ANALYSIS OF THE EVOLUTION OF INNOVATION IN THE EUROPEAN UNION BASED ON THE INNOVATION UNION SCORED

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Abstract:

In order to cope with the fierce competition at international level, the European Union has become aware of the need to implement innovation in the fields of the creative economy and beyond. Thus, we can say that at the level of the European Union, innovation is considered to be the driving force for future growth and sustainable development, and is now associated with all types of activities and not just the recognized industries for the promotion of new ones such as software, electronics, biotechnology, telecomunications.

In order to enhance research and innovation, two strategies (one already completed and the other under implementation) have been implemented at Union level whereby Member States have focused their efforts on supporting, developing and promoting those activities that lead to sustained development, on an innovative basis.

In view of the above mentioned considerations, we have selected this issue of innovation as a research topic in the bachelor thesis. This research aims to present the role and importance of innovation in the Lisbon and Europe 2020 Strategies and to analyze the levels of innovation achieved by the Member States through the Innovation Index - a complex and modern tool for quantifying innovation at Union level.

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

JEL Classification : O31, O52, O10

1. Measurement framework of the European Innovation Scoreboard 2017

For the European Innovation Scoreboard 2017, the measurement framework has been revised significantly. The European Innovation Scoreboard of 2016 largely followed the methodology of previous editions. The last major revision of the measurement framework was introduced in 2010 with the launch of the Innovation Union.

As a result of new developments in political priorities, economic theory and data availability, the measurement framework of last year needed adjustment. The framework review started in 2016 and has been discussed in various forums, including an expert workshop, various meetings of the Enterprise Policy Group Innovation Subgroup, a presentation in the Committee of the European Space for Research and Innovation European Research and Innovation Area Committee) in plenary and a workshop under its auspices. In particular, for the current edition of 2017, there were the following:

• Better align the dimensions of the European Innovation Scoreboard to changing policy priorities;

• Continually improve the quality, timeliness and analytical solidity of the indicators;

• Ensure that the European Innovation Scoreboard captures the increasingly important phenomena, including in areas such as digitization and entrepreneurship, and includes indicators on key areas such as human resources, competences and links between science and business;

• Provide a contextual analysis of the data presented, examining the effects of structural differences between Member States, to provide a reinforced evidence base for policy-making.

2. Evolution of components of the EU Innovation Index

In the following we aimed to analyze the situation of innovation in the European Union countries, with the main indicators, as well as Romania's position in the hierarchy. The state of innovation will be analyzed from 2009 to 2016.

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To achieve the objectives, we conducted a comparative analysis of the innovation situation, using the main innovation indicators, for the period 2009-2016.

As regards sources and availability of data, statistics on science, technology and innovation were used, which are based on Decision No 1608/2003 / EC of the European Parliament and of the Council on the production and development of Community statistics on science and technology. The decision was implemented by the European Commission as Regulation (EC) no. 753/2004 on statistics on science and technology, adopted in 2004. In 2012, a new European Commission (EU) Regulation no. 995/2012 on the development and development of Community statistics on science and technology.

Eurostat R & D expenditure statistics are compiled using the guidelines set out in the Frascati Manual, published in 2002 by the Organization for Economic Cooperation and Development (OECD). The Handbook has recently been updated through improved guidelines reflecting changes in how R & D is funded and realized in globalized economies, for example with new sections covering the different aspects of public R & D support (such as tax incentives).

Member States are classified into four performance groups based on their average performance scores.

Based on average performance scores, which are calculated by an indicator, the innovation index, Member States fall into four different performance groups (Figure 1). Denmark, Finland, Germany, the Netherlands, Sweden and the United Kingdom are part of the innovation leadership group, which has an advanced level of innovation performance well above the EU average. Austria, Belgium, France, Ireland, Luxembourg and Slovenia are among the strong innovators, with a level of performance above or close to the EU average. The performances of Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia and Spain are below the EU average, these countries being part of the moderate innovation group. Romania and Bulgaria have recorded performances below the EU average, and they are among the modest innovators.

Performance has grown for the EU, but we can not say the same for Member States. Compared to 2010, the innovation performance of the European Union increased by 2 percentage points. There are different results at the level of each Member State, in 15 countries we are experiencing performance gains, and in 13 countries we have a decline in performance. Performance grew most in Lithuania, Malta, the Netherlands and the United Kingdom and fell just as much in Cyprus and Romania.

