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From Lisbon to Bucharest: Innovation and Economic Development in Romania through the Lenses of the Lisbon Agenda

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1 Introduction

1.1 Background

The Lisbon European Council in March 2000 adopted a strategic document compounding a set of programs of economic reform that are intended to stimulate economic development at the European level in the context of serious problems faced by the EU that challenge its economic competitiveness and its position as a major player in the global economy. Recent studies show that the level of unemployment is growing, there is a gradual ageing of European societies, and in terms of productivity, investments in research and performance in science, technology and commerce, the EU lags behind its competitors, the USA and Japan. These serious challenges triggered the need for a coherent strategy at the EU level that can envision measures to stimulate economic growth and the Lisbon Agenda (Strategy) adopted in 2000 came as a response to this need.

The main aim of the Lisbon Agenda is to make the EU *"the most competitive and dynamic knowledge-based economy in the world, capable of sustained economic growth with more and better jobs and greater social cohesion"*. Some of the measures designed to achieve this goal target higher investments in education and training of human resources, increased investments in research & development (R&D) and the creation of a more favorable environment for business.

Policies towards innovation and R&D play an important role in the Lisbon Agenda. The Agenda is set to mark a turning point for EU enterprise and innovation policy by integrating the social and economic policy with initiatives to strengthen the research capacity of the EU, promote entrepreneurship and support the expansion of information society. One of the main provisions of the agenda towards innovation and research is represented by the Barcelona target: three percent of GDP should be spent on R&D, of which two percentage points should be private R&D expenditure. Thus, a clear focus is put on research, development and innovation as they are considered key factors of technological and economic growth. It is considered that increased investments and better policies in these fields can lead to a significant improvement in productivity at the same time being an important source of employment.

The Lisbon Agenda is the main program of economic reform at the EU level and has been a document of reference for national efforts in triggering economic growth. The implementation of the Agenda is regarded as a priority by the old member states as well as the new member states of the Eastern European region and the most recent acceding countries: Romania and Bulgaria.

1.2 Problem Description

There are difficulties arising in the implementation of the Lisbon Agenda. Studies such as the Wim Kok's report in 2004 show that the complexity and the multitude of objectives set in the Agenda are the main challenges for its implementation. The lack of a set of priorities among these objectives creates confusion for national governments around the issue of allocation and distribution of political and financial resources, namely governments are uncertain of where to raise and spend money and what priorities they should set. Should governments focus on education, social cohesion, R&D or agriculture? The Lisbon Agenda tells them to focus on all issues at once.

As a result of this complexity, the implementation process is tailor made for each country. Each government has its own interpretation on the scope and objectives of the agenda and sets its own priorities in relation with its own political agenda and the economic situation in each respective country. The difficulties in implementation and the relative weak success of the Agenda led to discussions about the *"Lisbon failure"* and determined in 2005 the reformation of the strategy giving it a new impetus. As the goals and targets of the Lisbon Agenda proved to be overly ambitious even for highly developed old member states, this triggers the need of serious and committed efforts from the part of national governments both in terms of the resources allocated and their capacity of decision making as well as their ability to design and implement viable policies.

These issues lead to an important question which is the research question of this paper: *if most developed member states of the EU face difficulties in implementing the Lisbon targets, are these attainable by the new, less developed member states such as Romania?* In the case of Romania, the discrepancy in technological and economic development between this new member state and Western European countries is even more pronounced. While most EU states are preoccupied about increasing social cohesion, creation of new jobs and better support for R&D sector, Romania has still more work to do in the fields of liberalization, competition, agriculture and improving the business environment. Will the Romanian government be able to set its priorities in alignment with the Lisbon objectives? Will it be able to commit sufficient resources and political will to implement the Agenda? The paper is intended to answer these questions with a special focus on the development of the R&D and innovation sector (RDI) as these are considered key drivers of economic growth in the Lisbon Strategy.

The research of this paper is oriented towards exploring the contribution of the Lisbon Agenda in triggering economic growth in Romania with consideration to national efforts (in terms of resources committed and policy making) made for its implementation. With serious committed efforts to improve the situation in the RDI sector, Romania might be able to reduce the technological and economic gap with the EU. Research focused on developments and possibilities in this respect is important as Romania can, through technological development and

economic reform, contribute to the development of the European knowledge base and increased economic competitiveness in the EU.

1.3 Approach

The paper consists of two main parts: a theoretical part (Chapters 2 and 3) intended to explore the rationale and logic of the Lisbon Agenda making use of the main theories on economic growth and studies on innovation and research, and an empirical research part consisting in an accurate analysis of the characteristics of the Romanian innovation system, the evolution of main innovation indicators, the development of policy measures to support the RDI sector and the policy tools in support of the innovatory private sector in Romania (Chapters 4,5 and 6). The theoretical part is intended to offer a better understanding of the rationale of the Lisbon Agenda and a better insight into the functioning and characteristics of innovation processes thus revealing the reasons for the clear focus of the Agenda on the RDI field. The empirical part offers a clear image on the characteristics and transformations of the Romanian innovation system as well as the progress that has been made especially in the post-accession period in the RDI field. The results of the research can indicate the capacity and efforts on the domestic level to implement the Lisbon Agenda and improve economic competitiveness of Romania.

Chapter 2 is focused on investigating the rationale of the Lisbon Agenda and explaining why great emphasis is put on knowledge and R&D in its policies envisaged to stem economic growth. The chapter starts with an overlook of the main objectives and priorities set by the Lisbon Agenda and continues with a definition of knowledge-based economy -which makes it necessary to give a definition of knowledge itself as opposed to information or mere data-, and ends with analyzing the main theories of economic growth (neoclassical and new growth theory) and the role attributed to knowledge in inducing economic development. Concentrating on these issues, this chapter will provide a good insight into the objectives and the rationale of the Lisbon Agenda, and a good understanding of its potential support for the member states in their efforts to trigger economic growth.

The Lisbon Agenda sets great importance on innovation and innovation policies. Since innovation is the key to growth, it is necessary to analyze how innovation occurs and how a country can enhance its innovative capacity. Chapter 3 will debut with an analysis of the innovation process and the transition from the linear model of innovation to a dynamic, systemic model. The linear model assumes that innovation stems from scientific research and creation of new knowledge while new studies of innovation claim that diffusion of knowledge, the relations between different actors in the economic system and the transfer of knowledge among them can also be sources of innovations. The systemic approach has led to the formation of the term *national innovation system* that has been increasingly adopted by national governments in the draft and implementation of policies towards innovation. Thus, this chapter will continue with an analysis of the concept of national innovation system, its definition and components, the

rationale for policy intervention and methods of measuring innovation. The study will give a good insight into the functioning of innovation processes that can lead to the formation of new policy perspectives and approaches in the field of RDI.

In order to assess the capacity of Romania to implement the measures prescribed by the Lisbon Agenda, it is necessary to analyze the characteristics and transformations of its national innovation system. Chapter 4 contains such an analysis, looking at the level and evolution of main indicators used for measuring innovation. This kind of research has however some limitations as there are few innovation studies regarding Romania based on the use of modern indicators (as developed by OECD and the Oslo Manual and the European Commission) that can better grasp the creation and transformation of relations between stakeholders in the innovation process, institutional changes and knowledge diffusion. New indicators are more useful in capturing the transformations and changes in the national innovation system. Thus, the research in Chapter 4 is limited to the use of traditional indicators such as: the number of researchers, the capabilities of education for research, R&D expenditures (public, private, foreign), the number of patents and the number of innovatory enterprises, which can nevertheless offer a clear picture of the progress in the field of RDI in Romania.

The lack of studies based on the application of modern innovation indicators is compensated in Chapter 5 by a study of main policy developments in the field of RDI that are intended to shape the Romanian innovation system. The study offers an even clearer image on the institutional changes and the connections between the actors in the innovation system namely: universities, R&D institutes, private enterprises and public authorities, which are to be created by the implementation of new policy tools. So Chapter 5 is intended to make an assessment of the main policy measures on RDI in relation with the requirements set in the Lisbon Agenda and taking into consideration the fields where there is a drastic need for public intervention as the main indicators show. Important policy documents will be analyzed in this chapter such as the *National RDI Strategy 2007-2013*, the *Sectoral Operational Program "Increasing Economic Competitiveness"* and other programs that have been designed in conformity with the Lisbon targets and the *National Development Plan 2007-2013.*

The Lisbon Agenda sets great importance on the private sector as stimuli of innovation especially on small and medium sized (SME) companies as they are the major source of employment and growth in Europe. Chapter 6 analyses the supportive measures designed for Romanian innovative enterprises in national policy that can reveal the potential of the business sector to innovate and induce economic development in the country. This chapter will concentrate on important supportive measures for SMEs such as fiscal incentives, micro credits, state aid regulations and the role of venture capital. Hopefully, this analysis will offer a clear picture on how stimulating is the environment for SMEs to innovate. There are effective policy tools which can be used to tackle market failures and encourage private investments in RDI. Romania can make use of these policy tools to create a more favorable environment for innovatory business sector.

Chapter 7 consists of the relevant conclusions drawn from the research as regards the capacity of Romania to implement the Lisbon targets by making serious reform in the field of RDI and shaping its national innovation system. Conclusions will show how far is Romania from achieving the objectives of the Lisbon Agenda, how far is from attaining at least similar levels of technological development as in the most of EU member states and how much progress is still to be made in this respect.

1.4 Methodology

The research in this paper is based on the consultation of relevant literature and journal articles containing studies on innovation processes, research and technological development especially for the theoretical part. Studies on the development of economic theories of economic growth are considered and a large number of studies on the concept of national innovation system, innovation models (linear, systemic) and innovation policy perspectives. The empirical research is based on diverse sources of information. Thus beside relevant literature and journal articles, there is the need to contain, analyze and compare data from European and national surveys, reports and statistics and also information provided by national policy programs and strategies. Moreover, in order to complete the information from the official sources and to gain a greater insight into the characteristics of the Romanian innovation system, secondary sources of information are used such as interviews and electronic correspondence with experts and professionals, data collected from specialized electronic forum of discussions and participation at national conferences organized on relevant topics for this paper.

