# PREMISES OF KNOWLEDGE BASED ECONOMY IN ROMANIA

*Alexandru-Emil POPA*[1]

**ABSTRACT**
*In order to establish the premises of knowledge based economy (KBE) in Romania we have to measure the inputs of knowledge. This study is presenting the stage of transition at knowledge-based economy of Romania by measuring four important indicators: research and development expenditures as percentage of GDP, human resources in science and technology as a share of labor force, the number of patents filled at the European Patent Office or under the European Patent Convention and the volume of high-tech exports. By comparing Romania's results with those of the EU countries we will have a complete picture of our country's stage of transition and where we should improve in order to be competitive at an international level.*

**KEYWORDS** *Knowledge-based economy, Knowledge inputs, European Union, R&D*

**JEL CLASSIFICATION:** *E29, H59, J21,O30, O52*

## 1. INTRODUCTION

*"In today's knowledge-based economy, what you earn depends on what you learn."*
William J. Clinton, former president of USA

The world is at a crossroads due to a series of fundamental changes generated by globalization, technological changes and the "new economy" which impacted the society we live in. Knowledge-based society is the newest form of society in which the key elements are the intangible assets. The new society comes with major changes in the economy, the most important is the higher importance granted to the intangible resources. Knowledge, as embodied in human beings (as "human capital") and in technology, has always been central to economic development. The term "knowledge-based economy" results from a fuller recognition of the role of knowledge and technology in economic growth (OECD, 1996).
All of these changes are the result of the knowledge revolution which consists in the transition from the economy based on physical resources to the new economy based on intangible resources. The backbone of knowledge revolution is represented by the progresses in the informational and communicational technologies which are one by one implemented in all economic activities.
The first great economist who introduced the concept of "knowledge economy" in the mid-60s is Peter Drucker (1966) who explained the characteristics of work in the new economy and the difference between the "knowledge worker" and the manual worker. Though, not Drucker was the first one who recognized the importance of knowledge in the economy, Schumpeter in 1911 said that the heart of innovation and entrepreneurship is made of new combinations of knowledge and Hayek in 1948 highlights that "*the most significant fact is the economy of knowledge or how little the individual participants need to know in order to be able to take action"* but the reason why Drucker is recognized as the first person who introduced "knowledge economy" is because he presented it as a new independent concept.

[1] The Bucharest University of Economic Studies, Romania, alexandrue.popa@gmail.com

## 2. KNOWLEDGE BASED ECONOMY

There are many specialists who argue that we move towards a "knowledge-based economy", an economy where competitive advantage is owned by those who hold the most knowledge. The need to define the concept has emerged in the 60s when it became clear to the economists that economic growth could no longer be explained in terms of traditional economic factors such as land, labour and capital (Cooke & Leydesdorff, 2006).

First of all it should be noted that there is no unanimously accepted definition of this concept. Peter Drucker says that the new economy is the first one in which the growth is unlimited due to the differences between knowledge and the others production factors (Drucker, 2009).

On one side there are economists who argue that the new economy is the product of the technological changes. Many authors state that information and communications technologies (ICT) are at the core of the new economy (Drechseler & Reinert & Kattel & Perez, 2009) presenting as example the internet related companies and their high levels of stock prices. But the complex transition to the new economy cannot be attributed only to the changes in the ICT. On the other side a knowledge-based economy is defined as an economy directly based on the production, distribution and use of knowledge. In such economies there is a high degree of connectivity between the agents involved, and knowledge is widely used and exploited in all manner of economic activity (Hidalgo & Albors, 2008).

In fact the knowledge-based economy is characterized by *the transformation of knowledge in raw material, capital, products, essential production factor for the economy, and by economic processes in which the generation, selling, acquisition, learning, stocking, developing, splitting and protection of the knowledge become predominant and decisive for long term profit gaining and sustainability assurance* (Nicolescu, 2011).

