R. & Frenken, K.,2015).

In the open innovation model, companies search for knowledge, which is a source of competitiveness and a prerequisite for successful participation in international trade and investment (McPhillips M., 2020).

The main source of innovation is science, namely fundamental and applied scientific research, the results of which are carried over into the production of material goods and services through technological development, technological engineering and the introduction of technical progress.

Research Methods. European Innovation Scoreboard 2020: The measurement framework

The annual innovation scoreboard (EIS-European Innovation Scoreboard) presents a comparative assessment of the research and innovation performance of EU member states and selected third countries, as well as the strengths and weaknesses of their research and innovation systems. It helps countries assess the fields into which they need to focus their efforts in order to achieve increased innovation performance. (The European Innovation Scoreboard reports have been published under the name "European Innovation Scoreboard" until 2009, as "Innovation Union Scoreboard" between 2010 and 2015, and again as "European Innovation Scoreboard" from 2016 onwards.)

For the European Innovation Scoreboard 2020 (which includes information for 2019) the measurement framework has not been significantly revised. Instead, it has largely followed the methodology of previous editions. The last major revision of the measurement framework took place in 2017.

As a result of the new developments in political priorities, economic theory and data availability, last year's measurement framework followed the revised methodology from 2017, which sought to cover the following needs:

• to better align the dimensions of the European Innovation Scoreboard with changing political priorities.

• to continuously improve the quality, timeliness and analytical soundness of indicators;

•to ensure that the European Innovation Scoreboard better captures increasingly important phenomena, in areas such as digitalization and entrepreneurship, and that it includes indicators on key areas such as human resources, skills and the relationship between science and business;

•to provide a contextual analysis of the data presented, by examining the effects of structural differences between member states, so as to build a consolidated evidence base for policy development.

We will continue by discussing the changes made to the European Innovation Scoreboard:

✓ The first change in the measurement framework involves regrouping the innovation dimensions in the European Innovation Scoreboard 2016 (Figure no. 1). The purpose is to better distinguish between framework conditions and investments in innovation, the innovation activities of enterprises and the impact of these activities.

✓ The second change was to add another dimension to better capture the business environment. Enterprises innovate in response to changes in their environment, in particular to new expansion opportunities or to threats from either existing enterprises or entrants. The results of the Community Innovation Survey show that most enterprises innovate to improve the quality of their products or services and to increase their range of products or their market share. Lack of internal funds, excessive innovation costs or lack of external funding are, for the majority of enterprises, the most important factors hindering their innovation activities. Also, the lack of qualified staff, the dominance of markets by start-ups and the uncertain demand for innovative goods or services are some of the factors hindering innovation. An "innovation-friendly" environment will act as a catalyst for the company to innovate or simply innovate more.

The European Union's set innovation goals stressed the need for means to quantify the results achieved by each country, means that would take into account the factors that determine and influence the level of innovation. In 2000, a complex index was proposed, consisting of several categories of indicators, called the European Innovation

Scoreboard; since then, it has undergone several changes and restructuring in order to better reflect the performance of EU member states and the factors which influence the results of innovation. In 2010 the name of the index was changed to the Innovation Union Scoreboard (innovation index), its structure and indicators being presented in Figure no. 2:

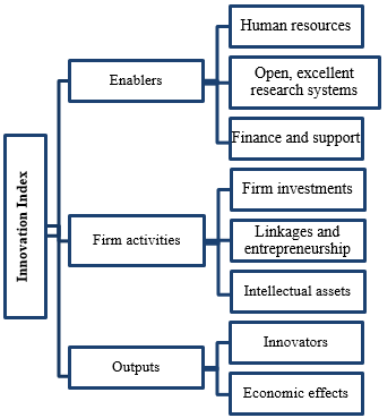

Figure 1. European Innovation Scoreboard 2016 – Structure and main indicators of the innovation index.
Source: *own processing based on https://ec.europa.eu/commission/presscorner/ detail/en/IP_20_1158*

✓ The third change involves dividing the European Innovation Scoreboard 2016, which measures economic effects, into two dimensions, one assessing the impact of employment and the other the impact of sales.