1.5 Related Work

Several studies have been carried out analyzing economic competitiveness with a focus on RDI indicators in Romania especially by Governmental institutions in the framework of preparations for the elaboration of the *National Strategy for RDI*, *National Economic Development Plan* and operational programs for the application of EU funds for regional development and economic and social cohesion. The evolution of innovation indicators in Romania is also monitored by the European Commission through the *European Trend Chart on Innovation* and *European Innovation Scoreboard*, by the OECD and the World Bank. However, most studies are based on the use of traditional innovation indicators (focused on inputs and outputs to innovation) that offer only a static snapshot of technology performance which neglects how the various actors in the country interact in the innovation process. Few studies have been elaborated (regarding Romania) based on the modern concept of national innovation systems.

The research of this paper is based on the application of modern evolutionary economic theories on economic growth that offer a new view on innovation processes regarded from a systemic approach and based on the concept of innovation systems. This new approach on research and innovation offers different policy perspectives in the RDI field which comes to help governments design better policies towards innovation. The developments in the RDI field in Romania are regarded from a national innovation system perspective with the aim of revealing

important transformations and changes in the system. Romania, as most of Central and Eastern European Countries is in process of re-shaping its RDI system and such perspective can reveal the institutional changes taking place in the restructuring process.

A similar approach has been used in the *Innovation Policy Trends and Appraisal Report* for Romania for the *European Trend Chart on Innovation* (2006) and the consultation with the experts that worked on the report was very insightful into the transformations in the RDI sector in Romania. Also the collaboration with the experts of the Group of Applied Economics, Bucharest, was a vital source of up-dated information, data and professional opinion.

2 The Rationale of the Lisbon Agenda

The Lisbon Agenda is committed to achieve an ambitious goal: to make the EU *"the most competitive and dynamic knowledge-based economy in the world, capable of sustained economic growth"*. The transition towards a knowledge-based economy is to be achieved through the implementation of better policies for R&D and information technologies and by fastening the process of structural reforms for innovation and competitiveness. The Agenda also refers to an increase in the commitment of resources towards research and development. As it can be noticed, the Lisbon Agenda, places great importance on the role of knowledge, R&D and technology as drivers of economic growth in the EU. The purpose of this chapter is to investigate the rationale of the Lisbon Agenda and to explain why great emphasis is put on knowledge and R&D in its policies envisaged to stem economic growth. The chapter starts with an overlook of the main objectives and priorities set by the Lisbon Agenda and continues with a definition of knowledge-based economy -which makes it necessary to give a definition of knowledge itself as opposed to information or mere data-, and ends with analyzing the main theories of economic growth (neoclassical and new growth theory) and the role attributed to knowledge in inducing economic development. Focusing on these issues, this chapter will hopefully provide a good insight into the objectives and the rationale of the Lisbon Agenda, and a good understanding of its potential support for the member states in their efforts to trigger economic growth.

2.1 Provisions of the Lisbon Agenda

At the Lisbon European Council in March 2000, the European leaders agreed on a ten year program aimed at revitalizing growth and sustainable development in the EU. The program was set as a response to the challenging that Europe was facing from globalization, an ageing population, unemployment and the emergence of a world -wide information society. It was decided that the response to the main economic and also social issues in the EU should be set in the context of *"a positive strategy which combines competitiveness and social cohesion"* with the overall goal of making the EU *"the most competitive knowledge-based economy in the world by 2010, capable of sustainable economic growth with more and better jobs and greater social cohesion"* (following the Presidency conclusions of the Lisbon Summit, 2000).

It was agreed, that in order to achieve this goal, a set of priorities and objectives need to be put in place. Thus, the strategy should be aimed at (EURACTIV, Lisbon Agenda): preparing the transition to a knowledge-based economy through better policies for the information society and R&D, and also by enhancing the process of structural reform for competitiveness and innovation and by completing the internal market; modernizing the European social model through investment in people and combating social exclusion; sustaining favorable growth prospects by applying appropriate macro-economic policy mix. A multitude of objectives are set according to these three priorities namely (Verdun, 2006): investment in education, R&D, improve the business climate by cutting down the red tape, investing in the skills of citizens,

increase childcare facilities, increase employment by providing apprenticeships for graduates and achieving a sustainable environment (including exploiting sources of sustainable energy).

Policies towards innovation and R&D play an important role in the Lisbon Agenda. The Agenda is set to mark a turning point for EU enterprise and innovation policy by integrating the social and economic policy with initiatives to strengthen the research capacity of the EU, promote entrepreneurship and support the expansion of information society. One of the main provisions of the agenda towards innovation and research is represented by the Barcelona target which refers to guideline 12 (To increase and facilitate investment in R&D) of the 23 integrated guidelines for growth and jobs. The target contains a clear mark: three percent of GDP should be spent on R&D, of which two percentage points should be private R&D expenditure (Groenendijk, 2006).

Thus, one of the priority areas that should be pursuit in order to enhance economic growth in the EU is underlined by the Lisbon Agenda as being the formation of the knowledge-society with a strong emphasis on innovation and research. Actually a major concern on the EU policy agenda today is how to shape an institutional context that enhances the innovation process as a whole, and that responds to the risks and social consequences of scientific advances (Borras, 2003). This requires a re-conceptualization of the functional borders of existing policy areas and the development of new ones. Issues such as designing better innovation policies and the implementation of the Barcelona target will be dealt with by member states in their national action plans which are coordinated at the EU level through the open method of coordination.

Investment in research and a focus on innovation was acknowledged as the response to the many challenges that the EU is facing. One of these problems is the high level of unemployment. Even the most optimistic forecasts for growth and unemployment hold out no hope of a rapid reduction in unemployment levels (Laredo&Mustard, 2001:163) which triggers the necessity of serious policy efforts to secure long-term development. Innovation policies and a focus on research are considered a way to create more jobs in the EU. There is another challenge that shows even more that Europe must innovate: the gradual ageing of Western societies. Many recent studies suggest that Europe's population will be one of the oldest in the world which triggers the need for a great increase in the level of productivity. Such an increase will only be possible if Europeans invest hugely in research and new technologies. Another worry at the EU level is that in terms of productivity, investments in research and performance in science, technology and commerce, the EU lags behind its competitors, the USA and Japan. Revitalizing the innovativeness of the EU economy and increasing investment in new technologies and research are considered by the European leaders a priority for stemming economic growth.

All in all, research and innovation play an important part in the Lisbon Agenda. They are considered important drivers of economic development and the key factors to a transition to a knowledge-based economy. It is important therefore to analyze the motivation of such consideration and the rationale of the Lisbon Agenda in this respect. It is important to ask

questions such as what a knowledge-based economy is and why knowledge and innovation are considered the main drivers of economic growth. These questions will be dealt with in the following sections.

2.2 Data, Information and Knowledge

A precondition of managing a definition of the knowledge-based economy is drawing a definition of knowledge. In any attempt of doing so one may ask what is the difference between data, information and knowledge considering that they are all intangible products of human mind? The importance of making the difference lies in the fact that, as we shall see, knowledge has its specific characteristics regarding its production and use, characteristics that once acknowledged, can play an important role in inducing change in the behavior of economic agents.

Rooney D. (2003) makes a clear distinction between data, information and knowledge. He defines data as being "*unorganized bits*" like numbers, sounds, images, words which form the basic building blocks of information. Unlike information and knowledge, data is unanalyzed, un -manipulated in other words, unprocessed. Once this data is organized in the form of texts, patents, statistics it becomes information. Information can be represented in the form of books, journals, even on the Internet websites. Information is important in the context of knowledge-based economies because in such economies the first economic interaction or contact involves the exchange of information. Knowledge is different than mere information in the sense that it results from the processing or sense making of information by the human mind. Knowledge consists not only of processed information, but also of values and beliefs acquired through "*meaningfully organized accumulation of information*" through experience, communication and inference (2003:4). Here lies the essentials for a distinction between types of knowledge: knowledge that is processed information which can easily be expressed in word, text, blueprints and can be easily captured in symbolic codes thus making it easy to be shared with social groups, also called codified knowledge; knowledge that cannot be easily captured or codified as it is acquired through one's experience also called tacit knowledge.

This difference can also be expressed in terms of "*publicness*" and universality versus *"tacitness*" and specificity of knowledge. Tacit refers to those elements of knowledge, insight, that individuals have which are ill defined, unpublished, un-codified and that cannot be fully expressed but which may to some significant degree be shared by individuals that have a common experience (Dosi, 1990:113). Thus, it can be said that scientific inputs are typically universal and public as they can be easily codified, while tacit knowledge is embedded in human beings as a result of their experience.

Another type of differentiation makes the distinction between "*know-who"*, "*know-what"*, *"know-how"* and "*know-why"* types of knowledge (OECD, 1996:12). Information is generally the "*know-what"* and "*know-why"* parts of knowledge as these are easily codified. The

"*know-how"* and "*know-who"* components are more difficult to be codified thus they constitute tacit knowledge. *"Know-what"* refers basically to facts and is close to what is normally called information. "*Know-why"* refers to scientific knowledge about the laws of nature. This type of knowledge produces technological development and product and process advances in industries. It is produced mainly in laboratories and universities. "*Know-how"* refers to skills required to do something like the worker handling complicated machines. It refers to the skills and capability to do something. The "*know-who*" refers to information about who detains the necessary knowledge namely where to go to obtain the needed knowledge. This type of knowledge assumes the formation and maintenance of social relations with and between experts that have the necessary skills and knowledge.

Understanding the special characteristics of knowledge is an important step to any attempt of defining the knowledge-based economy. This type of understanding revealed new insights into the processes of production, use, distribution and management of knowledge that ultimately laid down the basis for the transition to knowledge –base in several economies. The process of transition is dealt with in the following section.

