

**A COMPARATIVE ANALYSIS OF RESEARCH – DEVELOPMENT AND
INNOVATION ACTIVITIES IN ROMANIA**

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Abstract

When adopting the recommendations of the Lisbon Agenda or Strategy, the European states have decided that in order to make the European Union a space of competitiveness and greater social cohesion and a model of sustainable economic growth, research-development and innovation (RDI) must become the main pillar of the member states common policies. Consequently, the European Council recommended more investment in research and development, setting the collective EU target of raising research investment to 3% of the GDP, namely 1% from public funds and 2% from private sector.

The current economic and financial crisis and the pressure it poses on resources, public or private, has limited to some extent the achievement of these objectives. The investments might not increase as anticipated or they might even decrease. However, several states have understood that, in times of crisis, the investment in research and innovation might bring tremendous gains in terms of new technologies, human capital and knowledge or, in other words, gains in economic competitiveness.

This paper aims at providing a comparative analysis of the Romanian situation using the statistical indicators of the knowledge economy, those related to RDI financing and also to RDI results for the short period of time when financing has increased as a result of applying the objectives set out by the Lisbon Strategy. We underline the fact that without financing there is no research and innovation and without policies to support RDI the delays in development cannot be recovered. The final part of the paper provides several recommendations aiming at improving the RDI policies in Romania in accordance with post-2010 Lisbon Strategy.

Keywords: Knowledge economy, research financing, research results, Romania

JEL classification: I23, O31, O32

1. INTRODUCTION

Sustainability and, generally, long-term development imply and require permanent efforts in research and innovation. Within the framework of European integration, Romania holds as key elements the process of re-technologisation, of increased economic competitiveness, of an improved business environment; these stages have to be fully achieved. In the Porter model, three stages of economic competitiveness are identified: an economy based on factors, one based on investments and, finally, one based on innovation. In the third case, the ability to develop innovatory products and services by using the most advanced methods and techniques becomes the main source of the advantage in the competition. This is in fact, one of the objectives of the Lisbon Agenda.

Although such a project may appear to be too ambitious for Romania, the effort has to be made for two reasons. One is that the Lisbon Agenda is ranked very high among the priorities of the EU 'club'. Secondly, a *knowledge-based economy* represents Romania's chance of compounding supplementary added value to its products and services on a medium and long term. Thus, although this is not an element of compulsion, The Lisbon Agenda is complementary for the evolution of the Romanian economy.

In the current stage of Romania's development, the essential character of structural reforms tends to obscure a subtler aspect, that of research, an aspect which is, however, as important as the other one. As a new member of EU, Romania guides itself mainly by the Copenhagen Criteria and aims at creating a functional market economy able to withstand the pressure of competition and of the EU market mechanisms. Even if, in the present conditions, it seems hazardous to speak about establishing a *knowledge-based society*, the objectives that Romania has to attain on a short term basis (to consolidate its market economy, to create a friendly business environment, to increase external competitiveness) can be reached by following the recommendations of the Lisbon Agenda, which promotes *research - development* and *innovation*.

Unfortunately, economic growth through innovation is a model that appears still foreign to the Romanian economy. According to governmental estimates, 75.6% of the country's export is still dominated by low-technology products, based on low or medium qualified labour force. Additionally, export products are competitive by price, not by innovation contribution. Only 18% of Romania's exports incorporate high technology (it being the lowest percentage in the region). The technology used is mainly imported and, in most cases, it does not belong to the latest generation. The promoters of research and development in Romania are the joint ventures and they operate the technology transfer, but this transfer is used for low added value products.

Starting from these facts, the pursue of the Agenda goals would undeniably involve certain advantages for Romania. On one hand, the consolidation of research activities would bring about the increased value of domestic production and, consequently, a decreased need to import technology and equipment. Research and innovation also result in an increased added value of export-oriented production, which would also result in an improved competitiveness of Romania's production and in a positive balance of payments. On the other hand, a wider access to education and knowledge can influence the saving and investment behaviour, which would consequently result in an increased degree of capitalisation of private companies, in an improved ratio private capital - public capital as well as in other beneficial effects connected with an increased degree of trust in the national currency.