By comparing the Member States of the European Union with other European countries and neighboring countries, Switzerland remains the most innovative country in Europe. Iceland, Israel and Norway are powerful innovators that exceed the EU average, Serbia and Turkey are moderate innovators, and the former Yugoslav Republic of Macedonia and Ukraine are fashionable innovators.

Within 2 years, it is estimated that the European Union's innovation performance will increase by 2 percentage points. Last year's report introduced, for the first time, an analysis of the European Union's performance in innovation, discussing the latest developments, trends and changes expected. This exercise is repeated this year, using the revised measurement framework. The analysis shows the performance of EU trends on 19 indicators, for which a robust calculation of short-term changes proved possible.

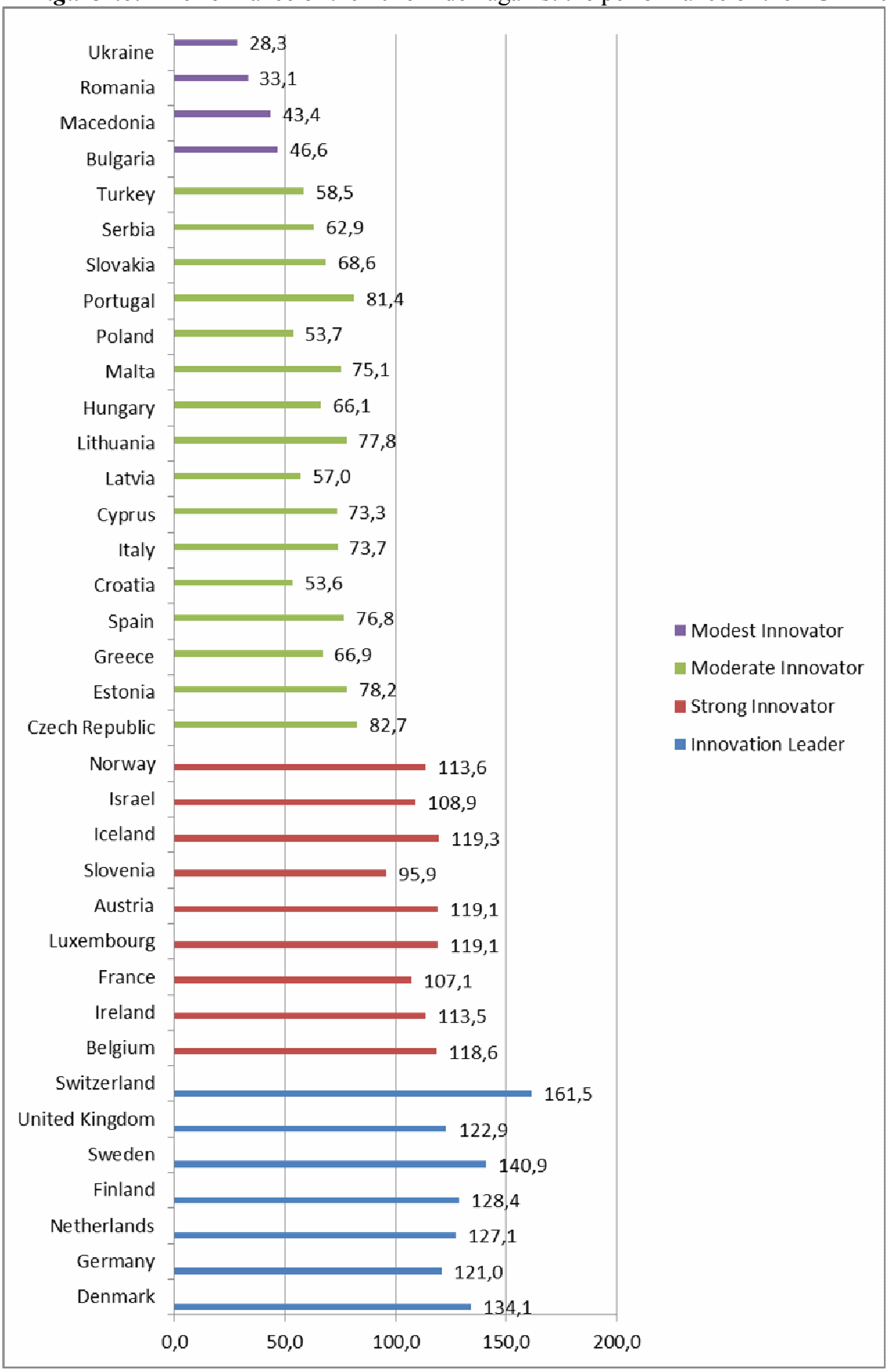
Performance improvement is expected for 12 of these indicators and performance drops for 6 indicators. Overall, the performance of EU innovation, relative to its 2020 performance, is expected to grow from 102% this year to 104% over the next two years. This analysis also includes a comparison of the EU's trends and its main competitors. Worldwide, the trends observed in recent years are expected to continue, while the EU performance gap with Japan and South Korea is rising and its leadership towards China further declining.