2.3 The Emergence of Knowledge-Based Economies

Economies in developed countries are increasingly based on knowledge and information. The term "*knowledge-based economy*" stems from the full recognition attributed to knowledge and technology in modern economies. So, what is a knowledge-based economy and how did it emerge?

As defined in the relevant literature, a knowledge-based economy is an economy in which knowledge is the most important productive factor (see Rooney, 2003:16). Thus, the phrase refers to the use of knowledge to produce economic benefits. The transition from a market economy to a knowledge based economy has been noticeable in the post-industrial era and has been preceded by important changes throughout the society, changes that are accurately analyzed in the works of Peter Drucker (1966, 1969 and 1993) and Bell Daniel (1974).

The term knowledge-economy was first introduced by Peter Drucker in 1966 in a book called *The Effective Executive* where he referred to the difference between the manual worker and the knowledge worker. While the manual worker works with his hands and produces things, the knowledge worker works with his head and produces ideas, knowledge and information (1966:3). Drucker accurately noticed the changes in the nature of work and the characteristics of workers in the post-industrial period and he attributed a greater role to knowledge as an input as well as an output of work than to goods and services. He gave a deeper insight into these changes in his following work *The Age of Discontinuity* (1969) where he observed the emergence of "*knowledge industries*" which have produced and distributed information and ideas rather than goods and services from 1950s onwards. He keenly noticed that the knowledge sector had been

gaining in importance thus by the late 1970s it would have accounted for one-half of the total national product in the United States. The expansion of the knowledge sector is emphasized:

> *" Every other dollar earned and spent in the American economy will be earned by producing and distributing ideas and information and will be spent on procuring ideas and information"* (1969:247).

Thus, it is emphasized that from an economy of goods, which the United States had been, it changed into a knowledge economy. In the knowledge economy the central role is played by the "*professional, managerial and technical people"* (1969:248) namely the knowledge workers which have overshadowed the role of the manual worker in economy. The knowledge worker is better paid than the manual worker and also has e greater job security. This reflects the fact that knowledge has become the central cost of the American economy and the productivity of knowledge has become the key to productivity and economic development. As, Drucker underlines,

> *"(…) knowledge has become the central factor of production in an advanced economy and (…) it is today the foundation and measurement of economic power"* (1969:249).

Thus, it is recognized that knowledge has come to represent now the main cost, investment and the main product of an advanced economy and the livelihood of the largest group of population. Drucker places even a greater role on the use of knowledge as a source of productivity rather than on science and technology. In other words the practical use of knowledge and its application increase productivity and growth rather than pure science. He also defined the technology gaps between countries in terms of the difference in levels of development of their knowledge-base:

> *"When the Europeans complain about the brain drain and the technology gap, they are only asserting that their economies are not sufficiently knowledge-based to perform, grow and compete"* (1969:250).

The characteristics of knowledge presented in the previous section play an important role in the knowledge economy. As Drucker underlines, a knowledge economy requires skilled persons who are applying knowledge to their work and are learning fast through experience namely are acquiring tacit knowledge. Thus knowledge substitutes systematic learning with *"exposure to experience"* (1969:251). Knowledge is different from information and has only relevance when applied to work:

> *"For the intellectual, knowledge is what is in a book. But as long as it is in a book, it is only information or mere data. Only when a man applies the information to do something does it become knowledge"* (1969:252).

The key towards a knowledge economy is the increase in working life span. Here the Scientific Agriculture and Scientific Management are the heroes as they introduced the appliance of knowledge to work which led to working less and more effective and efficient. Thus, the logic to productivity is not to work more but to work more efficient. This led people working longer in healthier conditions. This, together with the shift from farming as a basic occupation led to an increase in life-span. An increased life-span has led to substantial extension of years spent in being educated. More educated individuals required in turn more knowledge jobs.

Another factor stemming the expansion of the knowledge sector has been the change in the understanding and use of knowledge. Understanding of knowledge has shifted from being regarded as dealing with existential issues to being created and used in more practical and productive ways:

> *" Ideas about what knowledge is useful for changed from being seen to be about esoteric and existential issues, to being viewed as more about doing things and about its utility as a resource, an asset and a product"* (Drucker, 1993).

Furthermore, the transition towards a knowledge economy has implied not only changes in the production and use of knowledge but also a change in the diffusion of knowledge. Thus, especially during the 21st century, the speed and volume at which information is sent around the world through the mass media, the internet, and computer has been more observable. The development of communication technologies made it possible for a more extensive diffusion of information and transfer of both codified and tacit knowledge. An economy of ideas was in existence for a long time even before the industrial revolution which contributed to the economic wealth of communities but much knowledge was poorly distributed and inaccessible to the vast majority (Rooney, 2003:16). Suitable means and institutions for the promotion and diffusion of knowledge were not adequately developed and the links between knowledge and industry became stronger only in the post-industrial era. Thus, the expansion of the knowledge sector has been facilitated also by means of diffusion of knowledge.

The emergence of the knowledge economy is related by Bell Daniel to changes in post-industrial society in his work *The Coming of Post-Industrial Society* (1974). For Bell, the post-industrial society represents a fundamental shift from a society based on heavy industry to a society related to the age of information, high-tech and the service industries. People with technical knowledge - defined by Drucker as knowledge workers- such as economists, mathematicians, computer scientists and engineers come to play an important role in determining the direction of society. Thus, there has been an increase in white-collar workers which enjoy greater autonomy. Another determinant of change is the increase role of knowledge which provides the basis on which society moves forward through policy and social innovation. Moreover, what characterizes post-industrial society is that is organized around knowledge for the purpose of directing innovation and change (1974: 20).

All in all, it can be concluded that advanced countries have moved towards a knowledge economy in the post industrial era. The key to this change is the transformation of the understanding of knowledge as it has become used and applied to work. Knowledge is seen as a resource, an investment and product that can increase productivity and stem economic growth. A more efficient way of working increased the life span of individuals which attributed an increasing importance towards education. Nowadays, the single majority group consists of knowledge workers while manual workers are the minority. Knowledge is regarded an important factor of productivity underpinning economic growth and power. Thus, the efforts of the Lisbon Agenda to strengthen the knowledge base of the EU economy seem to be a justified step to enhance economic power. The transition to a knowledge economy seems to be the solution to economic problems. But one may ask, how does knowledge trigger economic growth? How is a knowledge economy different from a market or political economy? The next section is dealing with these questions by using economic theories in order to gain a deeper insight into the concept of knowledge economy.

2.4 Theories of Economic Growth

For a better understanding of the functioning and characteristics of the knowledge- based economy it is necessary to look into the main theories of economic growth and the role which they attribute to knowledge in underpinning economic advancement. Analyzing this relation between knowledge and growth can give an important insight into the rationale of the Lisbon Agenda which puts emphasis on knowledge, technology and innovation as central sources of economic development.

2.4.1 Neoclassical Theory

The main theories of economic growth analyzed in this section are the neoclassical theory and the *"new growth theory"* or the evolutionary theory of growth as they both represent important developments in our understanding of economic growth. Before exploring these theories it is necessary to draw the difference between certain terms that will be used in this section as to clarify beforehand their meaning. It is important to distinguish between science, technology and innovation. Science and technology are both types of knowledge in alignment with the classification made in the beginning of this chapter. In brief, science is "*know-why*" namely knowledge about the laws of nature while technology is "*know-how*" namely how to do things, which is mainly tacit knowledge embodied experience and is inherently much more difficult to transfer. There is a close relationship between science and technology as *"science without the byplay of technology becomes sterile, while technology without science becomes moribund"* (Jones, 1971:6). Without giving now a more detailed definition of innovation as this will be dealt with in another section, for now it suffice to say that innovation is the commercial exploitation of technical knowledge to win new markets or hold existing ones by introducing new or more efficient products or processes (1971:8).

The roles of knowledge (codified and tacit) in the form of science and technology and that of innovation are regarded differently in the two economic theories that are about to be discussed and also the connections between them. Firstly, it should be mentioned that in both theories of growth, knowledge and innovation are considered drivers of economic growth. Technological change caused economic advancement in many developed countries. The neoclassical theorists see as the primary source of technological change being scientific discoveries which are the stimulating force behind innovation (Grossman & Helpman, 1991: 4). Scientific advances are seen to reflect the interests and resources of a community of researchers operating outside the profit sector of the economy. Thus, in this view, a scientific basis for industrial innovation would move the technological progress from the realm of economic analysis. In the neoclassical theory, economic growth is mainly driven by accumulation of capital and labor while technological progress helps to explain the *"Solow residual"* growth namely the portion of measured growth in national product that cannot be attributed to the accumulation of inputs (1991:23). Thus, technological progress is considered an exogenous process driven only by time which implies the assumption that advances in technological knowledge stem largely from activities that take place outside the economic sector. The knowledge sector is exogenous and is supported by the government which by imposing taxes is funding the research. Innovation is considered to be driven by basic research which is available to everyone.

The economic system defined by the neoclassicists is characterized by equilibrium where the product space is given, technology is given, firms are mere holders for technological possibilities which are available to everyone and there is no noticeable process of competition (Aghion&Howitt, 1998:3). So, technological progress is the only source of productivity growth in the long-run equilibrium i.e. per capita income will be constant if technical progress does not accrue. Savings and investments decisions determine only the level of long-run productivity and not its growth rate as growth is independent of economic decisions (Hagemann&Seiter, 2003). Moreover, neoclassical theory is deducing all decision rules from maximization on the part of the firm (Freeman, 1990:10), namely any decision is dominated by the profit motive consideration. In this assumption, investments made by firms in research do not bring returns in capital as profit is mainly determined by lower prices and/or increased quantities of products.

