ANALYSIS OF THE EUROPEAN UNION'S SCIENCE AND TECHNOLOGY STRATEGY

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Abstract

In this article, the authors have explored how the European Union and the Member States are working towards the development of science, technology and innovation, in order to improve the quality of economic activity. In this context, the provisions of the European Union Strategy until 2020, launched in October 2010, are analyzed. The focus is on presenting the data on the spending of the European Union and each Member State in the field of research and development. To be relevant, these data are also compared with the indicators in this area of other high-standard economies such as the U.S., Japan and China. As a result, the largest share of R & D spending in the Gross Domestic Product is recorded by Japan, around 4.0-4.2% in the period 2013-2016. In all EU Member States, spending on research and development increased year-on-year from 2004 to 2014, as shown by graphical representation. Data was provided on the staff involved in this activity in the European Union as well as in each Member State.

Keywords: *research, innovation, science, strategy, innovative union*
JEL Classification: O31, O32

Introduction

EU statistics on science, technology and innovation cover a sufficiently important range, being called R & D activity. In this respect, the development of innovation, science and technology implies a better and more consistent use of human resources. Science is part of the development of society. Only through the development of science, ie innovation, inventions, in all fields is provided the foundation for the economic progress of each country. Europe has a long tradition of research and innovation, with many prestigious and high-efficiency projects in the industrial, biology, pharmaceutical, telecommunication or aerospace industries. As a rule, R & D is always considered to be the tip of

the lance that is behind the economic growth and the increase of the number of places both in the field of creation and in the field of economic activity. However, expanding the influence of research in the economic sphere ensures the protection of the environment, the international business environment, and the improvement of the quality of the products made in all fields, especially in the field of medicine, which ensures, through the progress achieved, a much higher state of health people in each country. In October 2010, the European Union launched the development program by 2020, the program called the Innovation Union, which aims to develop the research climate in the fields of energy, food security, health and the quality of life of the population. In the European Union, innovations are monitored and implemented through this Innovative Union. In this field, non-EU countries have also been attracted, considering, on the one hand, the possibility of attracting other countries to the European Union, or attracting other specialists, other specialists, other countries that have a tradition in this area.

Literature review

Buesaa, Heijsa, and Baumert (2010) analyze the determinants of regional innovation in Europe. Isaic-Maniu, Anghelache, Mitruţ, and Voineagu (2007) analyze the evolution of research, development and innovation activity in Romania. Akçomaka and ter Weel (2009) develop on social capital, innovation and growth in Europe. Cincera and Veugelers (2013) analyze the young leading innovators in correlation with the European Union's Research and Development intensity gap. Rodríguez-Pose (2008) evaluates the impact of research and development, spillovers, innovation systemson the regional growth in Europe. Cruz-Jesus, Oliveira, and Bacao (2012) are preoccupied by the European digital disparities, across the reference interval 2008-2010. Dachs and Pyka (2010) analyze the factors that influence the internationalisation of innovation. Pinto (2009) studies the characteristics of innovation diversity within the European Union. Moncada-Paternò-Castello et al. (2010) discuss on the corporate research and development system in the EU, compared to the non-EU one, in terms of performance. Srholec (2009) discusses on the impact of foreign ownership on cooperation in innovation issues. Anghelache, Niță, and Badiu (2016) evaluate the position and role of migrants remittances in the economic development of a country. Voigt and Moncada-Paternò-Castello (2012) evaluate the possible impact of fast growing R&D-Intensive small and medium enterprises on the economic structure of the European Union at the horizon of 2020. Barbosa and Faria (2011) are preoccupied by the institutional differences across Europe in matters regarding innovations. Block (2012) analyzes the case of Research & Development investments in family and

founder firms. Onetti et.al. (2012) present competitive business models for new technology-based firms. Bravo-Ortega and Marín (2011) develop on the relationships between Research & Development and Productivity. Farole, Rodríguez-Pose, and Storper (2011) analyze the characteristics of the EU cohesion policy.