Table no. 1. Performance of the 2016 Index against the performance of the EU in 2016

Country	Innovation Score Performance in 2016 in relation to EU performance in 2016	Degree of innovation
EU	100,0	
Belgium	118,6	Strong innovators
Bulgaria	46,6	Modest innovators
Cech Republic	82,7	Moderate innovators
Denmark	134,1	Innovation Leaders
Germany	121,0	Innovation Leaders
Estonia	78,2	Moderate innovators
Irlanda	113,5	Strong innovators
Greece	66,9	Moderate innovators
Spain	76,8	Moderate innovators
Frace	107,1	Strong innovators
Croatia	53,6	Moderate innovators
Italy	73,7	Moderate innovators
Ciprus	73,3	Moderate innovators
Letonia	57,0	Moderate innovators
Lithuania	77,8	Moderate innovators
Luxemburg	119,1	Strong innovators
Hungary	66,1	Moderate innovators
Malta	75,1	Moderate innovators
Nederland	127,1	Innovation Leaders
Austria	119,1	Strong innovators
Poland	53,7	Moderate innovators
Portugalia	81,4	Moderate innovators
Romania	33,10	Modest innovators
Slovenia	95,9	Strong innovators
Slovacia	68,6	Moderate innovators
Finland	128,4	Innovation Leaders
Sweden	140,9	Innovation Leaders
United Kingdom	122,9	Innovation Leaders
Island	119,3	Strong innovators
Israel	108,9	Strong innovators
Macedonia	43,4	Modest innovators
Norwey	113,6	Strong innovators
Serbia	62,9	Moderate innovators
Switzerland	161,5	Innovation Leaders
Ukraine	28,3	Modest innovators
Turkey	58,5	Moderate innovators