Thus, neoclassical theory on economic growth is based on the assumption that growth is mainly driven by accumulation of factors such as capital and labor and technology is used to explain the residual growth in national product that cannot be explained by the accumulation of inputs according to the Solowian model. The major force behind economic growth is casted upon the accumulation of capital. To capital the neoclassicists attributed a narrow interpretation. The typical specification invokes a competitive manufacturing sector that employs the services of capital in a constant-returns-to-scale production technology. It also makes the technology for producing capital similar to that which applies to the production of consumer goods (Grossman&Helpman, 1991:22). These assumptions seem appropriate when capital refers to

machinery and equipment. But human capital and knowledge capital have specific economic properties that cannot be well represented by the standards formulation.

All in all, in the neoclassical approach, technological progress is driven by basic research which is supported by the government and is made by a community of researchers not seeking profit. Thus, economic growth is considered to originate outside the economic system and it results from research and major discoveries that are taking place in laboratories and scientific institutions. But aren't firms also willing and capable to undertake research and induce technological progress? Is basic research the main driver of technological advancement? The advocates of the new growth theory oppose the basic assumptions of the neoclassicists and this will be dealt with further.

2.4.2 The New Growth Theory

Contrary to neoclassical assumptions, the *"new growth theory"* or also called *"evolutionary theory"*, claims that technological progress is not exogenous but stems inside the economic system and is not induced only by science and basic research but also by processes of learning and problem-solving undertaken by various organizations among which firms are the focus of attention. The environment in which economic agents operate is not one of equilibrium but a dynamic system where firms respond to changes and economic activities are underlined by uncertainty and unpredictability. In this competitive environment firms undertake research and innovation activities in order to improve their productivity and profitability which are determined by efficiency and innovation quality rather than prices and quantity. This section is providing more insight into the body of new growth theory.

In contrast with neoclassical theory, new growth theory places technological progress into the center of economic analysis by claiming that innovation activities stem from the innovative activities of firms which are expecting profitability. Schmookler (1966) made an influential study of almost a thousand inventions and he concluded that besides discoveries and major inventions,

> " (…) *the stimulus for innovation was the recognition of a costly problem to be solved or a potentially profitable opportunity to be seized, in short, a technical problem or opportunity evaluated in economic terms"* (in Grossman&Helpman, 1991: 5).

Schumpeter (1942) came to the same conclusion when asking:

> "*Was not the observed performance of technological progress due to that stream of inventions that revolutionized the technique of production rather than to the businessman's hunts for profits?"* (1991:5)

namely that it is the expected profitability of inventive activity that determines the pace and direction of industrial innovation.

The new growth theory has received great attention from the 1980s onwards when Paul Romer's seminal paper (1986) was written which lies down the basic principles of the new theory. Since then, the so called new growth theory challenged the traditional neoclassical assumptions which are considered to have theoretical and empirical shortcomings. The main criticism of Romer is that the Solowian type models cannot explain endogenously steady-state per capita growth and omit to cover the relations between economic activities and technical progress as well as productivity growth (in Hagemann&Seiter, 2003). In contrast with neoclassical claims, Romer underlines the fact that firms have a stimulus for research and innovation and this is driven by competition. Thus, competition between companies is seen as a precondition for technical progress. He considers that R&D leads to new products and therefore to competitive advantages for firms. If innovators are successful they will gain market power that enables them to gain extra profits. This is seen as the main incentive to invest in research and to bear the risks of failure. Further on, it is to be mentioned that there is actually no rivalry in the use of knowledge as competitors can make use of the new knowledge with zero costs and even challenge the position of the former innovators and become innovators themselves.

This process can be represented by Joseph Schumpeter's notion of *"creative destruction"*. This is a competitive process by which entrepreneurs are constantly looking for new ideas that will make their rival's ideas obsolete (Aghion&Howitt, 1998). On this token, the focus is on innovation as a distinct economic activity. This approach makes possible a deeper understanding of how organizations, institutions, markets, trade, government policy and laws affect long-run growth through their effects on economic agents' incentives to undertake innovative activities. It also involves a new approach on the activities of firms and the environment in which they operate. The commitment of the new growth theory is to have a *"behavioral*" approach to firms which has the premise that a firm at any time operates largely according to a set of decision rules that link the environmental stimuli to a series of responses on the part of firms (Freeman, 1990:8). While neoclassical theory attempts to deduce these decision rules from maximization on the part of the firm, the behavioral approach takes them as given and observable. Prominent among the process of rule change within the firm are those that involve deliberate, goal-oriented search or problem solving activity. Thus, while the profit motive remains the dominant motivational consideration, the new growth theory approach is consistent with a *"managerialist*" emphasis on growth (1990:9). The decisions and the strategy of firms are highly influenced by complex factors such as market prices, information concerning the decision rules of other firms (the basis for imitative behavior) and exogenous changes in relevant knowledge.

Thus the environment is not one of equilibrium and perfect information but it is a competitive environment characterized by uncertainty, struggle and motion. Any set of careful calculation or well defined choice is absent. This does not mean that firms do not carefully assess their decisions but the characteristics of the environment makes it difficult to make clear cut choices and makes it even harder to foresee the consequences of R&D and innovative activities.

In this environment firms operate in contrast with neoclassical ideas and in alignment with the Shumpeterian theory as *"innovative entrepreneurs"* who are seen as being the real drivers of the system (Hagemann&Seiter, 2003:17). Firms may seek profit and may innovate or imitate to achieve higher profit. Firms gain thus competitive advantages by innovating rather than by varying prices and quantity. Here a distinction can be drawn between the characters and functioning of firms in both theories. While the neoclassical theory sees an optimizing firm and taking as given technological capabilities and market prices the firm seeks to maximize profits on this basis by gaining advantages through lower cost products, the new growth theory focuses on innovating firms that seek to transform the technological and market conditions by undergoing historical transformation (Lazonick, 2004:31). This distinction is important as it leads to the core assumption of the new growth theory namely that technological progress stems from within the economic system with the central focus on firms as innovators and the key drivers of progress.

Another main distinction between the two theories is that while the neoclassical theory puts emphasis on human capital, the new growth theory focuses on knowledge (science and technology) as the engine of growth. In neoclassical assumption and Adam Smith's ideas need to be presented, the growth process is driven by the impact of capital accumulation on labor productivity (Salvadori, 2003:3). Smith draws attention on the factors determining the growth of labor productivity, that is, the factors affecting:

> *"(…) the state of the skill, dexterity and judgment with which labor is applied on any nation"* (2003: 4).

Here the accumulation of capital enters the scene because in Smith's assumption the key to the growth of labor productivity is the division of labor. However, what Smith's analysis foreshadows, and which is better captured in the new growth theory, are the concepts of induced and embodied technical progress namely learning by doing and learning by using which produces and uses tacit knowledge. The invention of new machines and techniques and the improvement of existent ones is said to be originally due to the workers in the production process and those who have the occasion to use the machines while the knowledge factor is neglected.

Knowledge is considered an actual economic commodity in the new growth theory hereto the term knowledge-based economy namely an economy where knowledge is the central factor of productivity and growth. But how exactly can knowledge induce growth? The main input into creation of knowledge is R&D. Basic research conducted by institutes and laboratories creates a public pool of knowledge which constitutes science and is public and universal. Research can be conducted within the innovative units of firms which involve processes of problem solving and learning. This type of knowledge is tacit and not public. It also involves the particular skills and capabilities of workers. Thus, the creation of new knowledge depends on investments in R&D, education and training (Jones, 1971:7). But no new knowledge by itself contributes to economic growth. Only when the knowledge or invention is incorporated into the production system (new

products or/and new processes) can economic growth result (1971:8). Thus the key factor in growth is innovation, the occurrence of new ideas that are economically exploited. The logic is thus as follows: when research leads to new knowledge which leads to innovation, then economic growth occurs. So, while the neoclassical theory claims that the level of technological development of a country depends primarily on the relation between capital and labor, the new growth theorists relate the technological level of a country to its level of *"innovative activity"* (Fagerberg, 1990: 56).

But innovation does not occur in an environment of perfect information. An innovative solution to a problem for example involves discovery and creation since no general algorithm can be derived from the information about the problem that generates its solution automatically. Innovators must rely on the knowledge available to them, on experience and skills. So a knowledge-base represents

> *"(…) the set of information inputs, knowledge and capabilities that inventors draw on when looking for innovative solutions" (*Dosi, 1990:12).

The fact that the environment is not of perfect information has great impact on the activity of innovators and it can be related to processes of *"knowledge diffusion"* and knowledge "*spillovers*". Knowledge is seen as multidimensional (tacit vs. codified) and open to interpretation. The creation, coordination and diffusion of knowledge are dynamic and cumulative processes and innovation processes result from the coordination of distributed knowledge (Llerena et. al., 2005). Innovation activities depend highly on the knowledge at the disposal of innovators which would imply the creation of various channels for acquiring knowledge which in turn involves the development of relations between organizations, firms, institutes, laboratories etc. Innovation is thus regarded from a systemic view. This is why Rooney (2003) talks about *"knowledge systems"* namely:

> *"Knowledge development proceeds in networks of dense interconnectivity tensions and complementarities which add an unpredictable quality to knowledge systems"* (2003:57).

Innovation also implies uncertainty due to knowledge spillovers. By spillovers it is generally meant that firms can acquire knowledge created by others and that the creators of the respective knowledge might not have effective recourse under prevailing laws (Grossman&Helpman, 1991:16). As knowledge is not a physical good, property can be protected more difficult in this case. Nevertheless, intellectual rights are assigned to owners of new ideas in order to allow them to appropriate the benefits of their inventive efforts. However, in the case of physical commodities, it is easier to prevent, when violations are alleged, and it is easier to establish culpability. In the case of ideas it is more difficult to ascertain whether there was an illegal use of another's property.