With sustained use and creation of knowledge at the center of the economic development process, an economy essentially becomes a knowledge-based economy. The World Bank (2005) developed a knowledge-based economy framework based on four pillars:

- *An economic incentive and institutional regime that provides good economic policies and institutions that permit efficient mobilization and allocation of resources and stimulate creativity and incentives for the efficient creation, dissemination, and use of existing knowledge.*
- *Educated and skilled workers who can continuously upgrade and adapt their skills to efficiently create and use knowledge.*
- *An effective innovation system of firms, research centers, universities, consultants, and other organizations that can keep up with the knowledge revolution and tap into the growing stock of global knowledge and assimilate and adapt it to local needs.*
- *A modern and adequate information infrastructure that can facilitate the effective communication, dissemination, and processing of information and knowledge.*

OECD developed four indicators in order to measure the inputs of knowledge in a country that can that can be adapted to our study's needs and help us to establish the premises of knowledge based economy in Romania: 1) research and development expenditures; 2) human resources in science and technology; 3) the number of patents field by the citizens of a country; 4) exports of high-tech products

## 3. METHODOLOGY

The study presented in this article is based on statistical data series provided by Eurostat database and on World Bank data. There is no concrete method to measure the stage of transition at knowledge-based economy in a country, the main problem in developing one is the unique character of knowledge. Unlike money or labor, knowledge is not a traditional resource and most of it is implicit and stored in the human resource.

In order to measure the stage of transition of a country to knowledge-based economy OECD proposed a model based on measuring knowledge inputs. First of all we chose to present the R&D intensity showing the expenditures made as a percentage of GDP. We measured all expenditures for research and development performed in all business enterprise sectors in Romania (between 2000 and 2011) without taking into consideration the source of funds.
The second indicator used to measure knowledge inputs is the percentage of knowledge workers as a share of labor force. In order to measure the employment rate of knowledge workers we used the data provided by Eurostat (between 2001 and 2012) regarding the number of workers between 25 and 64 years old who are employed in an occupation where education at the third level is required.
The third indicator proposed by OECD is the number of patents registered by a country. This indicator is measuring both knowledge inputs and knowledge outputs and can be measured in two ways: the applications field directly under the European Patent Office and the ones field under the European Patent Convention.
The last indicator used is the high tech exports. We calculated the percentage of high-tech exports reporting to the total exports between 2000 and 2010 totaling exports of the following products: aerospace, computers-office machines, electronics-telecommunications, pharmacy, scientific instruments, electrical machinery, chemistry, non-electrical machinery, armament. In order to make a better picture of high tech exports we used World Bank data to present the volume of exports in Euro for EU countries.
In order to show where Romania stands we compared the results of our country with those obtained by the countries members of the European Union.

## 4. RESULTS

One of the most important variable to be considered when measuring the stage of a country's transition to knowledge-based economy is the knowledge formation or knowledge inputs. It is fundamental to measure the knowledge inputs with high accuracy but there is no system that can do so given the fact that most of the knowledge are implicit.
Even if creating a favorable environment for R&D does not have an immediate effect in order to develop a knowledge-based economy, it is one of the cornerstones of a development based on knowledge, technology and learning (Komninos, 2013). R&D expenditures presented below are shown as a percentage of GDP and include all expenditures for R&D performed by a country in a given period of time, regardless of the source of funds. This percentage points out the efforts made by Romania in order to extend its knowledge base and the stage of research and development in our country compared to EU27 countries (without taking into account Greece where such data are not provided).
As Eurostat presents, research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications.
In Romania, as it is shown in Figure 1, R&D expenditures raised from 0.37% in 2000 up to 0.5% in 2011 with a maximum value of 0.58% in 2008. Considering the economic context this trend is a regular one and follows the trend of most of the EU countries.
Taking into account the latest data provided by Eurostat in 2011 the average expenditure on research and development of the 27 European Union countries far exceeds the expenditure of Romania. Our country spends four times less money on R&D activities than the EU average and is the second last one in EU.