Source: Eurostat, 2018, https://ec.europa.eu/docsroom/documents/24829

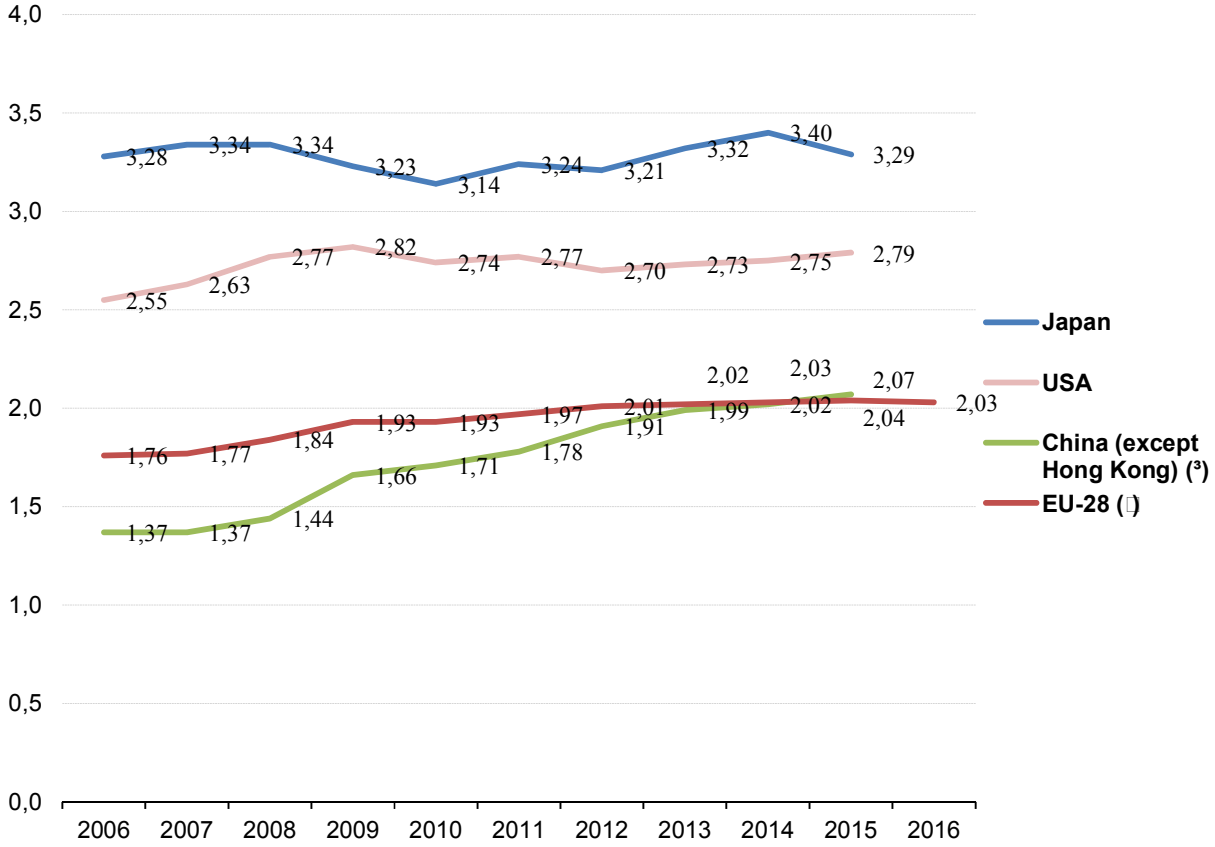
Figure no.1 Performance of the 2016 Index against the performance of the EU in 2016



Source: Eurostat, 2018, https://ec.europa.eu/docsroom/documents/24829

In 2015, R & D spending in the EU-28 was equivalent to two-thirds (66.6%) of those recorded by the United States, while EU R & D expenditure was 48.5% higher higher than in China, more than double the spending in Japan and more than five times higher than in South Korea. These figures are based on euro-denominated information and the depreciation of the euro (for example, against the dollar) can explain part of the movements of these reports over time. To make the figures comparable, gross domestic R & D expenditure is often expressed in terms of GDP or relative to the population.

Figure no.2. Share of R & D expenditures in GDP over 2006-2016



Source: Eurostat, 2018, http://ec.europa.eu/eurostat/statistics-explained/index.php/R%26_D_expenditure

The share of R & D expenditure in GDP, one of the five key indicators of the Europe 2020 strategy, is also used to quantify the intensity and level of R & D. This ratio increased modestly in the EU-28 over the period 2006-2012, rising from 1.76% to 2.01%. Between 2012 and 2016 it grew more slowly, fluctuating in the range of 2.01-2.04%. Despite these increases, EU-28 spending on R & D relative to GDP remained well below the corresponding rates in Japan (3.29%, 2015 data) and the United States (2.79% 2015) for a long time. In 2015, China's R & D intensity exceeded that of the EU-28, with Chinese R & D spending equivalent to 2.07% of GDP.

Between 2006 and 2015, there was a fluctuating pattern of R & D spending in the Japanese economy, as the R & D expenditure ratio was 3.14-3.40%. In the United States, the ratio of gross domestic R & D expenditure to GDP rose from 2.55% in 2006 to a peak of 2.82% in 2009, an increase of 0.27%. In 2010, research and development intensity in the United States fell to 2.74%, and in 2012 there was a further reduction; Subsequently, research and development intensity in the United States began to rise again, reaching 2.79% by 2015. China's R & D intensity grew faster than rates for the EU and other countries in the period presented in Figure no.2 , rising from 1.37% in 2006 to 2.07% by 2015, an increase of 0.70 percentage points.