Notwithstanding this, intellectual rights are a good incentive for innovators to gain monopoly of their inventions and to continue to innovate. On the other side of the coin, knowledge spillovers may be very important to the growth process (1991:17). The general knowledge that researchers generate and cannot prevent from entering the public domain often facilitates further innovation. Thus innovation can be a self-perpetuating process. In fact, while workers can produce ever-improved consumption goods, innovators can permanently invent new or better products or production processes that can trigger long-run growth (Hagemann&Sieter, 2003:16).

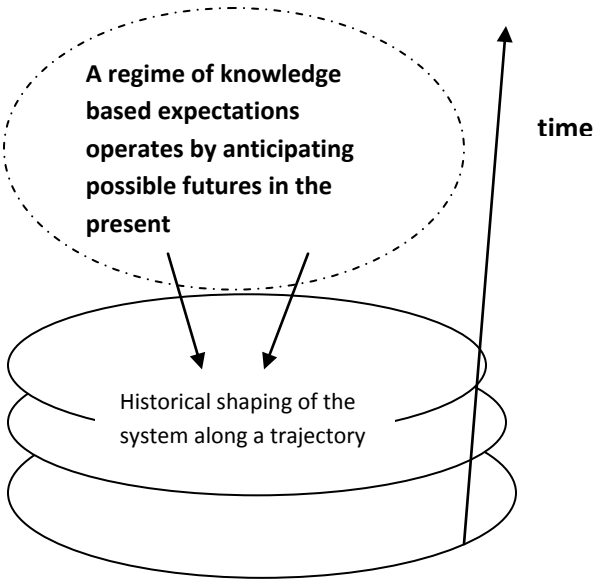
The previous section dealt with the definition of the knowledge-based economy. Studying the main assumptions of the new growth theory provided a better understanding of this concept and of the role of knowledge in inducing economic growth. Therefore it can be mentioned that the knowledge based economy is characterized by at least two features: that knowledge is a major factor in economic growth, and that innovation processes are systemic by nature. Moreover, it can be argued that a knowledge-based economy exhibits different dynamics than those of market-based or political economy. The systemic approach to knowledge provides a third coordination mechanism to the social system in addition to traditional mechanisms of economic exchange and political decision making (Leydesdorff, 2006:15).

To explain this matter, it is needed to be said that the knowledge base of a social system can be developed over time through processes of theoretically informed deconstructions and reconstructions. The way knowledge operates is by informing expectations in the present on the basis of previous operations in the system. Expectations open discourse towards future events and reconstructions. Thus, a knowledge based economy is driven more by codified anticipations than by its historical conditions (2006:17). So the orientation towards the future inverts the time axis locally. Thus, while a technological trajectory follows the axis of time, a knowledge based regime operates within the system in terms of expectations, that is, against the axis of time (see fig.1).

The production and control of organized knowledge also exists as a sub dynamic of the socio-economic system. The dynamics of innovation upset the market dynamism in the way that while market forces seek equilibrium at each moment of time, novelty production generates *an "orthogonal sub dynamic"* along the time axes (2006:19). Novelty production and economic substitution at each moment of time can be considered as independent sub dynamics. These sub dynamics however interact, in the case of innovation. Improving the system innovatively implies that one is able to handle the system purposefully namely reinforce it. This reinforcement can occur differently at some places.

Thus another dimension is added to the system, namely geography, potentially the nation level of whatever is invented, produced, traded or retained.

Figure 1. The operation of knowledge-based regimes according to the time axis



Source: Leydesdorff, 2006:17

Thus, innovation needs to be dealt with in a systemic way and the system can be reinforced. The system is also geographically determined mainly at the national level. So, the following question is: Can we talk about national systems of innovation? How do they operate and how can they be managed and reinforced? This matter will be dealt with in the following chapter.

*

In conclusion, it can be stated that advanced countries have moved towards a knowledge economy in the post industrial era and the key to this change is the transformation of the understanding of knowledge as it has become used and applied to work. Knowledge is seen as a resource, an investment and product that can increase productivity and stem economic growth. The main economic theories on economic growth provide a good understanding on the role of knowledge in stemming economic development. Thus, in the neoclassical approach, technological progress is driven by basic research which is supported by the government and is made by a community of researchers not seeking profit therefore economic growth is considered to originate outside the economic system. In contrast with neoclassical assumptions, the new growth theory claims that technological progress is not exogenous but stems inside the economic system and is not induced only by science and basic research but also by processes of learning and problem-solving undertaken by various organizations among which firms are the focus of attention. In this assumption, firms are innovative entrepreneurs that interact with various actors in processes of knowledge production and diffusion. Thus, innovation activities occur in a system and this system can be reinforced and transformed.

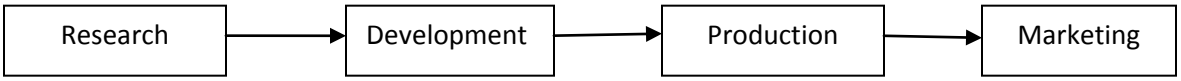
3 National Innovation Systems

The previous chapter has focused on explaining the rationale of the Lisbon Agenda and its focus on the transition to a knowledge based economy where knowledge is the main driver of economic growth. It has been explained that once the new growth theory emerged and developed, knowledge has increasingly been considered as the main factor of productivity and the central inducement of growth. Thus, differences in growth between countries are considered in this approach to be attributed mainly to their capacity to innovate and not to the mere accumulation of capital. In this view, new knowledge that is translated into innovation plays a central role in the process of economic growth. Since innovation is the key to growth, it is necessary to analyze how innovation occurs and how a country can enhance its innovative capacity. This chapter will debut with an analysis of the innovation process and the transition from the linear model of innovation to a dynamic, systemic model. The linear model assumes that innovation stems from scientific research and creation of new knowledge while new studies of innovation claim that diffusion of knowledge, the relations between different actors in the economic system and the transfer of knowledge among them can also be sources of innovations. The systemic approach has led to the formation of the term *national innovation system* that has been increasingly adopted by national governments in the draft and implementation of policies towards innovation. This chapter will continue with an analysis of the concept of national innovation system, its definition and components, the rationale for policy intervention and methods of measuring innovation. The Lisbon Agenda stresses the importance of innovation policies in the efforts of national governments to induce economic growth and the systemic approach has led to the formation of new policy perspectives in this respect.

3.1 The Linear vs. Systemic Model of Innovation

First of all, it should be mentioned that innovation must not be confused with invention. Invention is the first occurrence of an idea for a new product or process. Innovation is the first attempt to carry this new idea into practice (Fagerberg, 2004). This difference is important as any new idea has economical relevance only when it is put in practice. As to how does innovation occur, during most of the last century, the belief was that science was the main factor inducing innovation. Important studies of the innovation process have been carried out by Schumpeter Joseph who is considered a pioneer in the economic analysis of innovation concentrating much effort on this subject. He explained the vital role of innovation in growth and competitiveness and he explained the process of innovation through a linear model. According to this model (see figure 2), innovation is a process of discovery which proceeds via subsequent linear phases. In this approach, innovation stems from scientific research which produces new knowledge that can be put into new products, followed by processes of product development, and through production and marketing terminates with the sales of new products, services and processes (OECD, 1996:14).

Figure 2. Linear model of innovation



Source: Klein, S.J. and N. Rosenberg (1986*), "An Overview of Innovation"*, in R. Landau and N. Rosenberg (eds.), *The Positive Sum Strategy: Harnessing Technology for Economic Growth*, National Academy Press, Washington, DC.

The linear model is in accordance with the neoclassical assumptions while considering that basic research is the input for innovation. This explains why the main focus and support of many governments were on R&D and why there was often no separation between R&D and innovation policies (Jones, 1971) as the belief was that research leads automatically to innovations. The linear model is also focused on un-codified knowledge which is public and thus easy to be transferred among actors in the innovation process. Knowledge thus being easily transferable can produce new knowledge and innovations can produce new innovations. What is omitted from the model is tacit knowledge which is incorporated in human beings and technologies and is difficult to be transferred to other actors. In this case innovation can occur through the transfer of tacit knowledge among actors which implies the creation and development of relations between them.

Basically, the linear model gives a representation of R&D activities as homogenous, performed by one kind of researcher and generates just one kind of innovation. The focus is on the role of individuals rather than organizations in the innovation process, highlighting the character of outstanding individuals and defining innovations as *"Acts of Will*" rather than *"Acts of Intellect"* (Pavitt, 2004:60). In fact, there are many kinds of innovative activities generating many different kinds of knowledge. An element of heterogeneity needs to be introduced in the Schumpeterian model and this has been done by the systemic approach to innovation.

This model claims that innovation can stem from many sources including new manufacturing capabilities and acknowledgement of market needs (OECD, 1996). Innovation can also assume many forms such as improvements to existing products, application of technology to new markets and uses of new technology to serve an existing market. Innovators are not just individuals but also firms which acquire new knowledge through the transfer of know-how, human resources and from establishing relations with other actors such as institutions, laboratories, universities. Thus the process is not completely linear as innovation requires considerable communication between firms, laboratories, academic institutions and consumers as well as feedback from science, engineering, product development, marketing and manufacturing (1996:15).

The diffusion of knowledge among actors is important for innovation processes. Innovation plays a central role in explaining differences between firms, and their competitive advantages. Increasing complementarities between different types of knowledge and increasing dissimilarities between these bodies of knowledge characterize the innovation process (Llerena

et. al., 2005). So the internal and external management of knowledge becomes very important and this means that innovation needs to be considered in a systemic context. Knowledge must be coordinated and correlated across individuals and organizations. The firm, along with customers, suppliers and rivals and in interaction with other actors (universities, institutes) plays a unique role in the system. An innovation system is thus defined by its components, by the information flow and connections between these components and their evolution (2005:3). The difference between the two models is that the linear model of innovation gives centrality to the conditions of production of new knowledge which lead to innovation and does not consider the ways that knowledge is assimilated and diffused through society, processes that can also induce innovations. In the traditional view, agents are supposed to be able to assimilate new knowledge without significant costs.