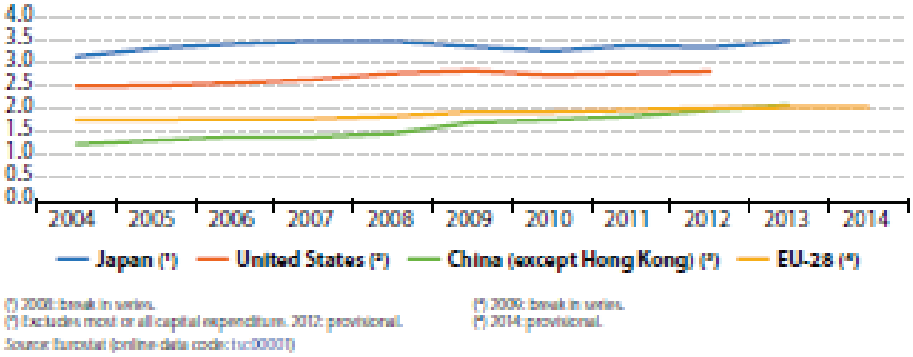
Research methodology, data, results and discussions

• Research and development costs

One of the key objectives of the European Union's strategy for increasing research and development is funding. In the European Union, the strategy set in 2010 by 2020 was targeted at long-term objectives which foresaw an annual 3% increase in funding in this area. Global R & D spending amounted to € 284 billion in 2014, up 3.4% year-on-year, up 42% higher than in 2004. In the field of research and development growth The European Union intends in this way to increase labor productivity and to increase the number of jobs offered to the population so that the concrete result of the growth of the gross domestic product will also ensure the possibility of improving the conditions of further development of the economy as a whole, as well as increasing living conditions, ultimately the quality of life. In 2012, there was an increase of 2.01% compared to 2010 and in 2013 by 2.03% as compared to 2012 and by 2014, 2015, 2016, basically the same growth rate, 2.10-2.20% compared to previous periods. As regards the use of research results, gross domestic product growth and growth has been ensured in most European Union countries with a stronger focus on some eastern and even central European countries, of course with a lower level of development , but which, by accessing the research results, have gained more intense growth. A comparative study was carried out between the level of R & D spending in the European Union compared to Japan, the United States and China (excluding Hong Kong). We find that Japan's highest growth rate of R & D has risen from 3.1% in 2004 to 3.5-3.6% in 2013, 2014 and 2015. The United States the same trend, slightly rising, ranging from 2.5% of GDP growth in 2004 to 2.0-1.2% in 2015, 2016, followed. China, for its part, rose steadily in 2008 being at the same level of gross domestic product allocation equal to that of the United States. The European Union has followed an almost constant trend of 1.7% in 2004, reaching 2% over the last four years. It is noted that all countries taking these as individual countries or a group of countries within the European Union have paid great attention to increasing R & D allocations for R & D. Figure 1 graphically represents the allocation of R & D spending for R & D and Figure 2 shows the evolution of R & D allocations for R & D over the period 2004-2015.

The share of R & D expenditures in the Gross Domestic Product in 2004-2014

Figure 1

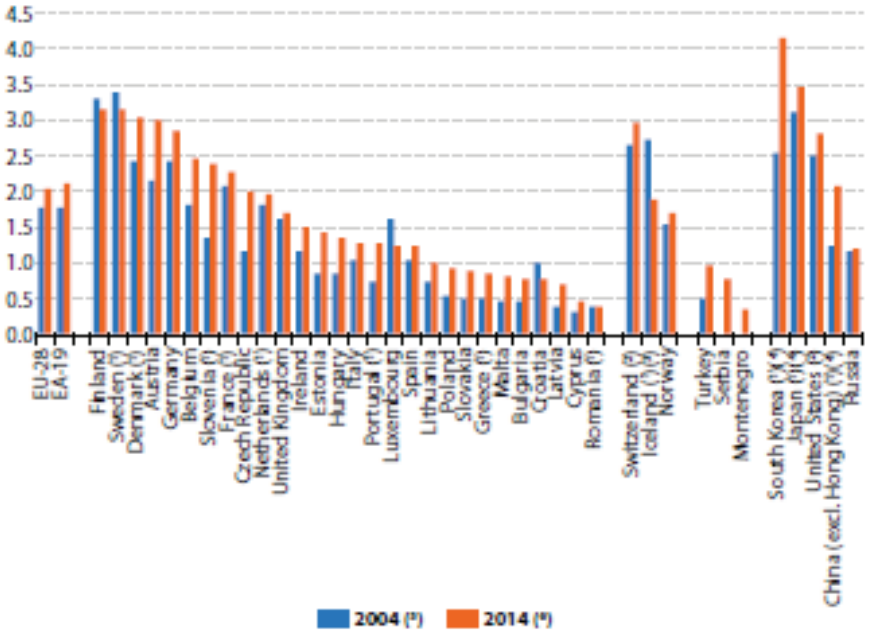


(*) 2008: break in series.
(*) Excludes most or all capital expenditure. 2012: provisional.
(*) 2009: break in series.
(*) 2014: provisional.
Source: Eurostat (online data code: tsc00001)