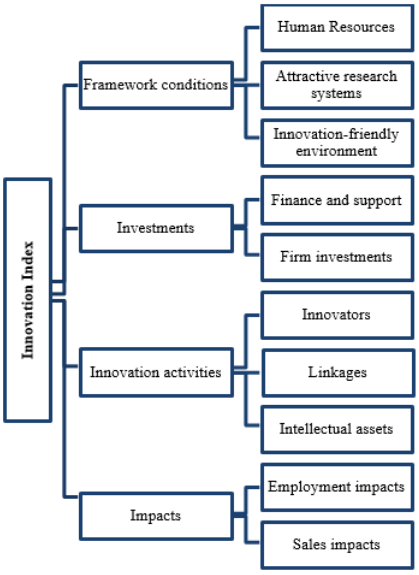

Figure 2. European Innovation Scoreboard 2017/2019 – Structure and main indicators of the innovation index.
Source: *own processing based on https://ec.europa.eu/commission/presscorner/ detail/ en/IP _20_1158*

Within each dimension, the performance of the research and innovation system is captured by two or three indicators. Table 1 summarizes the changes made, including the elimination of three indicators.

Table 1. Changes to the European Innovation Scoreboard 2020: eliminated, revised and new indicators

European Innovation Scoreboard 2016 Measurement framework	European Innovation Scoreboard 2019 Measurement framework
ENABLERS	**FRAMEWORK CONDITIONS**
Human resources	*Human resources*
1.1.1. New doctorate graduates	1.1.1. New doctorate graduates
1.1.2. Population aged 30-34 with tertiary education - REVISED	1.1.2. Population aged 25-34 with tertiary education - REVISED
1.1.3. Youth with at least upper secondary education - ELIMINATED	1.1.3. Lifelong learning - NEW
Open, excellent research systems	*Attractive research systems*
1.2.1. International scientific co-publications	1.2.1. International scientific co-publications
1.2.2. Top 10% most cited publications	1.2.2. Top 10% most cited publications
1.2.3. Non-EU doctorate students - REVISED	1.2.3. Foreign doctorate students - REVISED
Finance and support	*Innovation-friendly environment*
1.3.1. R&D expenditure in the public sector	1.3.1. Broadband penetration - NEW
1.3.2. Venture capital expenditures	1.3.2. Opportunity-driven entrepreneurship- NEW
FIRM ACTIVITIES	
Firm investments	**INVESTMENTS**
2.1.1. R&D expenditure in the business sector	*Finance and support*
2.1.2. Non-R&D innovation expenditures	2.1.1. R&D expenditure in the public sector
Linkages and entrepreneurship	2.1.2. Venture capital expenditures
2.2.1. SMEs innovating in-house	*Firm investments*
2.2.2. Innovative SMEs collaborating with others	2.2.1. R&D expenditure in the business sector
2.2.3. Public-private co-publications	2.2.2. Non-R&D innovation expenditures
Intellectual assets	2.2.3. Enterprises providing training to develop or upgrade ICT skills of their personnel - NEW
2.3.1. PCT patent applications	
2.3.2. PCT patent applications in societal challenges - ELIMINATED	
2.3.3. Trademarks applications - REVISED	
2.3.4. Design applications	
OUTPUTS	**INNOVATION ACTIVITIES**
Innovators	*Innovators*
3.1.1. SMEs with product or process innovations	3.1.1. SMEs with product or process innovations
3.1.2. SMEs with marketing or organizational innovations	3.1.2. SMEs with marketing or organizational innovations
3.1.3. Employment fast-growing enterprises of innovative sectors - REVISED	3.1.3. SMEs innovating in-house
Economic effects	*Linkages*
3.2.1. Employment in knowledge-intensive activities	3.2.1. Innovative SMEs collaborating with others
3.2.2. Medium and high-tech product exports	3.2.2. Public-private co-publications
3.2.3. Knowledge-intensive services exports - REVISED	3.2.3. Private co-funding of public R&D expenditures - NEW
3.2.4. Sales of new-to-market and new-to-firm product innovations	*Intellectual assets*
3.2.5. License and patent revenues from abroad - ELIMINATED	3.3.1. PCT patent applications
	3.3.2. Trademark applications - REVISED
	3.3.3. Design applications
	IMPACTS
	Employment impacts
	4.1.1. Employment in knowledge-intensive activities
	4.1.2. Employment fast-growing enterprises of innovative sectors - REVISED
	Sales impacts
	4.2.1. Medium and high-tech product exports
	4.2.2. Knowledge-intensive services exports- REVISED
	4.2.3. Sales of new-to-market and new-to-firm product innovations