Innovation is by its nature a systemic phenomenon, since it results from the interaction between different actors and organizations. The diversity of institutional actors and relationships in the innovation process has increased considerably. Complex networks of firms, government labs, and universities are now critical features of many industries especially in the field of rapid technological progress such as biotechnology, computers, pharmaceuticals etc (Walter&Grodal, 2004:58). Relationships between organizations lead to various benefits regarding the diffusion of information, the sharing of resources, access to specialized assets and inter organizational learning. As the commercialization of knowledge has gained greater importance in economic growth, collaboration across organizations has become more commonplace. In fact, studies prove that internal R&D intensity and technological sophistication are strongly correlated with the number and also the intensity of strategic alliances (2004:59).

Innovation requires learning. It is an uncertain process because by definition what needs to be learned about transforming technologies can only be known through the process itself. It also involves high investments in research and accumulation of knowledge. Therefore, firms seek for outside partners and networks to share the costs and risk associated with innovation, to gain access to new research results, to acquire new technology and to share assets in manufacturing, marketing and distribution (OECD, 1996:16). So firms will determine which activities they will undertake individually, in collaboration with other firms, in collaboration with universities, laboratories, and with the support of the government. Grossman (1994) emphasizes the importance of informal and formal interactions between actors in improving the innovatory capacity of an economy:

> *"The overall innovation performance of an economy depends not so much on how specific formal institutions (firms, research institutes, universities etc) perform, but on how they interact with each other as elements of a collective system of knowledge creation and use and on their interplay with social institutions (values, norms, legal frameworks)"* (1994:57).

Innovation thus stems from the interactions by a community of actors and institutions which together form what are termed *"national innovation systems".* How are they defined, what

are their components and how can they be managed and measured, the following section is intended to deal with all these questions.

3.2 Definition and Components of National Innovation Systems

The previous section dealt with an analysis of the process of innovation, explaining how innovation occurs and how it is reinforced. It was presented the linear model which dominated the studies on innovation in the last century, a model which assumes that basic research is the source of innovation and that innovation occurs automatically from the new results of this research. In contrast with this assumption, the systemic model takes into consideration not only the inputs (R&D) and outputs of innovation but it focuses on the innovation process itself. While considering the codified and tacit types of models and also processes of knowledge diffusion and transfer, the systemic model reveals that innovation can stem from learning, problem-solving and adaptation activities of individuals and organizations. The transfer of technology, know-how and human resources between organizations can also induce the occurrence of innovatory ideas. Therefore, it is imperative to analyze innovation from a systemic view in order to capture the whole process and not just its inputs or outputs. If one wants to have a look at the innovatory capacity of a country, one need to analyze the national innovation system (NIS). This section attempts to give a definition for national innovation system and to identify its functioning and components.

The first person to use the *term "national innovation system"* was Bengt-Ake Lundvall in 1985 and he developed the subject in an original and thought-provoking book in 1992 called *National Innovation Systems: Towards a Theory of Innovation and Interactive Learning.* Nevertheless, and as many authors would agree, the idea goes back to Friedrich List's conception of *"the national system of political economy"* which may as well be called *"national innovation system*". His main concern was of the problem of Germany overtaking England. He stressed in this respect that not only the protection of infant industries but also the design of a series of policies helped the acceleration of industrialization and economic growth (Freeman, 1995). These new policies focused mainly on learning about new technology and applying it. In his study of the causes of the great economic advancement in Germany, he concluded that was the designed policies for knowledge accumulation and diffusion rather than physical capital investment that triggered economic growth. These policies encouraged the assimilation of new technology and learning about it and adapting it and also targeted the education system.

So Germany has developed one of the best education and training system in world which is the foundation for superior skills and higher productivity. But the education system managed to contribute to economic growth due to the fact that it was oriented towards the needs of the industry and supplied the necessary technical knowledge. List recognized the importance of the connections between industry and research and he saw that industry should be linked to formal institutions of science and education:

"There scarcely exists a manufacturing business which has no relation to physics, mechanics, chemistry, mathematics, or to the art of design, etc. No progress, no new discoveries and inventions can be made in these sciences by which a hundred industries and processes could not be improved or altered" (1995:6).

Thus, List observed many features of the national innovation systems that have relevance nowadays such as education and training institutions, science, technical institutes, knowledge accumulation, adapting imported technology, promotion of strategic industries and the interlinks between industry and formal institutions of research and science. He also underlined the importance of long-term policies for industry and the economy carried out by the state. From List's study it can be concluded that the accumulation and transfer of knowledge, the connections between science and education institutions and industry, as well as the long-term policies for economic growth designed by the state are important elements of national innovation systems.

Many studies have been carried out since List's system of political economy and especially from the 1990s onwards on the subject of national innovation systems introducing the debate on what determines successful technology oriented economic development Important studies in this respect were made by Lundvall (1992), Freeman (1995, 1987), Nelson (1993) and Metcalfe (1995). The concept adequately captures insights that innovation is the outcome of the systemic interactions of various procedures and organizations, and of interconnected political, economic and social processes (Fromhold-Eisebith, 1997:218).

Lundvall (1992) recognizes the importance of production, accumulation and diffusion of knowledge as processes underpinning innovation and the relations that form between actors engaged in these processes. He thus defines national innovation systems on the base of the interactions and relations between actors participating in the innovation processes inside the borders of the nation:

" (...) a system of innovation is constituted by elements and relationships which interact in the production, diffusion and use of new, and economically useful knowledge and that a national system encompasses elements and relationships, either located within or rooted inside the borders of a nation" (1992:2).

While Lundvall focuses on the flow of economically useful knowledge inside the borders of the nation in defining NIS, Metcalfe underlines the role of institutions that contribute to the creation and transfer of new technology, the relations among them and the influence that government policies have on the innovatory activities of such institutions. On this basis, he defines national systems of innovation as:

"(…) that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies" (Metcalfe, 1995).

The process of diffusion of new technologies is also stressed in Freeman's definition of innovation systems, accentuating the networks that form between institutions both public and private that are engaged in the creation, modification and transfer of new technologies. According to him, national innovation systems are defined by:

" …the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies" (Freeman, 1987)

Nelson (1993) focuses on the role of industry in defining the innovation system which is:

"(…) a set of institutions whose interactions determine the innovative performance…of national firms" (1993:4).

Actually, Nelson stresses the importance of interaction between institutions within national innovation systems and he compares between a narrow definition of innovation systems and a broader one. The narrow definition of NIS focuses on organizations and formal institutions involved directly in the processes of scientific and technological exploration (Laredo&Mustar, 2001). The broad concept of NIS includes all economic, political and other social institutions affecting learning and searching activities. Nelson stresses the importance of the broad definition considering that specialists in innovation tend to "*play down the existence of active coherent industrial policies"* and of a *"well structured and thought through general policy*" (2001:3). The broad approach recognizes that the *"narrow"* institutions are embedded in a much wider socio-economic system in which political and social influences as well as economic policies help to determine the success of all innovative activities (Freeman, 2002:194). In support of this statement stand out the successes in Britain and USA in the 18th century where the elevation of science in the national culture, the multiplication of links between science and technology and the systematic widespread of both in industrial activities played a central role (2002: 195).

In conclusion, it could be said that the introduction of the concept of national innovation system in the studies of innovation is a step forward in the understanding of general technological performance of states. The traditional analysis of technology performance has focused in alignment with the linear model of innovation on inputs such as R&D and research personnel and outputs such as patents. While these indicators offer important information about the content of technological endeavor, their ability to grasp the general innovativeness of an economy is small. It offers just a static snapshot which neglects how various actors in a country interact in the innovation process. The concept of NIS rests on the premise that innovation and

technical progress are the result of a complex set of relations among actors producing, applying and transferring different kinds of knowledge (OECD, 1997:9). The innovative performance of a country depends heavily on how these actors relate to each other as elements of a collective system of knowledge. The actors are mainly enterprises, universities and research institutes and the people within them. The linkages between them take the form of joint research, personnel exchange, transfer of technology etc.

The NIS also stresses that policies and state influence have a bearing on innovation developments of a country. Therefore a lot of studies on NIS provide guidelines for regulation and have inspired many countries to pick up the notion in political context (Fromhold-Eisebith, 2007:219). As many European leaders have adopted the concept of NIS in the framework of designing better innovation policies, it is necessary to further analyze the rationale for policy intervention in such system. This analysis is also important for the implementation of the Lisbon Agenda which has committed political leaders to design and implement better policies for innovation in the context of realizing an accelerated economic growth.

3.3 Innovation Policies

Innovation policy as the means of encouraging technological progress and sustainable economic and social growth has recently come to play an increasingly strategic status within the EU. As underlined in the Lisbon Agenda, competitiveness growth, job creation and social progress are now key elements of EU's own *"raison d'être"*, and innovation policy is considered to have a lot to offer in this regard (Borras, 2003). European countries have developed their policies in three stages: science policy, technology policy and innovation policy according to the development of evolutionary theories of economic growth and the transition from a linear model of innovation to a systemic model which caused shift in paradigms regarding the role of government and national policies in stimulating innovation processes and stemming economic growth. This section attempts to give an insight into the process of change in the approach of national governments towards innovation and implicitly the changes in national policies on innovation, to define and study the main policy paradigms concerning innovation and their relative assumptions regarding the role of government intervention in innovation processes with a focus on the systemic policy approach which receives great attention in the recent innovation studies and has been adopted by many European governments (see OECD, 1997).

3.3.1 From Science &Technology to Innovation Policy

The focus of policies on innovation in most of the European countries had been, until the 1990s on science and technology. The central attention of research and technological development (RTD) policies had been during the World War II and until the 1970s on science and basic research. High investments were done especially in defense-related research as a way to improve military technological equipment. The basic assumption of RTD policies since World War II had been that science is close to a pure public good which means that massive under investment occurs without government support (Feldman&Link, 2001).