Source: Eurostat - Key figures on Europe 2016, p. 135

The share of R & D expenditures in the Gross Domestic Product in the years 2004 and 2014 in the European Union

Figure 2



Source: Eurostat - Key figures on Europe 2016, p. 136

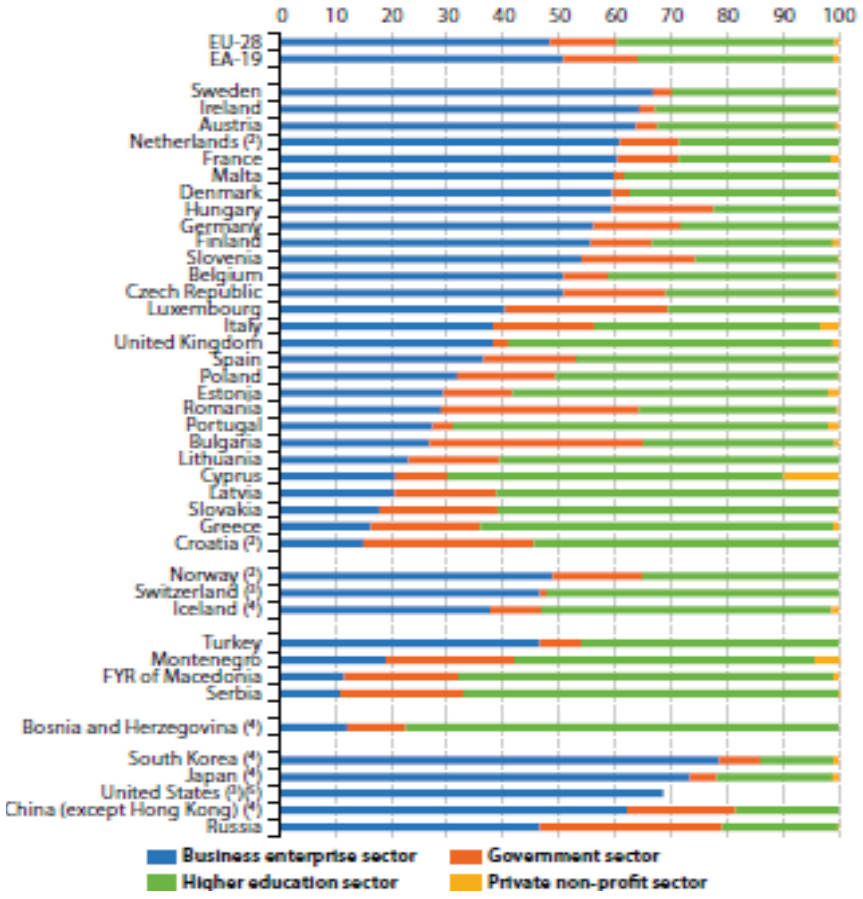
It is noted that Finland, Sweden, Denmark, Austria, Germany, Belgium, Slovenia, France, the Czech Republic, the Netherlands, the United Kingdom of Great Britain and Northern Ireland recorded a high rate of R & D spending. They have reached allocation rates of 3.3-3.4%, and in the UK around 2%. In the case of Romania, we find that this allocation in both 2004 and 2014 remained constant, of about 0.4% of the Gross Domestic Product. It is essential that almost all EU Member States, with the exception of Luxembourg and Croatia or Finland and Sweden, have allocated more funds in 2014 than in 2004. Romania has remained at a constant level, which implies the need for an increase in these allocations.