All indicators have been carefully examined for their contribution to measuring the performance of member states' research and innovation systems. Some indicators in previous editions of the European Innovation Scoreboard have been eliminated not because of their irrelevance, but to ensure that the total number of indicators would be comparable to that of the European Innovation Scoreboard 2016 (27 indicators in EIS 2019 compared to 25 indicators in EIS 2016).

Analysis and discussion of the results. Evolution of the Innovation Index in the EU and Romania

In this part of our study, we analyze the situation of innovation in the EU member states (including Romania), with the help of its main indicators. To achieve this, we performed a comparative analysis of the situation of innovation, with the help of the main innovation indicators, for the period 2012-2019.

In terms of data sources and availability, statistics on science, technology and innovation were used, which are based on a new European Commission Regulation (EU) no. 995/2012 on the elaboration and development of community statistics regarding science and technology.

Eurostat statistics on R&D expenditure are compiled using the guidelines set out in the Frascati Manual published in 2002 by the Organization for Economic Co-operation and Development (OECD). The manual has recently been updated with improved guidelines reflecting changes in the way R&D is funded and implemented in globalized economies. For example, new sections covering various aspects of public support for research and development (such as tax incentives) have been added.

On average, since 2012 EU innovation performance has increased by almost nine percentage points, mainly due to strong performance increases related to the following indicators: broadband penetration, international scientific co-publications and non-R&D innovation expenditures. Since 2012, innovation performance has increased in 24 EU countries and decreased in only three of them. The highest increase has been recorded in Lithuania, Latvia, Portugal and Greece, while the largest decrease has been recorded in Slovenia and Romania. The EU convergence process, in which lower-performing countries are on a faster growth path than higher-performing countries, continued in 2019.

Member states are classified into four performance groups based on their average performance scores (Figure no. 3). Luxembourg, Belgium, Denmark, Finland, Germany, the Netherlands and Sweden are part of the performance group called Innovation Leaders, which have an advanced level of innovation performance, well above the EU average. Austria, France, Ireland, Estonia and Slovenia are part of the Strong Innovators group, with a level of performance above or close to the EU average. Croatia, Cyprus, the Czech Republic, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia and Spain register a performance level below the EU average and fall into the group of Moderate Innovators. Romania and Bulgaria have performed below the EU average and are Modest Innovators.

Statistics on European Innovation show that Romania is still far, even from its own performance in 2012: had we compared the results of 2019 to the EU average of 2012, the index would have been 34.4, compared to 40.2, as it had then compared to the EU average.

While the EU average increased by almost nine percentage points compared to 2012, Romania's performance decreased by 5.7 percentage points, being surpassed in this respect only by Slovenia (minus 9.9 percentage points).

Table no. 2. The performance of the Innovation Index in 2019 compared to the EU performance in 2012.