During the late 1970s, most advanced industrialized countries made changes in the nature and content of RTD policies. These new policies became more project funding oriented contrary to an en-bloc funding which was the norm for decades following WW II (Biegelbouer&Borras, 2003). This change was the result of an increased utilization of RTD policies for solving wider economic problems. The necessity of problem-solving of a diverse range of economic issues was induced by the severe oil crises and the new social movements in a period of economic strain. Governments were therefore anxious to use more tangibly scientific knowledge in order to help regaining economic growth and creating more jobs (Borras, 2003:3). So, governments moved from science policy that focused mostly on the generation of scientific knowledge towards technology policy that encouraged more actively the industrial application of knowledge. Nevertheless, the policy was selective and focused attention on strategic industries having thus a national protectionist attitude (2003:10).

A new wave of changes affected policy-making in the 1990s, period which was dominated by an eclectic mix in economic policy. From the problem-solving approach of the 1970s, RTD policy has gained a broader perspective on the innovation process focusing on the systemic nature of technological performance (Biegelbauer&Borras, 2003). Thus, a typical characteristic of current RTD policies is their integration with other national policies such as: education, competition, agricultural, regulatory and foreign policies. This change was due to new perspectives on the role and scope of RTD policies (2003:2). Firstly, there is a new understanding of RTD infrastructure that goes beyond the conventional laboratory and equipment and covers a large area including educational sector, telecoms, IT access and usage. Secondly, the focus of the new policy approach is on the use of knowledge as a main factor of production. So the attention has been shifted to the expansion of the knowledge base and the ability of individuals to learn and adapt to new conditions. Finally, the RTD policies in the 1990s have attempted to create and facilitate the formation of links between institutions operating in the system by fostering networks of firms and by forming bridging-institutions. These efforts have the aim of enhancing the communication, the synergy and the flexibility of innovation systems. The flexibility of the system should encourage rapid technological change which would consequently trigger economic advancement. Policies designed in this way can create a model of change and the management of change is one of the key roles of policy in the knowledge portfolios (Grossman, 1994:57).

The change in policy approach occurred with the growing influence and the development of the evolutionary theory of economic growth and the distancing from the linear model of the innovation process. The evolutionary theory departed from the equilibrium approach in the neo-classical theory mainstream, which assumes a model of perfect competition, deterministic environments, perfect information, constant returns to scale and stresses an optimal behavior on the part of the firms (Smith, 2000: 75). Contrariwise, in an evolutionary context the complexity of interactions between heterogeneous agents is increased and the optimality of solutions can only assessed ex post. Such a new view of technology policy has to be framed by an

understanding of the innovation process as search, experimentation and learning (Cantner&Pyka, 1999). Policy measures need to be aimed at sustaining the forces of these processes instead of not yet achieved optimal solutions.

Furthermore, the evolutionary approach departs from the simple linear model of innovation where an exogenous inventive stage is followed by an innovation stage when firms can draw on well defined technological opportunities and finally a diffusion stage when successful innovation can spread through the economy. The systemic approach argues that actors in different stages of the innovation process influence each other. In this perspective, different actors and institutions jointly and individually contribute to the exploitation of new and given technologies (1999: 3). This environment of risk and uncertainty necessitates policy intervention to support innovation processes.

All in all, the policy approach towards innovation changed once the evolutionary models grew in importance and caused a departure from the linear model of the innovation process. Until the 1990s, policies on innovation focused mainly on the generation of knowledge through science and basic research implying large investments in R&D, hence the name *"Science and Technology"* policies. The focus of attention was on inputs and outputs to innovation while the innovation process itself was left out of the scope of national policy. Due to the development in economic theory, new policy paradigms on innovation developed also. These will be analyzed in the following section.

3.3.2 Policy Paradigms on Innovation

One important question for the design of innovation policy is what is to be performed by the state through public action and what not. A necessary condition justifying public intervention is that there should be a problem that cannot be solved solely by the private sector. The policy paradigms on innovation presented in this chapter differ in the way they identify the problem and implicitly the way they justify the rationale for public intervention in the innovation processes. They also differ in their prescriptions for government intervention, thus they differ in aims, scope of policy but also the policy tools they suggest. Analyzing the main policy paradigms on innovation can give a useful insight and a better understanding on the process of innovation and the rationale and means of public intervention. The policy paradigms considered in this section are the market failure paradigm and the mission paradigm which dominated the period up until the late 1990s but they still have relevance in the present, and the systemic paradigm which has recently grown in importance for policy-makers and scholars in innovation studies.

3.3.2.1 The Market Failure Paradigm

The market failure paradigm stems from neo-classical ideas that science is a pure public good and technology is seen as a purely private good. In this assumption, the public role for intervention is to provide purely public science goods while private technological goods are provided by the industry (Feldman&Link, 2001:38). The main role of governments in the

innovation process is to provide the production of scientific knowledge which being public is easily spread in the industry resulting in innovation. This reasoning explains the focus of many European governments on inputs to innovation namely R&D in the period following the World War II. Also this reasoning implies a specific understanding of knowledge (see Smith, 2000:83). Firstly, knowledge is considered to be generic namely it can be widely applied among firms and industries. Knowledge is codified namely written or recorded which makes it easy to be transmitted. It is costly accessible namely firms do not face differentiate cost barriers in accessing knowledge. Finally, it is context independent namely firms have equal capabilities in transforming knowledge into production capabilities.

Thus the process of knowledge diffusion is unproblematic in this case and the main concern is with the production of knowledge. The innovation flows from and to the private sector require minimal government role. The free market will, if unfettered, allocate goods and services efficiently and if let to its own devices, will lead to optimal rates of science production, technical change and economic growth. Nevertheless, the market failure paradigm recognizes that there may be a role for government in science and technology affairs but only in the case there are clear externalities such as benefits cannot be captured in the market, when transactions costs are high, or when the information in the market is distorted or unavailable (Laredo&Mustard, 2001:51). So factors such as financial market failures, external benefits to the production of knowledge and others imply that reliance solely on the market system will result in underinvestment in innovation, relative to the socially desirable level (Martin&Scott, 2000:438).

Due to these factors innovators may lose their incentive to innovate. The innovation activity is costly, risky and uncertain as regards its final outcomes. Moreover, economic gains are hard to appropriate since they may benefit consumers who have access to better products without necessarily being charged a correspondingly increased price this being the basis of consumer surplus and *"market"* externalities (Llerena et.al., 2005:19). They can also benefit the competitors who can use the technology produced by the innovator without costs giving rise to knowledge and network externalities. In these cases the incentives to innovate are diminished and the investment in innovative activity is inferior to its socially optimal level. The problem triggering public intervention in this case is identified as deriving from market failures which requires nonetheless minimal government role and a focus on deregulation.

The policy actions prescribed by the market approach are based on the assumption that a completely competitive market system will provide a sub-optimal level of knowledge, and this makes the case for public subsidies for knowledge creation and the creation of intellectual property rights (Smith, 2000:94). Policy action should be focused on the inputs to innovation namely on the supply side of knowledge which require incentives for R&D in the private and public sector. Policy instruments to promote R&D play a central role in the prescriptions of the market approach. Among a large number of policy tools towards R&D, the competition policy, R&D tax credits, as well as subsidies and actual R&D carried out by public research units play an important part in the promotion of R&D investment (Martin&Scott, 2000:439). Each of these

policy tools are designed to reduce the perceived market failure leading to under-investment in innovation. Direct fiscal incentives for R&D and programs offering financial support for firms are aimed at stimulating additional investment by the private sector (see Jaumote&Pain, 2005:5). Public research organizations can be funded to undertake basic research which has immediate commercial applications. Labor and educational policies have an important role in the supply of skilled human resources to perform innovative activities. Awareness of new technology can be made by information disclosure by innovators who are offered strong intellectual property rights.

An underlining feature of innovation policy in the market approach is its focus on investment in inputs for innovation. Innovative inputs may have a generic character namely they can be used in many industries with modest additional development which means that for such technologies, complete appropriability of returns from innovation is problematic. Whether appropriability is high or low, an effective instrument of public support should make capital funding available to SMEs and start-ups (Martin&Scott, 2000:440). This would enable innovative firms to bring new products to the market. Nonetheless, policy tools should focus on deregulation and the contraction of the government role. Lowering barriers through such policy tools can maintain the competition pressure inducing firms to continue to innovate. Discriminatory measures such as *"picking winners"* is to be avoided in the market approach because it is claimed that governments have a poor record on identifying successful lines of technological development in advance. Thus, public support for firms should not take the form of direct grants nor should take the form of government debt or direct equity financing.

All in all, the market failure paradigm of innovation policy is linear and deterministic (Borras, 2003:13). In its simplest form, it assumes that there is significant need for new scientific and technological resources for economic productivity, and that the competitive workings of the market enable the private sector to respond in an economically efficient manner. The main justification for public intervention in this case is due to market failure, namely the fact that the market will otherwise invest less in innovative activities than is socially desirable. The government intervention is yet minimal in the market paradigm and policy in this case should target deregulation, the contraction of the government role and the stimulation of an increased investment in R&D.

3.3.2.2 The Mission Paradigm

In contrast with the market failure paradigm, the mission approach stresses the role of the government in *"picking winners"* and the focus on specific technologies in order to enhance the knowledge base and induce technological development. The mission paradigm assumes that the role of the government in science and technology should flow directly from the legitimated missions of agencies but should not extend however beyond those missions in pursuit of more generalized technology development, innovation or competitive goals (Laredo&Mustard, 2001:52). For this purpose, the mission oriented policy concentrates on a small number of technologies in an early phase of the technological cycle (Cantner&Pyka, 1999:6). So, a specific

characteristic of mission oriented policy is its concentration namely, only a small number of technologies are selected for public funding and the assumption is that in general, only large corporations have the adequate infrastructure to develop these programs.