• **Staff in research and development**

An essential element in achieving R & D is the number of researchers, innovators, who are attracted to these areas of greatest importance for the development of research results in the European Union. The number of researchers in the European Union has increased in the last few years, with 1,760,000 researchers in 2014, an increase of 441,000 researchers, or about 33,6% over 2004. From the study of the staff involved research and development, we find that 48% were concentrated in business sector research, in higher education, or in other key sectors of the national economy. As we have seen, in a number of countries such as Sweden, the Netherlands, Austria, Ireland, France, Malta, Denmark, there has been a significant number of researchers in all these areas. In contrast to the situation in these countries, in the state sector in Bulgaria and Romania there is a large number of researchers engaged in activity among those who have this possibility, but their total number is reduced compared to the other states. Analyzing the research and the number of people in the main fields of activity, we find that 67% of them were of the same gender and that of the females being almost half of the staff. In R & D staff, we find that 2% of the workforce in Denmark, 1.9% in Finland, or in Luxembourg were R & D. At the European Union level, 28 states, the extent of research activity was 1.1% of total employment. In Romania, the level of engagement in the total labor force is 0.3% as in Cyprus, and in Sweden by 1.6%. An age group study, an art that in recent years has increased the number of researchers aged 20-29, the number of graduate graduates dedicated to research has reached 12.7 ‰, of course there are differences from one country to another. Figure 3 shows the share of the full-time occupation rate with a labor contract in the field of research.

Full-time researchers by sectors of activity in 2014 (% of total)

Figure 3



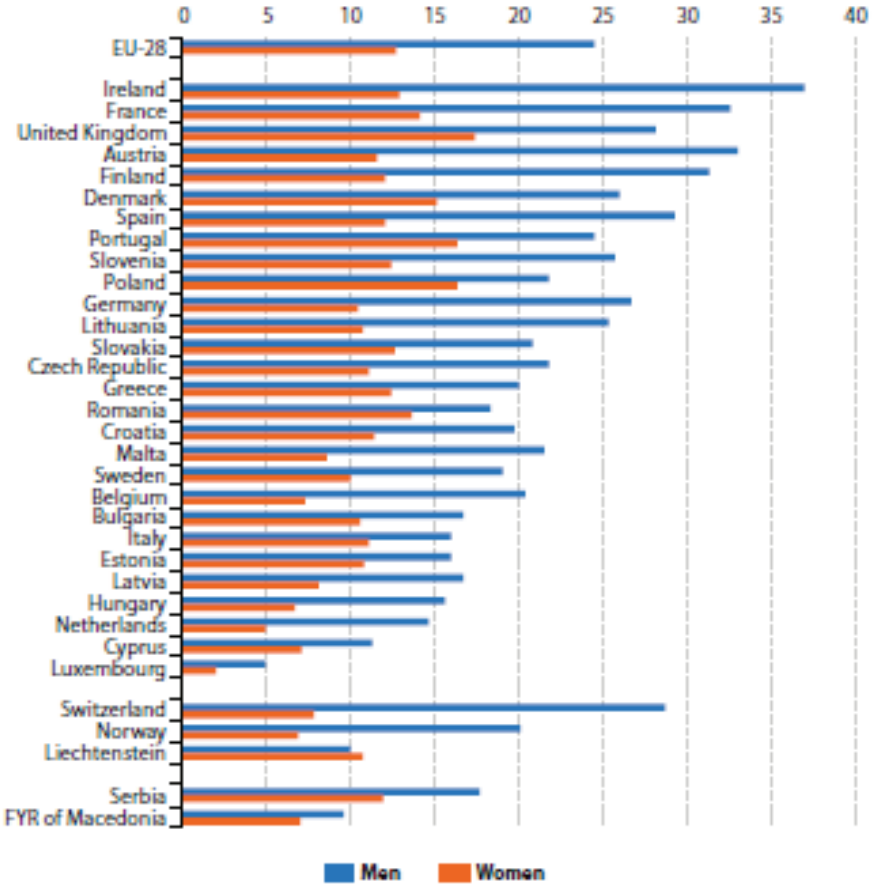
Source: Eurostat - Key figures on Europe 2016, p. 138

Four areas were considered in this regard, namely the business sector, the higher education sector, the government sector and the private non-profit sector. It is noted that the highest share is occupied in the business sector and then the higher education sector in these countries. In Romania we find that three areas have the important share of research in the field of business, research in the field of higher education and government-supported research, the research activity in the private field being practically insignificant. The study shows that the share of business research is high in most developed countries such as Sweden, Austria, the Netherlands, France, Malta, Germany

and others, being somewhat lower in countries such as Romania, Bulgaria, Cyprus, Croatia and Greece much to undertake to achieve a high standard of research and employment in this area. Fugue 4 shows the number of graduates working in science and technology, this being represented in promiles and refers to the age group of 20-29 years.