Country/Group	The performance of the Innovation Index in 2019 compared to the EU performance in 2012
EU27_2020	107,4
Belgium/ Innovation Leaders	130,2
Bulgaria/ Modest Innovators	48,8
Czechia/ Moderate Innovators	90,5
Denmark / Innovation Leaders	144,4
Germany/ Innovation Leaders	128,7
Estonia/ Strong Innovators	106,3
Ireland/ Strong Innovators	120,3
Greece/ Moderate Innovators	82,3
Spain/ Moderate Innovators	91,4
France/ Strong Innovators	112,2
Croatia/ Moderate Innovators	63,1
Italy/ Moderate Innovators	88,9
Cyprus/ Strong Innovators	95,4
Latvia/ Moderate Innovators	67,7
Lithuania/ Moderate Innovators	85,6
Luxembourg/ Innovation Leaders	135,3
Hungary/ Moderate Innovators	71,3
Malta/ Moderate Innovators	90,2
Netherlands/ Innovation Leaders	137,2
Austria/ Innovation Leaders	126,1
Poland/ Moderate Innovators	63,2
Portugal/ Strong Innovators	103,8
Romania/ Modest Innovators	33,9
Slovenia/ Moderate Innovators	91,2
Slovakia/ Moderate Innovators	71,5
Finland/ Innovation Leaders	150,2
Sweden/ Innovation Leaders	151,0
Iceland/ Strong Innovators	122,5
United Kingdom/ Innovation Leaders	129,8

Source: *Eurostat 2020, https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_1150*

Romania's great handicaps are human resources and companies' investments in research and development – indicators which place the country far behind other states, on the penultimate place. In lifelong learning, Romania scores 0% of the EU average, and in exports of knowledge-based services only 56%.

The other three indicators where Romania scores zero are: product and process innovations in SMEs, marketing or organizational innovations in SMEs and SMEs which innovate in-house.

Unfortunately, the statistics regarding the evolution in Romania show an alarming deterioration of some sub-indicators. For example, the number of researchers decreased by 4.6% in 2019 compared to 2017, the investments of private companies in Research, Development and Innovation (RDI) decreased by 51% in 2019 compared to 2011, while the number of SMEs involved in the innovation process decreased by 42.5% in 2019 compared to 2011.

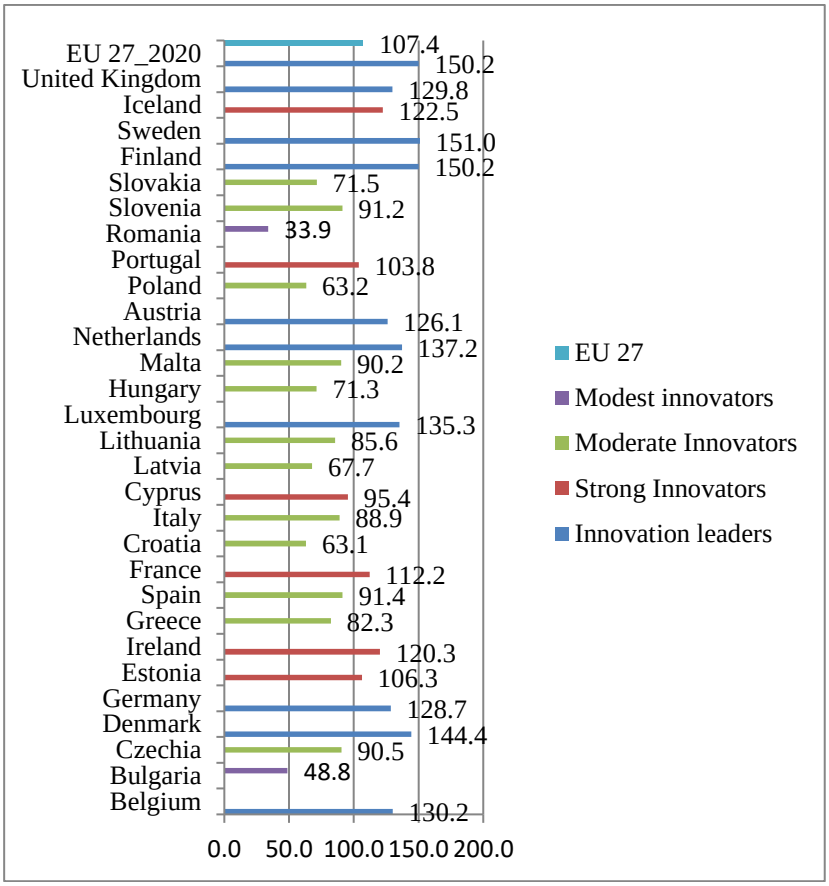

Figure 3. The performance of the Innovation Index in 2019 compared to the EU performance in 2012.
Source: *Eurostat, 2020. https://ec.europa.eu/commission/presscorner/detail/en/QANDA_20_1150*

Analysis and discussion of the results. Evolution of research and development expenditure in the EU

Research and development expenditure in EU countries, as a percentage of the GDP, stood at 2.19% in 2019 (compared to 2.18% in 2018 and 1.97% in 2009). Romania scores last in this respect, with less than 1% of the GDP.