To prove an understanding of how important these political activities are, public policies have been expressed in the regulating document NATIONAL RESEARCH, DEVELOPMENT AND INNOVATION STRATEGY for 2007 – 2013, which set several national interest goals as well as the means to achieve them. These goals have been defined in relation with the goals of the European strategy and concern the following aspects: promotion and development of the research-development national system in order to support the country's economic development and the development of knowledge; integration within the international community; protection of Romanian technical-scientific inheritance; development of human resources involved in the research activity; development of the material resources and financing of research activities.

The main instrument for the implementation of the National Strategy is the National Research Development and Innovation Plan for 2007 – 2013. This document refers specifically to supplementary budgetary resources that will be involved in the domain of RDI, from salary raises for researchers, to ways of supporting the institutions involved in this activity in order to increase their productivity.

Obviously, these regulating documents are questionable, since they appear as new bureaucratic formulas that will be never or not to soon applied, the more so due to the current financial and budgetary crisis. However, they have a more than beneficial role within the context of economic and social policies in Romania, as they emphasize the need for a continuous budgetary effort and for stable policies to this end, if Romania's emergence out of the current deadlock situation is desired.

2. THE CONTEXT OF RDI ACTIVITIES IN ROMANIA

Following 1990, the RDI system in Romania went through a very difficult period, mainly due to great under financing, but also due to lack of clear policies to support RDI; these circumstances resulted in a loss in quality in the area of human resources, in the deterioration and even destruction of research teams or institutions, in an increase in the disparities in research infrastructure, difficult or impossible access to international databases, in isolation from global or European research etc.

The economy of knowledge can be analysed by means of a series of indicators referring to various aspects of research, innovation, education. The case of Romania is briefly presented in the following section in view of the most important indicators of the *knowledge-based economy*.

a. **Gross expenditures for research-development from the GDP (GERD).** The changes that Romanian economy was subject to had effects on the GERD not only in terms of absolute value, but it also resulted in ranking the research - development - innovation programme as lower in the hierarchy within the general economic framework. Thus, public allotments for RDI as a percentage of the GNP have had a modest evolution, with a raise from 0.19% of the GDP in 2003, to 0.33% in 2006, to 0.35 % in 2007 and 0.47% in 2008. The current economic crisis has hindered the ambitious goal [1], [2] that in 2010 public spending for RDI should amount to 1% of the GDP. In 2009 the public effort for RDI hardly totalled the sum spent in 2005, i.e. 0.24%. Figure no.1 presents the planning of Romania's budgetary effort for RDI as provided by the National Authority for Scientific Research, in agreement with the goals of the Lisbon strategy, while Graph no.1 presents the real evolution of expenditure for RDI, both public and private. When totalled, this effort should have reached 3% of GDP until 2010, 1% of public expenditure, 2% of private expenditure. As it can be seen in

Table no.1, according to the estimates of National Institute of Statistics and the Ministry of Public Finance, this cumulated expenditure reaches only 0.87% of the GDP in 2008, instead of 3%.