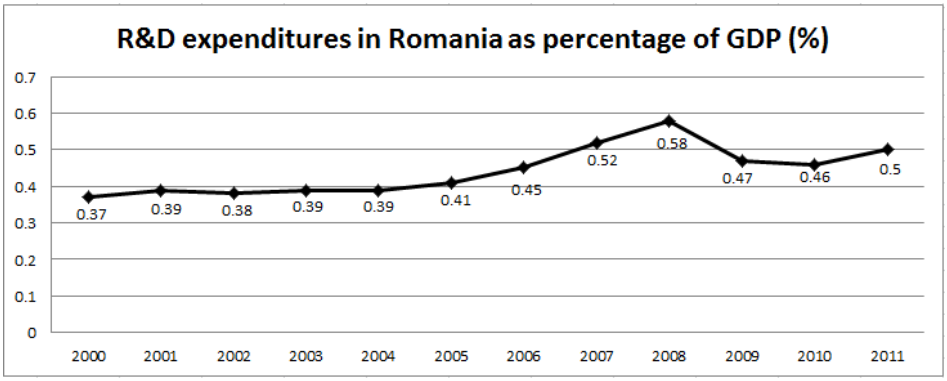


**Figure 1. R&D expenditures in Romania as percentage of GDP**
*Source:* Eurostat data

The EU countries can be divided into three categories: countries with big R&D expenditures (Finland – 3.78%, Sweden – 3.37%, Denmark – 3.09%, Germany – 2.84%, Austria – 2.75% and Slovenia – 2.47%), countries with medium R&D expenditures (Estonia – 2.38%, France – 2.24%, Netherlands – 2.04%, Belgium – 2.04%, Czech Republic – 1.75%, United Kingdom – 1.75%, Ireland – 1.72%, Portugal – 1.49%, Luxembourg – 1.43%, Spain – 1.33%, Italy – 1.25% and Hungary – 1.21%) and countries with small R&D expenditures (Lithuania – 0.92%, Poland – 0.76%, Croatia – 0.76%, Malta – 0.72%, Latvia – 0.7%, Slovakia – 0.68%, Bulgaria – 0.58%, Romania – 0.5% and Cyprus – 0.48%).

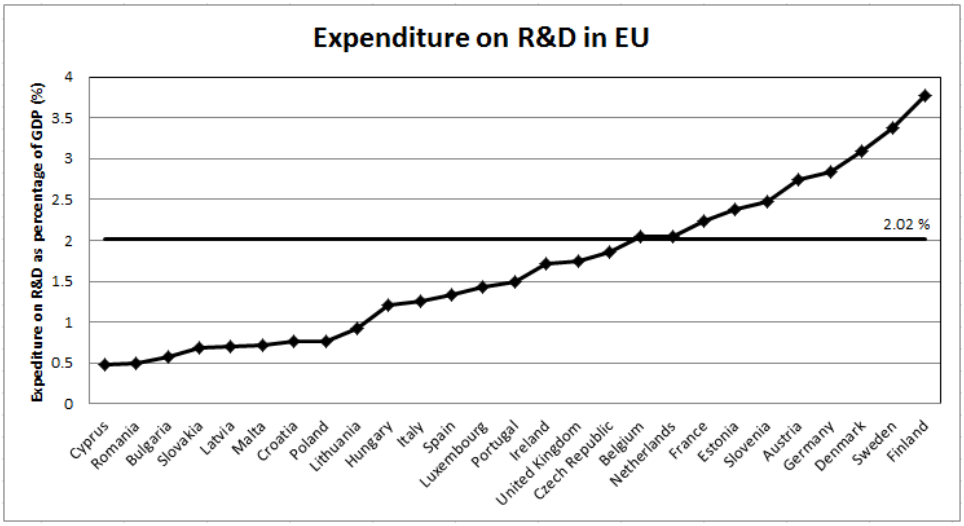


**Figure 2. Expenditure on R&D in EU as percentage of GDP**
*Source:* Eurostat data

It became clear to all specialists that knowledge workers are the heart of innovation, which is itself the key to long term sustainability and growth. One of the greatest challenges of the knowledge-based economy is to succeed to enhance the productivity of knowledge at least to the level of manual labor in the last century.
In Romania the percentage of knowledge workers increased from 19.4% in 2001 up to 25.7% in 2012 with a maximum value of 25.8% in 2011. However of all labor force only nearly 2% of them are working in technology and knowledge-intensive sectors, the main generator of knowledge. This comes as a result of the small number of companies or research institutes existing in Romania, their poor equipment and because employments in public research organizations are blocked since 2010 while the private sector has reduced the number of researchers