Research and development is a key driver of innovation, and R&D expenditure together with the share of GDP allocated to research are two indicators used to monitor the resources allocated to science and technology globally.

In 2019, the 27 EU member states spent more than 306 billion euros on research and development. Compared to other major economies, the share of GDP allocated by the EU is lower than in South Korea (4.52% in 2018), Japan (3.28% in 2018) and the USA (2.82% in 2018) but is at the same level as China (2.06% in 2018), higher than in the UK (1.76%) and much higher than in Russia (1.03%) and Turkey (1.03% in 2018).

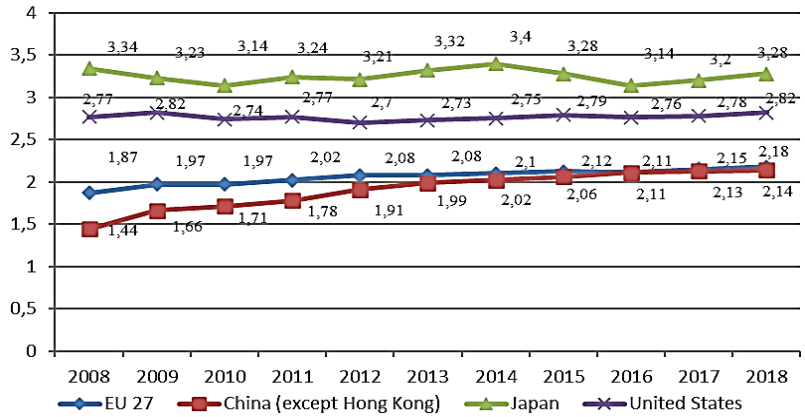

Figure 4. Gross domestic expenditure on Research and Development, 2008-2018.
Source: *Eurostat, 2020, https://ec.europa.eu/eurostat/statisticsexplained/index.php?title=File:Gross_domestic_expenditure_on_R%26D,_2008_and_2018_(%25,_relative_to_GDP)_final_F2.png&oldid=503694*

Table no. 4. The GDP expenditure on R&D in 2018 and 2019 compared to 2008 (percentage of the GDP).

	2008	2018	2019
EU-27	1,87	2,18	2,19
Sweden	3,47	3,32	3,39
Austria	2,57	3,14	3,19
Germany	2,62	3,12	3,17
Denmark	2,77	3,03	2,96
Finland	3,54	2,76	2,79
Belgium	1,94	2,68	2,89
France	2,06	2,19	2,19
Netherlands	1,62	2,14	2,16
Slovenia	1,63	1,95	2,04
Czechia	1,23	1,9	1,94
Hungary	0,98	1,53	1,48
Italy	1,16	1,43	1,45
Estonia	1,25	1,41	1,61
Portugal	1,44	1,36	1,4
Spain	1,33	1,24	1,14
Luxembourg	1,62	1,21	1,19
Poland	0,6	1,21	1,32
Greece	0,66	1,18	1,27
Ireland	1,39	0,99	0,78
Croatia	0,89	0,97	1,11
Lithuania	0,79	0,94	0,99
Slovakia	0,46	0,84	0,83
Bulgaria	0,45	0,76	0,84
Latvia	0,58	0,64	0,64
Cyprus	0,39	0,63	0,63
Malta	0,53	0,6	0,61
Romania	0,55	0,5	0,48

Source: Eurostat, 2020, http://ec.europa.eu/eurostat/statistics-explained/index.php/R_%26_D_expenditure