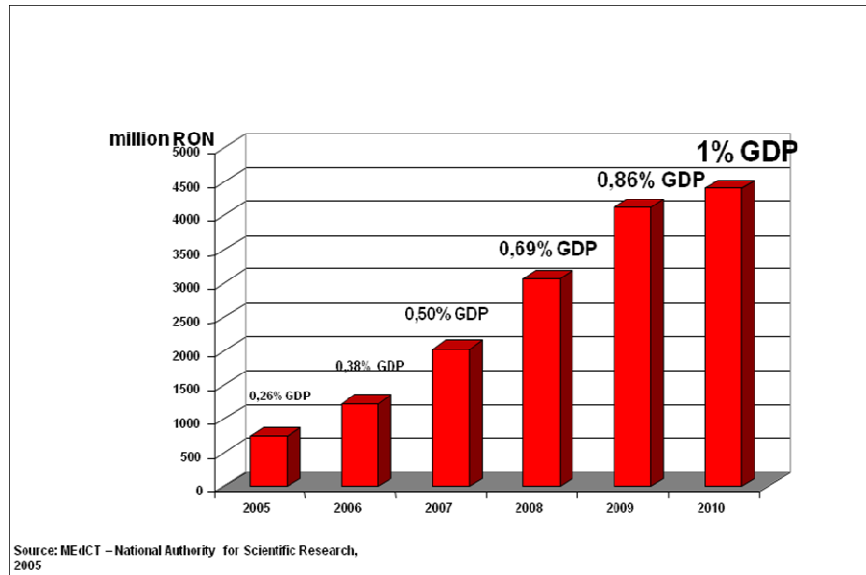


Figure no. 1 Planning of Romania's public expenditure for RDI until 2010

Table no. 1 The evolution of investments in RDI activities between 2003 - 2008

Year		2003	2004	2005	2006	2007	2008
Indicator							
Public expenditure ¹ (MROL)	Total	368.6	432.7	679.4	1129.9	1767.4	1963.3 *)
	Increase	-	64.1	246.7	450.5	637.5	195.9
	Value MEuro	92.8	108	169.8	282.5	441.8	490.8
	% GDP	0.19	0.18	0.24	0.33	0.35	0.47 **)
Private expenditure ² (MROL)	Total	355.5	419.1	432.0	479.4	1416.5	1760.0
	Increase	-	63.6	12.9	47.4	937.1	343.5
	% GDP	0.18	0.17	0.15	0.14	0.35	0.40

Source: [INS – Romania's Statistic Yearbook in 2007; GBAORD (Government Budget Appropriations or Outlays for Research and Development) - funds allocated through the state budget, according to annual laws of passing the state budget; BERD (Business Expenditure for Research and Development) - funds spent by companies as financing sources for RD activities (not as an execution sector); *) preliminary data provided by MFP; **) ANCS forecast on the basis of preliminary data provided by MFP]

According to recent analyses (Innovation inquiry by NIS; the European classification regarding innovation European Innovation Scoreboard, EUROSTAT CIS 4), the ratio of innovative firms in Romania is still very low compared to the European ratio (where more

than 50% of the firms are innovative technologically), but there is a rising tendency from 19.9% between 2002 – 2004 (according to EIS 2002 – 2004), to 21.1% (according to the EIS analysis regarding innovation between 2002 – 2004 , EUROSTAT CIS 3 – Romania's yearly statistics).

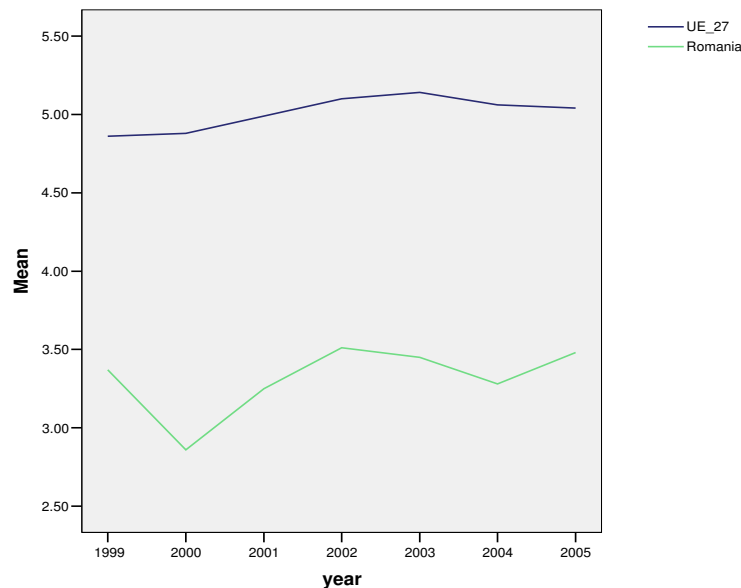
In order to generate and maintain the growth pace on a long term, especially given the political and economic framework generated by the implementation of the Lisbon strategy within the European region, continuous efforts are required in order to develop a competitive economy, capable of technological performance, in agreement with the competitive conditions at a global level. As it can be seen from Table no. 1 , in order to reach the 2% of the GDP level, stipulated in the Lisbon strategy, economic agents' expenditure for research and development should increase five times in comparison with the current level, while public expenditure should increase at least two times compared to the level of the year 2008 and ignoring the current budgetary crisis.

b. The Ratio of public expenditures on Education in the GDP. In this particular case, with a 2.86% in 2000 and 3.48% in 2005, Romania is at a distance from the level in Bulgaria with 4.24% in 2006, Czech Republic, with 4.61%, Hungary, with 5.41%, or Estonia (7.6%), and much closer to the minimum level (Table no. 2 and Figure no. 2).