Number of graduates in science and technology in 2014 (tertiary science and technology graduates from 1 000 people aged 20-29)

Figure 4



Source: Eurostat - Key figures on Europe 2016, p. 139

Please note that in most countries the number of men employed in this area is significantly higher. And in Romania there are about 18 ‰ men in the research and technological field and only 13.5 ‰ among women. Some

countries, such as Luxembourg, Cyprus, have a rather low occupation, simply because these countries do not have a very substantial level of economic development and therefore their share is somewhat reduced. The data can be deepened by determining the level of graduate engagement in these two areas that give meaning and essence to the research that underpins the economic development of each country.

• **Innovation**

Innovation is the most accurate form of research development to ensure the sustainable growth of the Member States of the European Union. The EU's established strategy encourages Member States to pursue an appropriate policy of enhancing innovation in all areas, but especially at the cutting edge of the national economy. Almost half of the EU member states showed that in the field of economic research 48.9% represented innovations in 2008-2010, which represented 3.9% of the total number of researchers. Approximately one quarter of the EU Member States have organized innovation activities, with significant outcomes that have been introduced in the field of business activity. Of the total of the European Union, approximately 23.7% of enterprises have appealed and introduced innovative processes both in the field of activities and in the wider field of the national economy. From this point of view, we can appreciate that in the area of the innovation implementation system, enterprises from various fields of activity organized their own innovation activity, individually supported innovation or attracted innovative projects in economic activity. Approximately 6 out of 10 innovation projects have been used effectively and comprehensively, being implemented in the work of the major producers in each Member State. 28.5% of entrepreneurs in the economic field consider it important to attract new innovations and inventions so as to ensure a competitive and significant increase in economic activity. Less than half of these methods are of particular importance, but we find that by 2016 the level of implementation of innovations in economic and social activities reached 51.2%. Table 1 shows the extent to which innovations have been implemented in economic activity. It is the percentage of enterprises that have recourse to them, as well as the percentage of entrepreneurial innovations that have found their use and application in the economic fields.

Share of innovative enterprises by type of implementation, 2010-2012

Table 1

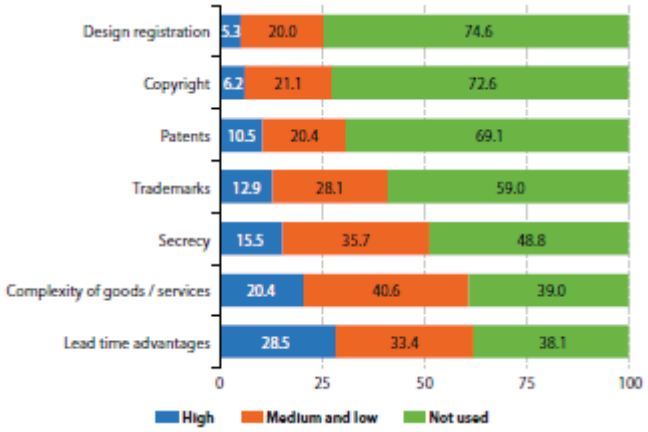
	Process innovative enterprises	Enterprises that developed process innovation by introducing new or improved logistics, delivery or distribution methods	Enterprises that developed process innovation by introducing new or improved methods to manufacture or produce goods or services	Enterprises that developed process innovation by introducing new or improved supporting activities for processes
	(% of all enterprises)	(% of all process innovative enterprises)		
EU-28 (*)	21.4	34.9	65.5	58.9
Belgium	31.1	35.2	60.3	53.3
Bulgaria	9.3	28.1	61.7	48.7
Czech Republic	24.0	39.6	68.0	59.2
Denmark	22.9	37.7	41.9	77.8
Germany	25.5	44.1	74.9	53.3
Estonia	23.8	25.4	65.9	48.4
Ireland	25.9	40.5	59.9	70.0
Greece	25.6	28.3	59.7	63.3
Spain	15.1	20.3	61.8	56.1
France	24.1	35.9	72.4	48.0
Croatia	19.0	40.8	65.3	69.0
Italy	30.4	31.3	61.3	66.8
Cyprus	28.2	95.7	57.8	84.7
Latvia	12.7	32.6	71.9	40.3
Lithuania	13.1	25.4	70.1	58.3
Luxembourg	32.8	41.7	59.1	64.9
Hungary	8.3	19.6	58.9	55.1
Malta	26.4	52.4	57.8	74.8
Netherlands	25.9	32.7	62.1	55.4
Austria	28.7	32.5	55.4	72.8
Poland	11.0	29.2	61.7	54.1
Portugal	33.5	37.2	60.7	72.2
Romania	4.6	31.6	69.3	34.9
Slovenia	22.5	34.1	68.2	66.6
Slovakia	13.5	38.6	62.9	64.4
Finland	29.3	33.9	64.0	62.9
Sweden	23.9	32.0	57.2	61.2
United Kingdom	14.1	:	:	:
Norway	11.9	25.4	60.8	47.4
Serbia	22.0	40.9	49.9	74.8
Turkey	20.4	45.3	79.9	58.4