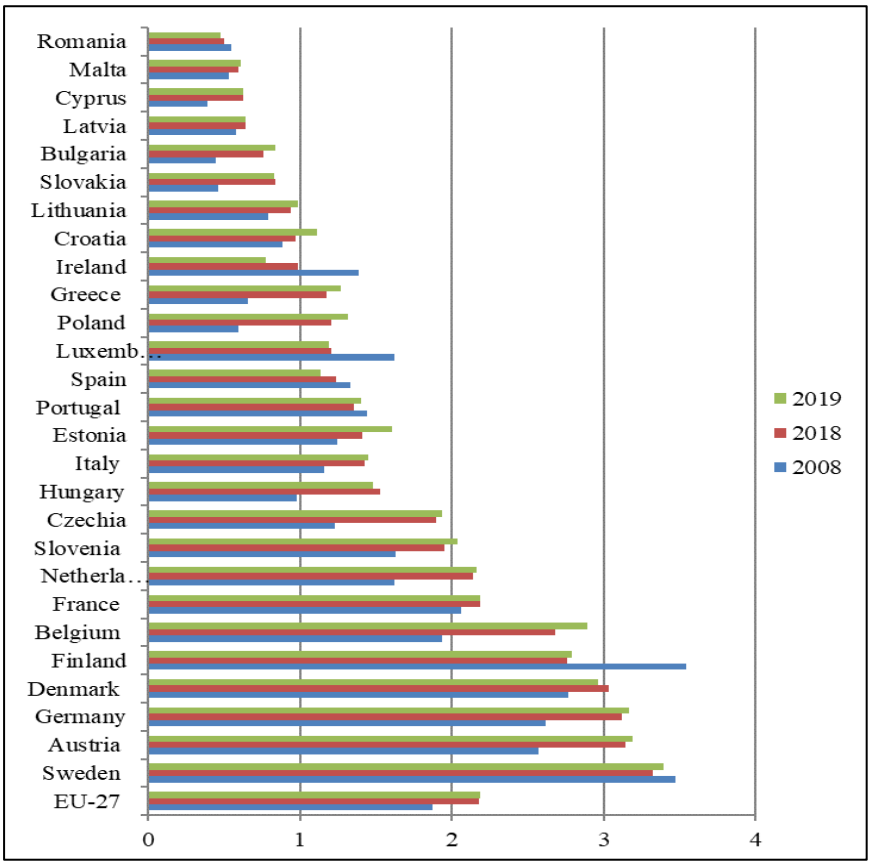

Figure 5. The GDP expenditure on R&D in 2019 compared to 2018 and 2008 (percentage of the GDP).
Source*: Eurostat, 2020, http://ec.europa.eu/eurostat/statistics-explained/index.php/R_%26_D_expenditure*

In 2019, the highest GDP expenditures on research and development, of over 3%, were in Sweden (3.39%), Austria (3.19%) and Germany (3.17%). These countries are followed by Denmark (2.96%), Belgium (2.89%) and Finland (2.79%), therefore close to 3% (Figure no. 5).

Most of the research and development expenditure went to the enterprise and business ideas sector: 66% of the total R&D allocated in 2019, followed by the higher education sector (22%), the government sector (11%) and the private not-for-profit sector (1%).

On the other hand, eight member states allocated less than 1% of GDP to research and development expenditures: Romania (0.48%), Malta (0.61%), Cyprus (0.63%), Latvia (0.64%), Ireland (0.78%), Slovakia (0.83%), Bulgaria (0.84%) and Lithuania (0.99%).4

In the last ten years, the share of GDP allocated to research and development expenditure has increased in 19 member states, the most significant growth being recorded in Belgium (from 2% of GDP in 2009 to 2.89% in 2019, an increase of 0.89 percentage points (pp), Poland (0.66 pp), the Czech Republic (0.65 pp) and Greece (0.64 pp).

In contrast, the share of GDP allocated to research and development expenditure decreased in six member states, with the most significant decline being in Finland (minus 0.94 pp) and Ireland (minus 0.83 pp), while in France and Sweden it remained stable.

Analysis of the relationship between the Innovation Index and the percentage of GDP allocated to research and development in 2019, based on the Pearson coefficient.

In our research, we noticed that the countries which allocate higher percentages of GDP to research and innovation also have better results i.e., they register higher values of the Innovation Index than those which spend less in this sector. This relationship is represented in the figures below (*Figure no. 6* and *Figure no. 7*).