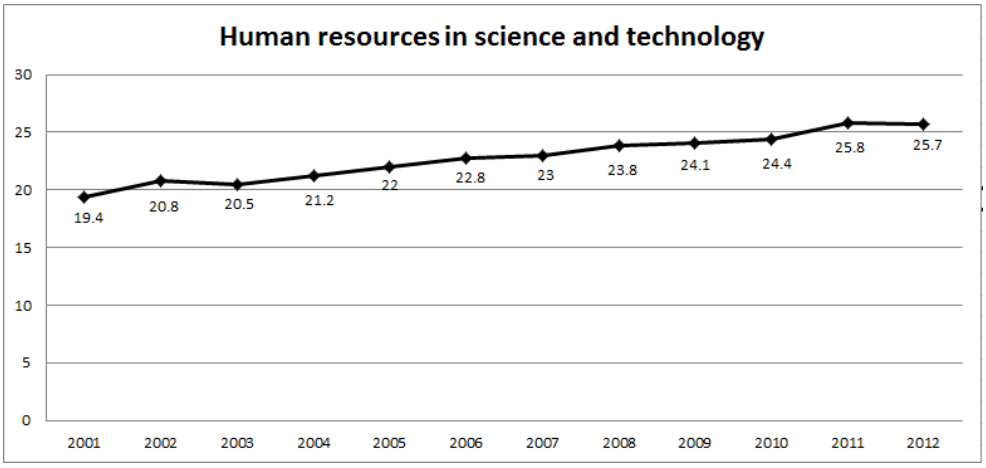


**Figure 3. Human resources in science and technology as a share of labor force in Romania**
*Source:* Eurostat data

Romania ranks last in the European Union at this indicator with 25.7% knowledge workers. It is followed closely by Portugal with 28.7%, Croatia – 32.3%, Slovakia – 32.5%, Bulgaria – 32.6%, Greece – 34.2%, Italy – 34.4% and Hungary with 35.5%. At the opposite pole with a percentage of over 50% is situated Luxembourg with 58.6%, Finland – 53.7%, United Kingdom – 53.1%, Denmark – 52.9%, Sweden – 52.6%, Netherlands – 52.2%, Ireland – 55.5% and Belgium with 50.3%.

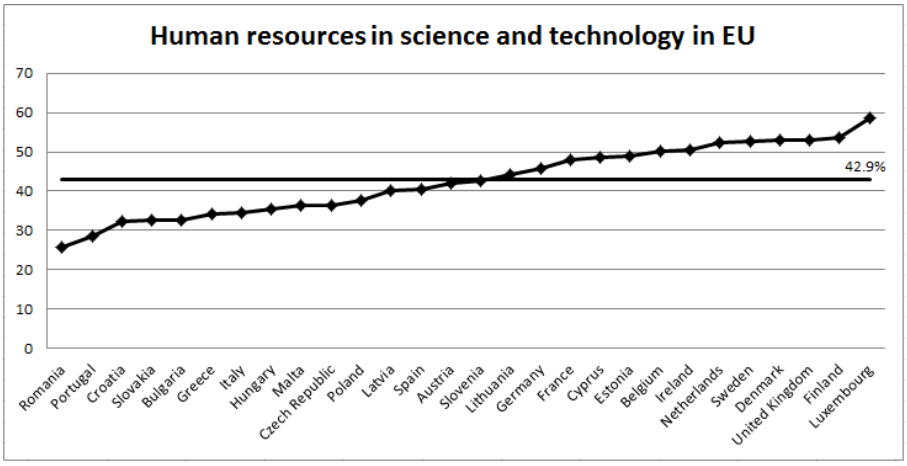


**Figure 4. Human resources in science and technology as a share of labour force in EU**
*Source:* Eurostat data

Patents represent the practical side of knowledge-based ideas, however the comparison between two countries (in number of patents registered) is hard to be made because of the differences in the national patenting systems or because not all patents are equally significant. The number of patents filed under the Patent Cooperation Treaty by romanian citizens raised between 2000 and 2010 from 6.12 patents at one million inhabitants to 32.72 patents at one million inhabitants. However the number of patents registered at the European Patent Office (EPO) is very small, only 1.52 patents at one million inhabitants in 2010. This may be due to the significant costs of registration of one patent at the EPO, due to the stricter rules or to the reduced accessibility.