Source: Eurostat - Key figures on Europe 2016, p. 141

As far as Romania is concerned, we find that in 2010, 4.6% were attracted innovations, and from the point of view of logistics, distribution, and so on, it increased from 31.6% to 69.3% with regard to the use of new methods of increasing economic processes. Figure 5, Methods for Maintaining and Enhancing Competitiveness in Production and Innovative Process, presents a graph showing how the percentage was used in the production process.

Methods for Maintaining and Enhancing Competitiveness in Production and / or Innovative Process by Importance, EU-28, 2010-2012 (% of all innovative product and / or process enterprises)

Figure 5



Source: Eurostat - Key figures on Europe 2016, p. 142

Fields are taken for design, patents, processes, innovations, complexity of goods and services, the idea of increasing the values and benefits of economic activity.

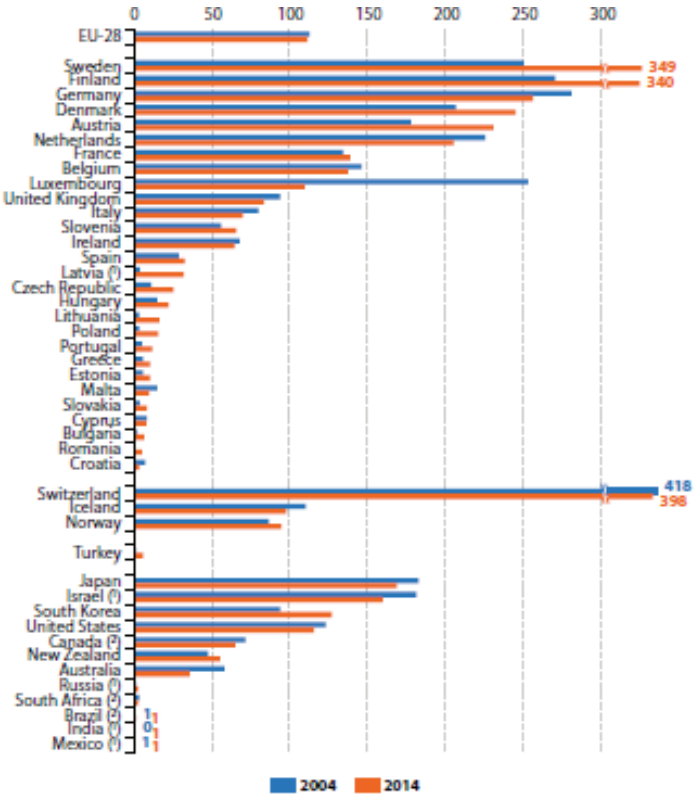
• **Analysis of the use of manufacturing patents**

The patents reflect the initiative of exploitation activity and capacity in the economic potential of innovations. In this context, the indicators used show increased access of all EU Member States to manufacturing patents. Of the total number of patents applied in the European Union, 142.7 thousand were used in 2014, which increased from 56.6 thousand in 2010. The patents used increased annually, thus ensuring an increase in the efficiency of the quality and results of the activities economic. Among the Member States, Germany has the highest percentage of patents applicable in 2014, namely 20.7 thousand (36.5% of the total European Union), followed by France by 9.1 thousand, Italy 4.2 thousand, the Netherlands 3, 2 thousand, Sweden 3,4 thousand. And some non-member countries have a high percentage of use of manufacturing patents, such as the United States - 36.8 thousand, Japan - 21.3 thousand, followed by China - 7.5 thousand or South Korea - 6.8 thousands. In terms of population, the number of patents is high in Sweden, Finland, Denmark or Austria, with a high number of patents compared to the population of the European Union. Applied patents in the field of information and technological communications represent a third,

almost 32% of the total used in 2012-2016. Their number has increased and will further increase as a result of the development of the information system, of the technological communications. Thus, in a number of EU Member States, we have a record of applied patents such as Germany, France, Great Britain, Sweden, Holland, Italy, Finland, which have over 500 applications. Other Member States of the European Union have a lower number of patents applied to them, also taking into account the extent of their economic development. The number of these patents applied in non-EU countries was high enough, for example in the United States - 11.9 thousand, in Japan - 7.6 thousand, in China and South Korea registering higher percentages than in the Member States of the European Union and even in Germany. Figure 6 shows patents applied over the period 2000-2014 as a structure for one million citizens.