Table no.2. Share of R & D expenditure in GDP in 2016 as compared to 2006 (percentage of GDP)

	2006	**2016**
EU-28	1,76	2,03
Euro Zone	1,80	2,13
Sweden	3,50	3,25
Austria	2,36	3,09
Germany	2,46	2,94
Denmark	2,40	2,87
Finland	3,34	2,75
Belgia	1,81	2,49
France	2,05	2,25
Netherlands	1,76	2,03
Slovenia	1,53	2,00
United Kingdom	1,59	1,69
Czech Republic	1,23	1,68
Italy	1,09	1,27
Estonia	1,12	1,28
Portugal	0,95	1,27
Luxembourg	1,67	1,24
Hungary	0,98	1,21
Spain	1,17	1,19
Irland	1,20	1,18
Greece	0,56	1,01
Poland	0,55	0,97
Croatia	0,74	0,85
Lithuania	0,79	0,85
Slovacia	0,48	0,79
Bulgaria	0,45	0,79
Malta	0,58	0,61
Ciprus	0,38	0,50
Romania	0,45	0,48
Latvia	0,65	0,44
Island	2,92	2,08
Switzerland	2,71	3,37
Norwey	1,46	2,03
Serbia	na	0,89
Turkey	0,56	0,88
Macedonia	na	0,43
Montenegro	na	0,37
Bosnia and Herzegovina	na	0,26
South Coreea	2,83	4,23
Japan	3,28	3,29
USA	2,55	2,79
China (except Hong Kong)	1,37	2,07
Russia	1,01	1,10

Source: Eurostat, 2018, http://ec.europa.eu/eurostat/statistics-explained/index.php/ R_%26_D _expenditure

Among the Member States of the European Union, the highest levels of R & D expenditure in GDP in 2016 were recorded in Sweden (3.25%) and Austria (3.09%). These were the only Member States that reported a level above 3.00% in 2016; Important weightings

were also recorded in Germany (2.94%), Denmark (2.87%) and Finland (2.75%). There were nine Member States reporting R & D expenditure below 1.00% of GDP in 2016, each of which were Member States that joined the European Union in 2004 or more recently with the lowest intensity of research - development in Cyprus (0.50%), Romania (0.48%) and Latvia (0.44%)) (Tabel no.3.).

Most EU Member States reported a higher share of R & D expenditure in GDP in 2016 than in 2006: there were five exceptions, including two high-Finland (-0.59 percentage point) and Sweden (-0.25 percentage points), while the other three Member States registering decreases registered R & D intensity levels in GDP below the EU-28 average, Luxembourg (-0.43 points), Latvia (-0.21) and Ireland (where there was almost no change), -0.02 points). At the other end of the interval, the highest increases in R & D levels (in percentage points of GDP) between 2006 and 2016 were recorded in Austria (0.73 points), Belgium (0.68 points), Germany (0, 48 points), Denmark, Slovenia (both 0.47 points), the Czech Republic and Greece (both 0.45 points).

3. Analyze the relationship between the Innovation Index and the percentage of GDP allocated to R & D in 2016 based on the Pearson coefficient

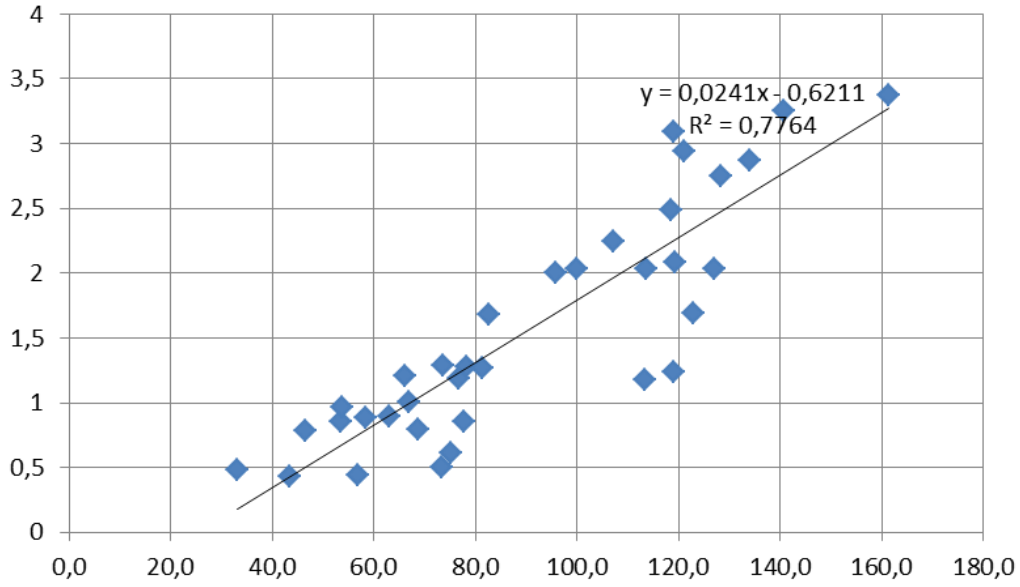
In our research we noticed that states allocate higher percentages of GDP for research - innovation, and they have higher results, ie they record higher values of the innovation index than those who spend little in this sector. This relationship of correspondence is represented in Figure no. 3.