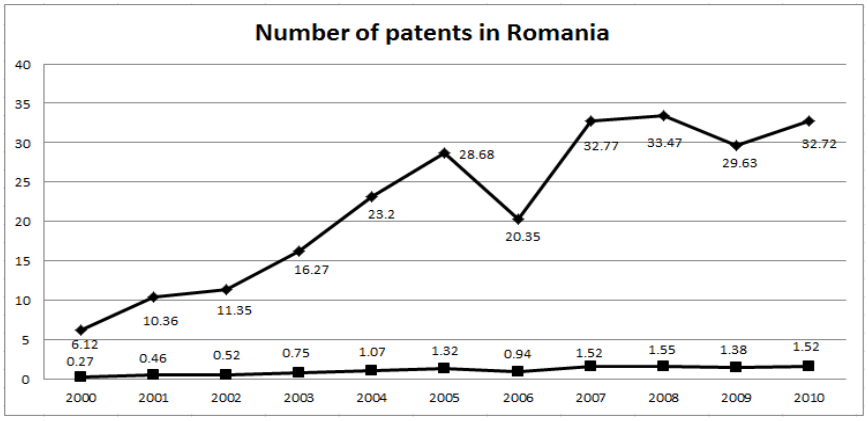


**Figure 5. Number of patents in Romania (applications per million inhabitants)**
*Source:* Eurostat data

In European Union (excluding Malta and Latvia where such data were not provided) Romania is again the last country with only 1.52 patents at one million inhabitants. Our country is far below the average of 85.77 patents at one million inhabitants alongside Bulgaria with 1.54 patents at one million inhabitants and Lithuania with 2.4 patents at one million inhabitants. Most of the patents are registered by Germany (277.73 patents at one million inhabitants), Finland (241.77 patents at one million inhabitants) and Sweden (241.77 patents at one million inhabitants). The situation is much more dramatic if we refer at the patents filed under the Patent Cooperation Treaty, with only 32.72 patents at one million inhabitants we surpass countries like Slovakia (27 patents at one million inhabitants), Croatia (18.84 patents at one million inhabitants), Cyprus (17.53 patents at one million inhabitants), Bulgaria (11.62 patents at one million inhabitants) and Lithuania (8 patents at one million inhabitants) but the difference between us and the leading countries is extremely high, in Germany there are 22,718.71 patents at one million inhabitants, in France 8,605.18 patents at one million inhabitants and in the United Kingdom 5,098.88 patents at one million inhabitants.

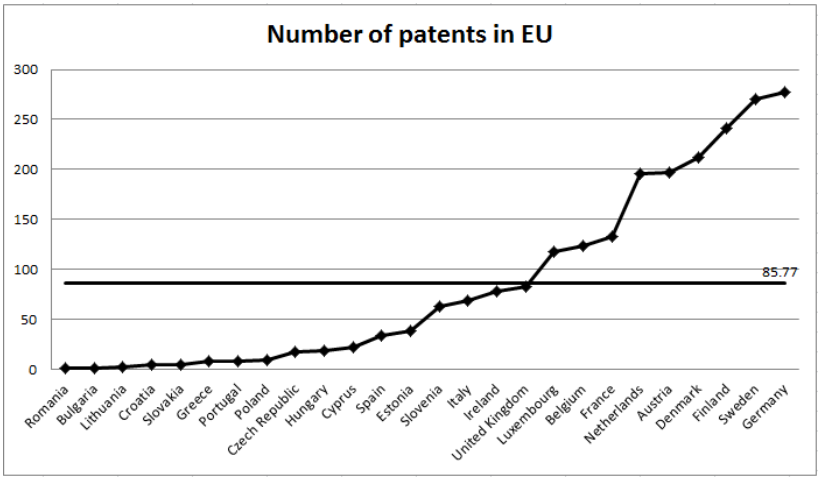


**Figure 6. Number of patents in EU (applications per million inhabitants)**
*Source:* Eurostat data

High tech exports measures international movements of technical knowledge through payments of licensing fees and other direct "purchases" of knowledge, and thus is more appropriately a flow measure than an input measure. But there is no claim that the technology balance of payments measures the full flow of technical knowledge between any two countries. International transfers of knowledge through employment of foreign personnel, consulting services, foreign direct investment or intra-firm transfers are important avenues of diffusion that are not factored into these indicators.