Table no. 2: The Ratio of public expenditures on Education in the GDP

Year	<i>public expenditures on Education in the GDP(%) in Eu 27</i>	<i>public expenditures on Education in the GDP(%) in Romania</i>
1999	4.86	3.37
2000	4.88	2.86
2001	4.99	3.25
2002	5.10	3.51
2003	5.14	3.45
2004	5.06	3.28
2005	5.04	3.48
2006	5.05	.

Source: [Eurostat]



Source: [Eurostat]

Figure no. 2 Total public expenditure on education as a percentage of GDP

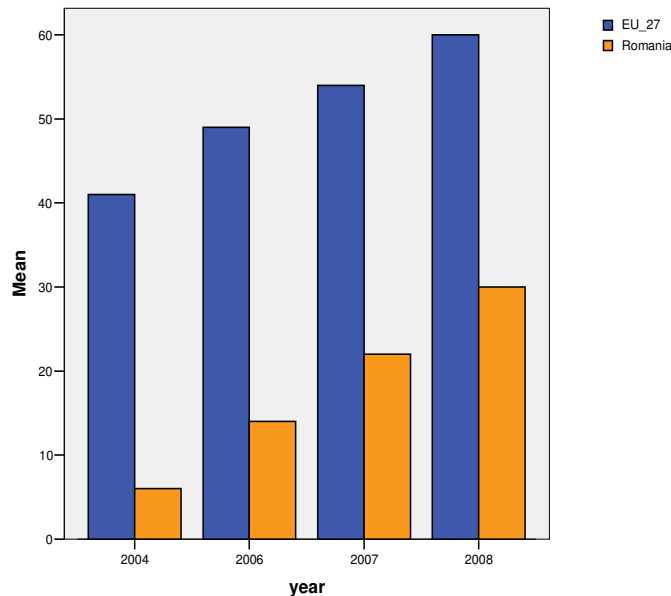
Regarding the education expenditures as a percentage of GNI, in 2006, Romania was situated on the rank 98 out of 134 (3, 27%).

c. **The number of researchers involved in research - development activities per number of inhabitants** represents an alternative statistic of characterising the situation of research - development. In 2002, 20286 researchers were employed in Romania, while in 2007 there were 30740 researchers [3]. Although after 2003, the trend in the number of researchers has had a slight increase, especially as a result of the effort in increasing financing, Romania has 4.89 personal involved in research per 1000 employees, compared to the average of 13.80, 3.52 researcher per 1000 employees (2007) compared to the average 5.6 for EU 27 (2006), 10.7 in Japan and 9.3 in the U.S. respectively. In Romania, there was a small number of research units as compared to the total population, as there are 167 national interest research units (45 national institutes, 56 accredited public universities, 66 institutes and research centres of the Romanian Academy), organized as 96 research and development institutes, centres and stations organized as public institutions and in 32 private accredited universities. These public institutes develop research projects in partnership with only 213 private economic agents [4]. This shows the insufficient concern for the practical applicability of research compared with the most competitive countries, especially U.S., where research is conducted especially in the private companies or in the private universities or even state universities, but the financing is usually private.

d. **The index of competitiveness**, which has the lowest value in Romania compared to the other EU countries and the candidate countries. In Global Competitiveness Report 2009 -

2010, from the point of view of competitiveness Romania was situated on the 64th position of the total 133, far behind most of the EU states (World Economic Forum). In 2009, Romania was following Czech Republic, Slovenia, Poland, Lithuania, Hungary, Estonia, and Bulgaria.

e. **The Access to the Internet, the number of patents per million inhabitants and the IT expenditures** are other indicators of a knowledge based economy; Romania is again situated on bottom place. For instance, in 2001, in Romania there were 1000 Internet users and 35.7 personal computers/1000 inhabitants, while in Denmark and Switzerland were 540 personal computers/1000 inhabitants, and in Sweden, 561. After this date, Internet access and the number of PCs have grown considerably, along with the development of the infrastructure of Internet services and cable TV, however, as it can be seen from Figure 3, Romania still is behind most other European countries in this respect, with a ratio of 28% of the population with Internet access compared to the European average 27 of 60%, much smaller than that recorded in Greece (81.2%) or in Bulgaria (44.3%).