Patent applications to the EPO, 2004 and 2014 (per million inhabitants)

Figure 6

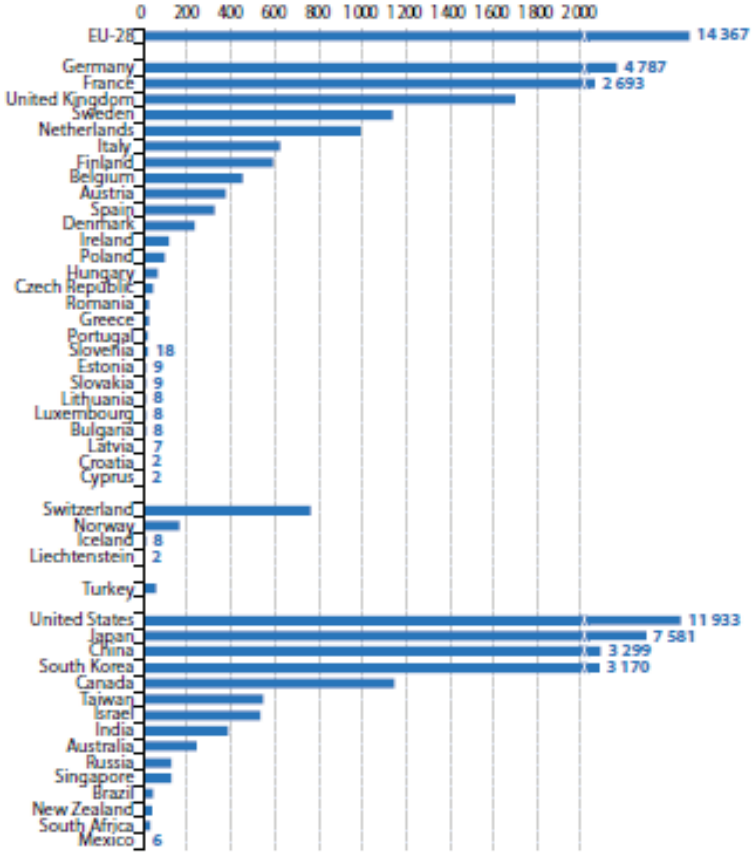


Source: Eurostat - Key figures on Europe 2016, p. 144

Here are the top places in 2004 and 2014, with Sweden, Finland, Germany, Denmark, Austria, Holland, France or Belgium rising. In Luxembourg as well as in Germany or the Netherlands, the number of patents applied in 2014 was lower than those used and implemented in 2004. As far as Romania is concerned, we find that in 2004, there are no data or more sincere, the level of patent application in that domain was reduced, reaching about 2 percent in 2014. Figure 7 also shows graphically applying patents in the field of information and communications. It refers to the number of such patents used.

Patent applications at EPO - ICT, 2012 (number)

Figure 7



Source: Eurostat - Key figures on Europe 2016, p. 145

At the European Union level, the level was 10,367 per total, of which Germany implemented 4.787, France 2,693 followed by Great Britain,

Holland, Italy, Finland. Regarding Romania's situation, we find that it has implemented only 10-15 annual patents from 2012 to 2016. Compared with non-member states, we find that the four United States (11,933 patents), Japan (7,581 patents) China (3,299 patents), South Korea (3,177 patents) or located net above the entire community of the European Union, from the point of view of the use of manufacturing patents.

Conclusions

Regarding the study carried out in relation to the evolution of science, we first notice an increase in the level of research and development, the engagement of an increasing number of staff in these fields, the increase of the innovations and the patents applied in the activity social and economic. It is noted that the level of research and development included ever higher weightings that ensured improved production quality, improved economic, social and administrative management, ensure unrestricted access to information and high documentation capability. The figures analyzed reveal the European Union's concern that the strategy for the last decade 2010-2020 in this area is to achieve the goal and ensure a superior implementation of the results of research and innovation in the economic activity. The article highlights the European Union's concern to improve research and development in the Member States, allowing for the launch of large-scale joint projects.

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