Table 5. Comparative presentation of the Innovation Index versus Percentage of GDP allocated to research and development in 2019

	Summary Innovation Index 2019	Gross domestic expenditure on R&D 2018	Gross domestic expenditure on R&D 2019
EU27_2020	107,40	2,18	2,19
Belgium	130,20	2,68	2,89
Bulgaria	48,80	0,76	0,84
Czechia	90,47	1,90	1,94
Denmark	144,38	3,03	2,96
Germany	128,70	3,12	3,17
Estonia	106,27	1,43	1,61
Ireland	120,26	0,99	0,78
Greece	82,34	1,18	1,27
Spain	91,37	1,24	1,14
France	112,19	2,19	2,19
Croatia	63,11	0,97	1,11
Italy	88,91	1,43	1,45
Cyprus	95,44	0,63	0,63
Latvia	67,68	0,64	0,64
Lithuania	85,59	0,94	0,99
Luxembourg	135,27	1,21	1,19
Hungary	71,30	1,53	1,48
Malta	90,20	0,60	0,61
Netherlands	137,18	2,14	2,16
Austria	126,12	3,14	3,19
Poland	63,19	1,21	1,32
Portugal	103,84	1,41	1,40
Romania	33,93	0,50	0,48
Slovenia	91,16	1,95	2,04
Slovakia	71,49	0,84	0,83
Finland	150,15	2,76	2,79
Sweden	151,04	3,32	3,39
United Kingdom	129,80	1,73	1,76

***Source**: Eurostat, 2020, https://ec.europa.eu/eurostat/statisticsexplained/index.php?title=File:Gross_domestic_expenditure_on_R%26D,_2008_and_2018_(%25,_relative_to_GDP)_final_F2.png&oldid=503694*

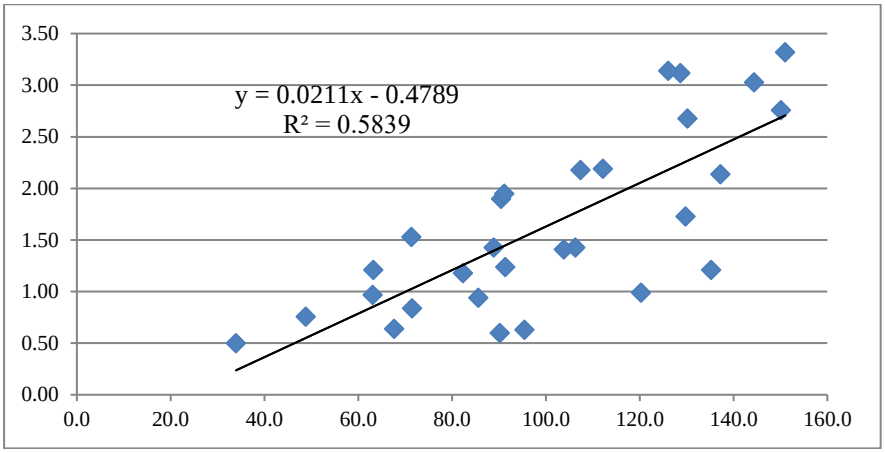

Figure 6. The relationship between the Innovation Index 2018
and the percentage of GDP allocated to research and development in 2018.

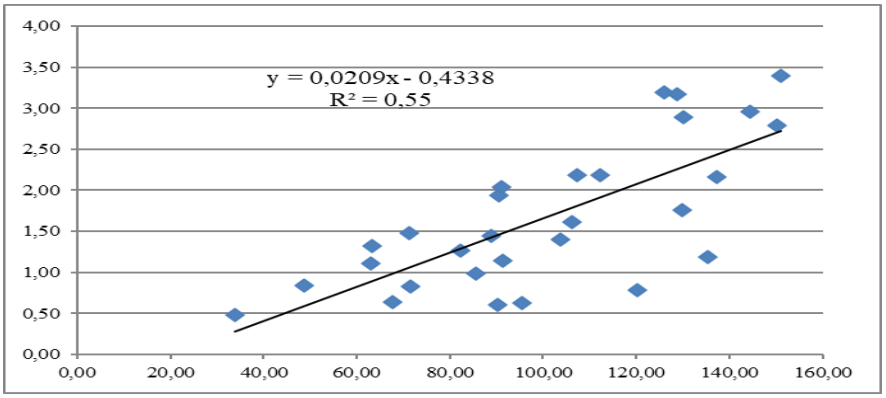

Figure 7. The relationship between the Innovation Index 2019
and the percentage of GDP allocated to research and development in 2019.