Source: [Eurostat]

Figure no. 3 Percentage of households who have Internet access at home

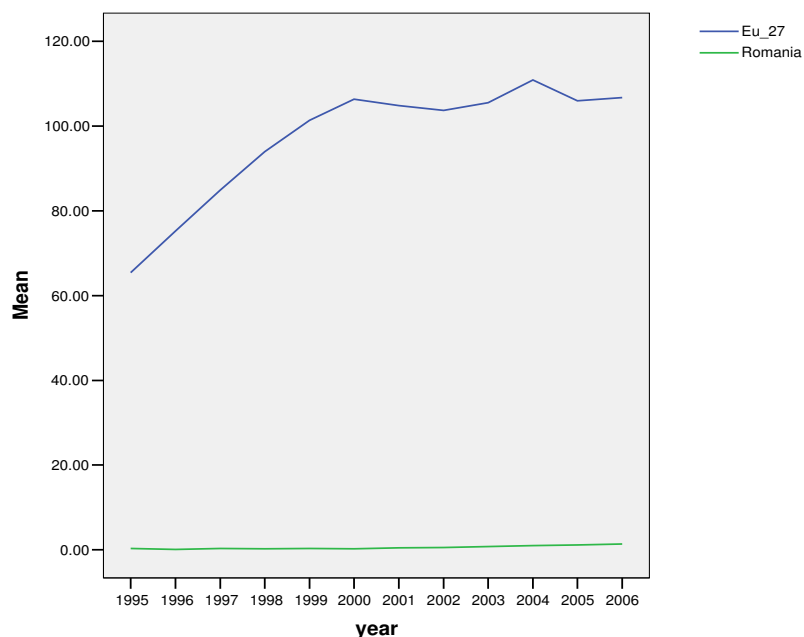
f. **The number of patents per million inhabitants.** The number of patents on the domestic market is very low and it reveals the crisis of the research system in Romania. Most applications for patents come from inventors, whose number has been continually rising since 1998, reaching a 75% in 2002. This reflects not only the Romanians' potential for innovation, but also the reduced capacity of the research system of using this potential (although it is presupposed that 70% of the research units are involved in technological research) and of redirecting it towards more complex types of innovation. The number of patents granted

places Romania on the lowest position behind any other member states of the EU 27. Data presented in Table 3 and Figure 4 refers to applications filed directly under the European Patent Convention or to applications filed under the Patent Co-operation Treaty and designated to the EPO (Euro-PCT). Patent applications are counted according to the year in which they were filed at the EPO and are broken down according to the International Patent Classification (IPC). They are also broken down according to the inventor's place of residence, using fractional counting if multiple inventors or IPC classes are provided to avoid double counting.

Table no. 3 Number of applications per million inhabitants

Year	EU_27	Romania
1995	65.41	.33
1996	75.28	.12
1997	84.91	.31
1998	93.99	.23
1999	101.41	.34
2000	106.33	.27
2001	104.87	.46
2002	103.70	.51
2003	105.57	.75
2004	110.93	1.00
2005	105.95	1.14
2006	106.72	1.35

Source: [Eurostat]

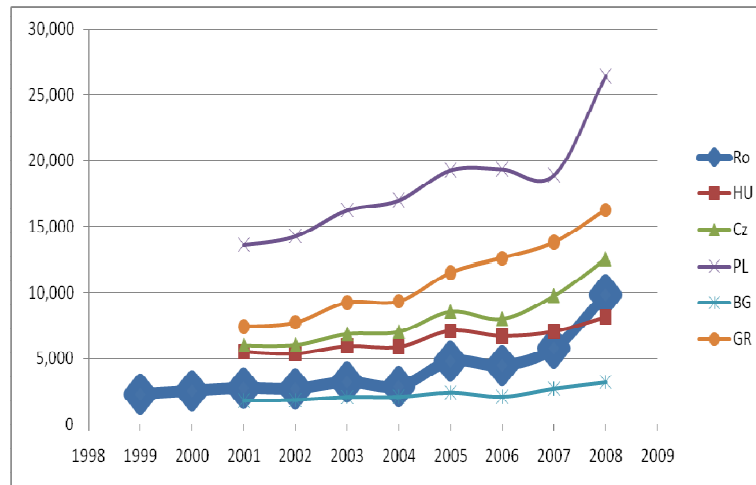


Source: [Eurostat]

Figure no. 4 Number of applications per million inhabitants:

g. **The number of ISI articles** (or equivalents) published in scientific journals reaches an average of 1000 a year between 2007-2008, the evolution is mainly due to the national programmes in the RDI National Plan and the substantial growth of financing through grants. Such results are meritorious, since, for the sake of comparison, all the ISI (or equivalents) papers with at least one author affiliated to an organization in Romanian were about 1600 in 2006. The increase of this indicator is also due to the increase in the number of Romanian journals (Journals, Bulletins) recorded by the international databases; in 2008 there were 54 ISI journals as compared to 6 in 2004.