International joint ventures and co-operative research agreements are also instrumental in the global diffusion of knowledge.
In Romania in the last few years high-tech exports have suffered a decline from the maximum value of 9.8% in 2010 to 8.8% in 2011 and 6.3% in 2012 but are still higher than in 2007 (3.5%) or 2008 (5.4%).

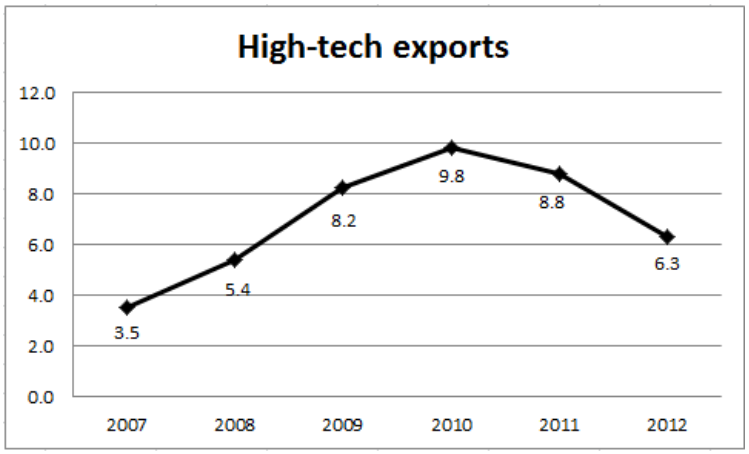


**Figure 7. Exports of high technology products as a share of total exports (in Romania)**
*Source:* Eurostat data

If we compare the EU countries, the country with the biggest percentage high-tech export is Malta with 31.8%, followed by Luxembourg with 26.2% and Ireland with 20.6% of total export. Romania is again situated under the EU average (of 15.6%) with 6.3% surpassing countries such as Latvia (6.3%), Poland (5.9%), Lithuania (5.8%), Slovenia (5.2%), Spain (4.9%) Bulgaria (3.8%), Greece (3.3%) and Portugal (3.2%).

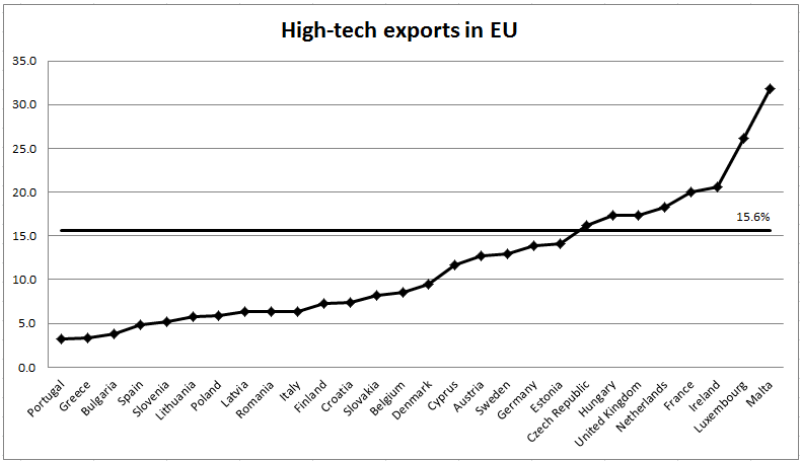


**Figure 8. Exports of high technology products as a share of total exports (in EU)**
*Source:* Eurostat data

Measuring exports of high technology products as a share of total exports can generate a wrong idea about the high-tech exports in European Uninon because of its mesurement system so we used the data provided by the World Bank in order to make a ranking based on the size of the receipts generated by high tech exports. If we compare the volume of high tech export earnings we ranked 16th in the EU with 3,681,227,474 € exports far below Germany with 135,921,309,789 € but above countries like Cyprus, Bulgaria, Greece or Malta.