Table 6. The evolution of the Pearson correlation coefficient

	Pearson correlation coefficient
Correlation between the Summary Innovation Index and the Gross Domestic Expenditure on R&D in 2018	0,764
Correlation between the Summary Innovation Index and the Gross Domestic Expenditure on R&D in 2019	0,742

From the figure and data presented above, it can be seen that for most EU countries there is a clear relationship between the percentage allocated to research and innovation and the value of the Innovation Index. However, there are also certain exceptions, such as

Luxembourg or Ireland, with high values of the index, despite a lower percentage of GDP expenditure.

To measure the strength of the relationship between the percentage of GDP spent on research and development and the Innovation Index in EU countries, we calculated the Pearson correlation coefficient using SPSS for Windows.

The value of the Pearson correlation coefficient was 0.764 (for 2018) and 0.742 (for 2019) respectively, which shows a strong relationship, of a directly proportional nature, between the two variables analyzed: the percentage of GDP allocated to research and innovation and the Innovation Index. As indicated by the software, the value obtained is statistically significant.

From the point of view of the determination coefficients / mean square deviations (R2), we notice the return of a value of 0.58 at the level of 2018 and, respectively, 0.55 at the level of 2019, which highlights an interconditioning of approximately 55% -60% between two variables, on the two intervals under analysis.

The results show that a country which allocates a higher percentage for research, development and innovation has a higher Innovation Index as well. The amounts allocated in this field can be used to increase the values of other indicators taken into account in the calculation of the innovation index.

CONCLUSIONS

Research and innovation have a major role to play in the lives of Europeans, as they can improve their living and working conditions, create new jobs, and improve Europe's overall competitiveness. As research and innovation gain access to areas such as transport, healthcare, and stimulate the enhancement of many new products and services, there is an increase in the quality of life.

Despite the economic crisis of recent years, the European Union and its member states have managed to maintain their level of knowledge competitiveness. Nonetheless, the European Union is facing strong international competition in research and technological production. As a consequence, greater efforts are needed to stimulate new ideas that can be materialized in the form of new products and technologies. Through a collaborative approach, many funding policies and programs can be implemented, in addition to national policies.

The importance of the innovation policy is widely recognized. It is also closely linked to other EU policies, such as those regarding competitiveness, the environment, employment, industry and energy. The aim of innovation is to transform research results into new and better services and products, in order to remain effective on the world market and to improve the quality of life for European citizens.

The development of the European Union and of each member state cannot be achieved without scientific contribution and innovation, regarded as the key elements through which the Union can ensure its evolution and close the gap that separates it from the USA and Japan, as the main competitors in the market. The EU policy and the strategies implemented or in the process of implementation clearly promote the importance of innovation in all areas of activity and call on the member states to be actively involved in providing financial, scientific and logistical support.

At the heart of a thriving national economy lies solid and innovative entrepreneurship. The development of entrepreneurship requires the creation and development of a strong infrastructure, which will solve some of the main current

hindrances, namely the lack of efficient networking between the participants in the innovation process, the lack of information transparency, low innovation drive, limited funding and commercialization of innovations, because the effectiveness of innovation processes depends not only on the activity of the participants involved, but also on their interaction. We are of the opinion that strengthening the innovation infrastructure is a must, as it will intensify research and development so as to fulfill real needs and will help establish effective communication between the participants in the innovation process. Supporting and funding these research and development activities would create conditions for the development of more competitive innovations in this market.

It can be concluded that financial support is the key to productive scientific research and innovation for any member state of the European Union.

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