Tabel nr.3. Comparative presentation Innovation Score (Index) vs. Procent of GDP allocated to research and development in 2016

Country	Innovation Score (Index) 2016	Procent of GDP allocated to R&D (2016)
EU	100,0	2,03
Belgium	118,6	2,49
Bulgaria	46,6	0,78
Czech Republic	82,7	1,68
Denmark	134,1	2,87
Germany	121,0	2,94
Estonia	78,2	1,28
Irland	113,5	1,18
Greece	66,9	1,01
Spania	76,8	1,19
France	107,1	2,25
Croatia	53,6	0,85
Italy	73,7	1,29
Ciprus	73,3	0,5
Letonia	57,0	0,44
Lithuania	77,8	0,85
Luxembourg	119,1	1,24
Hungary	66,1	1,21
Malta	75,1	0,61
Nederland	127,1	2,03
Austria	119,1	3,09

Country	Innovation Score (Index) 2016	Procent of GDP allocated to R&D (2016)
Poland	53,7	0,97
Portugal	81,4	1,27
Romania	33,1	0,48
Slovenia	95,9	2
Slovakia	68,6	0,79
Finland	128,4	2,75
Sweden	140,9	3,25
Great Britain	122,9	1,69
Macedonia	43,4	0,43
Serbia	62,9	0,89
Turkey	58,5	0,88
Island	119,3	2,08
Norwey	113,6	2,03
Switzerland	161,5	3,37

Figura nr. 3.. The relationship between the Innovation Index and the share of GDP allocated to research and development in 2016



	Pearson correlation coefficient
Innovation Index 2016 and Percentage of GDP allocated to R&D (2016)	**0,881141585**

From the figure and data presented above, it can be seen that for most of the EU Member States there is an obvious link between the research-innovation share and the value of the innovation index, but there are also some exceptions such as Ireland or the United Kingdom have high index values, with a lower GDP contribution.

To measure the intensity of the link between the share of GDP spent on R & D and the innovation index in the European Union, we calculated the Pearson correlation coefficient with SPSS for Windows.

The value of the Pearson correlation coefficient resulted in 0.881, which shows a strong link between the two variables analyzed - the percentage of GDP allocated to research and innovation and the innovation index. As the program indicates, the value obtained is statistically significant.

The results show that a country that allocates a higher percentage for research - development - innovation also gets a higher Innovation Index. Amounts allocated for this area can be used to increase other indicators that are taken into account in the innovation index.

4. Conclusions

Despite the economic crisis in recent years, the European Union and the Member States have managed to maintain their level of competitiveness in terms of knowledge. However, the European Union has strong international competition on research and technological production. This requires more effort to make the new ideas happen and thus materialize through new products and new technologies. With collaboration, many policies and funding programs can be made, alongside their own Member State policies.

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

The development of the European Union and individual Member States can not be done without scientific input and innovation, considered key elements by which the Union can ensure its upward trend and recover from the gap with the US and Japan as the main competitors on the market. EU policy and strategies implemented or underway clearly promote the importance of innovation in all areas of activity and calls on Member States to actively engage in providing financial, scientific and logistical support. It can be concluded that financial support is the basic element for scientific research and effective innovation for any state in the union.

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