In 2008 the total number of ISI papers (or equivalents) by researchers published in scientific journals practically doubled compared to that in 2007, exceeding the number in Hungary, as it can be seen in Figure no. 5.



Source: [http://www.alinagorghi.ro/wp-content/uploads/2009/06/motiunea.doc, p. 17.]

Figure no. 5 Total number of ISI journals in Romania and other European countries.

h. **The proportion of high technology products or services in the economy** is another way of emphasizing knowledge based economy. The evolution of this indicator in the past two years is very good in Romania due to an increase in RDI financing, as it can be seen in Table 4. One can notice the growth by 75% of the number of employees in high-tech domains (of the total of processing industries) and, in direct relation, the growth by about 52% of high-tech exports. At the global level, Romania was placed on the 53rd position in 134 countries with a total of 3.49 high-tech exports as a percentage of total goods exports, on a slightly superior position compared to Bulgaria (3.2%) or Poland (2.%), but clearly inferior to other developed European countries such as United Kingdom (25,8%), Hungary (20,06%) or France (16,67%)[5].

Table no. 4: The evolution of high-tech domains in Romania

	Indicator	UM	2007	2008
1	Ratio of firms with innovation activities (According to Community Innovation Survey)	%	21,2	-
2	Employees in high-tech domains of the total processing industry	% of total employment	0,4	0,8
3	Employees in knowledge high-tech intensive services of the total employment	% of total employment	1,5	2,6
4	„high-tech” product exports	% of total exports	3,8	5,7

Source: [Romania's Statistic Yearbook 2007, National Institute of Statistics, 2008]

The positive evolution of the past two indicators in the recent period can be explained first through an increase in expenses for RDI and coherent public policies in this area through the implementation of the Lisbon strategy in our country as well. Unfortunately, the

economic financial crisis in 2008 has troubled public expenditure to a great extent and has delivered a blow to this domain that had barely started to be revigorated, as the research indicators for those years show.

3. CONCLUDING COMMENTS

Starting from the importance of the RDI contribution to an increased productivity and the achievement of social objectives, the role played by governments must be recognised in the enhancement and stimulation of expenditures necessary for the research - development expenditures. This increment can be achieved either through an increase in governmental expenditures, or by stimulating, through various methods, increased investments in research in the private sector. In the EU member states and in the candidate states, this type of assistance (fiscal, subsidies, patents, etc.) is regulated by the *acquis communautaire*. Among the recommendations for strategies concerning the RDI policies one could count that referring to the research - development expenditures in the private sector, which must be supported by those indirect financial measures which are consented to by the EU regulations. Fiscal incentives can be granted relating to: the proportion of the research - development expenditures in the total turnover, the proportion of the employees involved in research - development activities of the total number of employees, the number of patents registered each year.

As shown in the previous paragraph, in order to achieve this goal of 1% of the GDP of total expenditures for the RDI by 2010, it is to achieve both an increase by 2.5 times compared to the current budget, and an by 5 times of expenditures for the RD of the economic agents. Having this in mind and according to the requirements of reaching a goal of 3%, it is necessary to correlate the policies in the RDI domain with the complementary incentive measures that should result in the significant increase of the expenditures for Research and Development of the economic agents.

Expenditure in research and innovation has grown in real terms in all the 27 member states between 2000 and 2006, although the growth rate has been widely different, between 3.4% in Belgium and 211% in Estonia. Expenditure in the domain exceeded 100% between 2000 and 2006 in the three Baltic states and in Cyprus. The same level of expenditure was by 60% greater in Hungary, Romania, the Czech Republic, Ireland and Spain.