**Table 1. Exports of high technology products (in euro currency)**
*Source:* World Bank data

| Country | 2012 |
|---|---|
| Germany | € 135,921,309,789 |
| France | € 77,904,525,937 |
| United Kingdom | € 51,098,176,943 |
| Netherlands | € 49,772,342,725 |
| Belgium | € 25,831,541,208 |
| Italy | € 23,097,151,831 |
| Ireland | € 18,700,513,114 |
| Czech Republic | € 17,025,617,339 |
| Hungary | € 15,305,760,871 |
| Sweden | € 13,706,101,036 |
| Austria (in 2010) | € 10,170,769,704 |
| Spain (in 2010) | € 8,368,777,240 |
| Denmark | € 7,015,348,508 |
| Poland | € 6,384,739,121 |
| Finland | € 3,971,332,638 |
| Romania | € 3,681,227,474 |
| Slovakia | € 3,497,128,497 |
| Portugal | € 1,146,992,374 |
| Estonia | € 1,144,776,236 |
| Lithuania | € 1,126,785,261 |
| Slovenia | € 1,040,162,338 |
| Malta | € 970,580,746 |
| Luxembourg | € 915,016,105 |
| Greece | € 867,886,524 |
| Bulgaria | € 752,689,533 |
| Croatia | € 498,512,410 |
| Latvia | € 415,520,269 |
| Cyprus | € 75,343,943 |

## 5. CONCLUSIONS

The gap between Romania and the developed countries from EU is huge, that is the reason why it is imperative to stimulate the knowledge industries, to inovate more and to develop the educational system in order to be competitive on the national and international level. While Romania has set some basic foundations of a knowledge-based economy this is not enought and the efforts should be accelerated in the key areas.

Taking into consideration only the evolution of Romania in the recent years we can state that improvements were made in almost all sectors. Research and development expenditures are raising, human resources hired in in science and technology maintain at the same level (exceeding the 2000 level) number of patents is fluctuating but exceeds the number filled in 2000 but the volume of high tech export decreased in the last two years. When comparing the results of Romania with those of the European Union countries we can see that our country is way behind the developed countries due to multiple factors like:

- There are no tax incentive schemes for R&D activities.
- Since 2010 in Romania the hiring process in the research and development public organizations is blocked;
- There is no institutional funding for R&D;
- The banks offer loans for R&D;
- The phenomenon of brain drain is negatively impacting Romania's results. Romania is among the countries with the greatest loss of qualified personnel in the R&D field;

The main resource present in all four indicators is the human resource. The knowledge based economy requires well trained, creative, skilled and innovative human resource. The education system and the employment policies have to change in order to have more knowledge workers.

Taking into consideration that the core of the new economy is the capacity of a country to generate knowledge, it is crucial that the R&D activities to be supported by the government either by

creating special programs that encourage the R&D activities either by developing tax incentive schemes either by any other measure that will have a long term effect.
To make progress on this very important topic Romania will have to define its strengths and weaknesses within the four indicators in order to implement the right reforms in making a successful transition to the knowledge-based economy.

## 6. REFERENCES

Cooke, P., Loet, L. (2006). Regional Development in the Knowledge-Based Economy: The construction of Advantage. *Journal of Technology Transfer, 31*, 5-15.

Drechseler, P., Reinert, E., Kattel, R., Perez, C. (2009). *Techno-economic paradigms: essays in honour of Carlota Perez.* London: Anthem Press

Drucker, P. (1967). *The Effective Executive*. New York: Harper Business

Drucker, P. (2009). *Management: Revised edition.* New York: Harper Collins

Hayek, F. (1948). *Economics and Knowledge in individualism and economic Order*. Chicago: University of Chicago Press.

Hidalgo, A., Albors, J. (2008). Innovation management techniques and tools: a review from theory and practice. *R&D Management, 38*, 113-127.

Knmninos, N. (2013). *Intelligent Cities: Innovation, Knowledge Systems and Digital Spaces*. Abingdon: Routledge.

OECD. (1996). *The Knowledge Based Economy,* p. 9.

Nicolescu, O., Nicolescu, C. (2011). *Organiza□ia □i managementul bazate pe cuno□tin□e*. Bucure□ti: Editura Prounivesitaria.

Schumpeter, J. (1911). *The Theory of Economic Development*. Oxford: Oxford University Press.

The World Bank. (2005). *The Knowledge Economy, the KAM Methodology and World Bank Operations,* p. 4.