Thus, considering the current situation of innovation in the European countries, short term convergence for Slovenia could be expected within a 15 year period. In the case of Poland, Latvia, Bulgaria, Slovakia, Malta, Romania, convergence could be extended up to 20 years. In the case of Hungary and Italy, the process of catching up with the difference could be of up to 30 years. However, for states such as Belgium, France, Holland, and Denmark, which display an above the average ratio of research and development, it would take 5 to 10 years to regress to equal the European average, considering that the average European performance grows faster than the performance in innovation considered individually for each of the respective countries [6].

The growth in the innovation potential in the **private area** would imply:

- a. *the development of co-operation between the research - development sector and the production sector by*
 - ✓ promoting and co-financing within the national research - development programmes of projects in a partnership between research - development units and institutions and the economic agents working in partnership;

- ✓ a fast process of turning to account the results obtained in research - development, especially in those sectors that have "mature" technologies
- ✓ means of stimulating the formation of "technological clusters" - groups/associations/consortia of economic agents and research - development organisations in the same technological sector, integrated through functional connections and common economic projects;
- b. *the stimulation of RDI activities performed by or for private firms* by
 - ✓ supporting the mobilities of the researchers, specialists, students by firms;
 - ✓ an improved access of private firms to information facilities and scientific assistance services, as well as by courses and training sessions for the beneficiaries and the users of the research - development results;
 - ✓ the stimulation for university/industry cooperation (spin-off) in implementing the results of the research-development activities;
- c. *the support in the creation and development of innovative economic agents, especially in the high-technology sectors* by
 - ✓ developing those areas and infrastructures which have special facilities for the creation and functioning of innovative economic agents: technology and business incubators, technological and scientific parks;
 - ✓ the increased capacity and competitiveness of the RD system by promoting the nuclei, centres and networks of scientific and technological excellence,
 - ✓ the support of integrating Romanian RD units within international network and programmes that is an increase in the capacity of integration of Romania in the European research environment (especially the RDT Framework Programmes of the European Union) and increase international visibility and of the degree of involvement of the Romanian scientific and technological community in the activity of the RDI international organisms.

Besides these steps, others are necessary in order to support and increase the research potential in the **public area** mainly through the following steps:

a. *the development of cooperation between Romanian researchers in the country and Romanian researchers abroad.* This can be achieved through the creation of permanent discussion and information forums that should aim at creating partnerships for the national research projects and especially for the international ones;

b. *improving access to internal and international resources of technical and scientific information ; participation in European RDI initiatives and organisms in high-tech specific domains;*

c. *supporting researchers as well as RDI in general, with a generous amount of resources that should consider the following:*

- The creation of new scientific research centres by authorizing or accrediting several public, private or mixed centres; supporting the creation of excellence centres through partnerships within the public research institutions and firms through special grants, as it is known that firms can inspire new directions in research and the cooperation between science and economy is necessary for an increase in productivity;
- Implement a European behaviour related to RDI. An increase in the real funds allocated to RDI up to the level of 1% of the GDP public funds before the year

2010, or at least retaining this goal for the post 2010 period, according to the European strategies in the domain;

- Entering normality in terms of research, through pre-financing of at least 90% of the total value of the projects. Multi-annual planning of resources and guaranteeing them over the planned periods, given the fact that projects cannot be financed through credits, while the resources for ongoing projects have been reduced by 75% in 2009;

d. the creation of opportunities for the young researchers in order to put a stop to brain drain through the following steps:

- The recognition of young researchers. The creation of national competitions and funds for the activities specific to the incipient career, destined to students who wish to become researchers and academicians in the future;
- Promoting the interest of the students for an depth study and further university degrees. Allocation of special funds to young graduates who can make a significant contribution to future innovation and research in science and engineering;
- Increased opportunities for students through active support and programmes for the participation of students in research activities;
- Continuous growth of income in research and salary differences in direct relation with real performance (ISI articles and patents) to motivate young researchers with the greatest creative or innovative potential.

To conclude with, we could say that the state retains its status as the main "engine" of the research activity. At the same time, a difference should be made between the desire of the firms to involve in research activities and their actual capacity to finance such activities. However, we could estimate that, in Romania, progress has been made in the financing of research activities, in the years before the crisis, while the will to set things right has been clearly expressed in the National Strategy in the National Research Development and Innovation Plan for 2007 – 2013. At the European level, the goals of the post 2010 Lisbon Strategy are becoming clearer; they will increasingly emphasize economic competitiveness and increased importance for RDI activities. It is yet to be seen to what extent they can be pursued, given the budgetary constraints in the following period.

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