Another characteristic of the mission approach is the high share of public research performed *"in-house*" for example by public research institutes. However, in the definition of the mission-oriented policy, is the specificity of a measure and not the recipient that is constituent for this type of policy (1999:7). For example, public funds can be directed towards research performed by private firms with the aim of developing a specific technology, measures which are clearly designed as mission-oriented. Thus, policies designed according to the mission paradigms are typically embodied in single programs or even single projects with clear defined aims and missionary targets. Neoclassical theory and the market failure advocates see no place for such *"focused"* policies as they distort market signals in undesirable ways. Moreover, they are skeptical about the ability of governments to select successful lines of technologies. These critics can be noticed in slogans such as *"governments cannot pick winners"*. Indeed, many governments, especially in Europe have squandered large amounts of funds on programs in the name of Science and Technology. In fact, many economists argue that if it were between no policies in this area and the picking of winners by bureaucrats and support for national champions, the preferred choice would be no policy at all (Lipsey, 2001:25).

But this kind of view should not impede one to observe also relevant successes of mission policies as both failures and achievements should be taken into account. There are examples of successes that plea for the success of the mission approach especially within the class of technological systems such as: nuclear, aerospace, high-speed trains (see Biegelbauer&Borras, 2003:74). In these cases, the instruments of the policy are consistent with the general structures of the society. For instance, in the case of France, the general conditions prevailing the society namely centralization of political and administrative procedures, elitist education and training facilitate this mission-types of policies to be set up quite efficiently. A factor that led to success was that mission oriented programs require a high level of competencies in public agencies which has led to generating a class of high skilled people who are interested in reinforcing the same procedures (2003:75). This evolution of institutions reveals some path-dependent features which makes the changing of an institution hard as it interferes with the way in which numerous operations are carried out and would induce substantial costs. Due to inertia, the organizational structure can become locked-in to a set of routines, objectives and procedures. Thus, path-dependency and institutional inertia facilitate the set-up and implementation of mission oriented policies. Moreover, the more focused a policy is, the more likely is to be captured and supported by politicians, who have a self-interest in the projects that are accepted or rejected.

Mission-oriented policies started to develop especially since the 1970s, when governments encouraged the performance of non-defense missions in a wider area of policy and the attention was on the performance of large technology industries in energy, agriculture,

aerospace, nuclear etc. The support was targeted to specific technologies and industries that were considered the most appropriate and able to trigger economic growth. The policy tools specific to the mission approach are direct grants and funding based on programs. Although these discriminatory policy tools are rejected by the neoclassicists and the market failure paradigm advocates, the evolutionary theory suggests a significant role for focused policies (Lipsey, 2001:26). The main supposed utility of the policy is that it targets support exactly where is needed. It discriminates between the private sector's innovative activities according to their estimated potential to create social benefits that the firm cannot capture. It would not aim however to internalize all social benefits, but instead it aims only for sufficient incentives. So, the government's role is limited to fulfilling the missions of agencies and should not compete with the private sector in innovation and technology (Laredo&Mustard, 2001:50). The government role is in connection with traditional activities of line agencies and is not focused on all innovative activities.

3.3.2.3 The Systemic Paradigm

According to the market failure and mission policy paradigms on innovation, the focus of attention of public intervention should be on inputs to innovation such as R&D and outputs such as patents. The main assumption of these paradigms is that science is a public good and technology a pure private good so the scope of government intervention should not extend beyond fixing the market failures or beyond the missionary goals of its agencies. The systemic approach pleas for an extension of public intervention upon the overall innovatory activities in a country and policy in this case is based on a systemic view of innovation processes which take place within national boundaries.

The systemic approach focuses on the innovation process itself and is based on the concept of national innovation systems which underlines the significance of the interactions and linkages among the people and institutions involved in technology development in translating the inputs into outputs. Innovation is thus the result of a complex interaction between various actors and institutions and technical change does not occur in a linear sequence, but through feedback loops within the system (OECD, 1997:12). Firms are situated in the centre of the system, also the way they organize production and innovation and the channels through which they gain access to external sources of knowledge. These sources may be other firms, universities, public or private research institutes and transfer institutes. So, the systemic approach causes a departure from the linear model which has relevance in the market failure and mission paradigm, by claiming that ideas for innovation can come from many sources and at any stage of research, development, marketing and diffusion and takes many forms including adaptation of products and improvements to processes.

The change in approach is due to a new understanding of knowledge and its economic value. The study of innovation systems focuses on flows of knowledge and the relevance of tacit knowledge namely embodied in human beings and technology for stemming innovation. As

knowledge flows and connections between actors in the innovation process are important, the innovation system is a device used to correlate and communicate knowledge and coordinate access to complementary knowledge (Llerena et.al., 2005). Public intervention therefore, should be aimed at facilitating the emergence of an innovation system; it should create the framework within which the system can organize itself. So policy needs a new conceptual basis for assessing government roles in supporting technological development, based on the concept of national innovation system.

The new focus is on the concept of networks as the basic structure of a modern, effective R&D establishment (Feldman&Link, 2001:38). This premise distinguishes the required policy model from the simplistic concepts where science is a pure public good and technology a pure private good. Under this assumption, the government role is poorly conceived. Studies on national innovation systems reveal that differences in the innovative performance of states can be explained on the basis of diverse sets of formal and informal institutional arrangements. The performance of actors in the innovation process depends both on the intensity and the number of formal and informal interactions among them. Thus, innovation is both socially and institutionally embedded. Following this new understanding, the role of public policy was transformed towards a systemic perspective which allows a wider array of elements to be considered having a role in the innovation process (Borras, 2003:13). As innovation is deeply embedded in social institutions, the fields of public action are more than those covered by technology policy and the linear model. In this sense, policy makers advocate public action that enhances diversity and learning processes that supports the technological paradigms of evolution.

Within a system of innovation framework, identifying the problems is the same as identifying the deficiencies in the functioning of the system. Problems in this approach are caused by system's failures which trigger a broader scope for public intervention than the market failure problems. As identified by Edquist (2001:19), there are at least four categories of system failures which are partly overlapping. These categories include: functions in the system may be inappropriate or missing; organization may be inappropriate or missing; institutions may be inappropriate or missing; or the interactions and links between the elements of the system of innovation may be inappropriate or missing. The role of the government is therefore called upon to create or to facilitate the creation of institutions, organizations and linkages between elements of the system (Meeus&Oerlemans, 2005:56). Thus, besides the economic exchange between agents, government policy is a major enabling factor in the generation of linkage mechanisms.

Policy tools in the case of system failures should both increase: new opportunities and capabilities, and address areas where there are missing components or connections, or misplaced boundaries. In the absence of such a framework the self-organization of the system may fail because different agents in a diversity of organizations have different agendas (Llerena et.al., 2005:20). The government can design means for bridging between different agendas such, as for example private/public collaborative research programs, incubators, science parks, clusters, technology transfer offices etc. The system approach, due to its assumptions about the rationale

and means of public intervention, goes beyond the market failure designed policies. It does, however, not necessarily drop such policies. It certainly recognizes the existence of generic knowledge bases, and would make provisions for the supply of non-appropriable generic knowledge (Smith, 2000:22). The most important distinction between the two policy approaches is that market-based systems not only suffer from an under-supply of knowledge, but are likely to actually determine areas of systematically weak performance.

Indeed, while the market failure approach focuses on increasing investments in R&D and the supply of knowledge, it cannot guarantee that once these investments have been made, the innovatory performance of agents would improve. Undergoing technological change, firms need to adapt, improve, alter or change their technologies a process which requires not only investment capacity but also information, knowledge and expertise regarding the new technologies. In this respect, the access to external sources of knowledge and collaboration with different actors is extremely important. Systemic failures may call for actions contrary to conditions of perfect competition, for instance, cooperation and collaboration between firms to facilitate knowledge flows, government regulation and the creation of incentives. Thus, besides under-investments in innovation, the systemic approach identifies problems that constitute obstacles or impediments to technological change.

Systemic failures in this case take the form of "*transition failures"* and *"lock-in failures"* (Smith, 2000:23-25). Systems theories underline the fact that the notions of firm-level knowledge and learning imply serious problems for firms and sectors in adapting to transitions. In adjusting to technical change, firms, especially small firms, are quite limited in their technological horizons. In general, firms have high competence within their area of expertise but limited capabilities in even closely related areas. So, in the case there may be a change in technological opportunities or patterns of demand that push the market into new technological areas, even minor shifts can provide serious problems for firms which have no background in the new technology domains. There can even be major shifts in technological regimes or paradigms. These changes are rather difficult because they request adaptation to completely new generic technologies. Public policies need to be aimed at transition failures and they would imply in case of change in technological paradigm important implications for policy capabilities and objectives.

Technological change can be impeded by path dependency or lock-in to existing technologies. Path dependence is enforced by the existence of network externalities combined with the fact that technologies are closely linked to their social and economic environment. Thus, technological alternatives must compete not only with existing technologies, but with the overall system in which they are embedded (2000:25). Industries and the whole socio-economic system can be locked-in to a particular technological paradigm. A change in paradigm must involve a complex and integrated process of change in science, engineering practice, physical infrastructure, social organization etc. Individual agents are unlikely to overcome lock-ins. External agencies with the power to create incentives, to develop technological alternatives and

to nurture the emerging systems are needed. In this situation arises important rationale for public action although it would not be frequently used but only when important change in the system is envisaged.

Thus, due to its focus on the systems of innovation and system failures, the systemic policy approach have a greater potential for identifying where public support should go and can provide a good framework that can produce and sustain technological change. Its focus on knowledge flows and diffusion of innovation allows the design of measures to increase actual innovatory performance of firms and to create conditions to facilitate the adaptation to technological shifts in the market. Absorptive capacities and receiver competencies are required for both generation and dissemination of technological know-how. In many cases problems arise just here, and any market incentive or disincentive to innovative activities are subordinate (Cantner&Pyka, 1999:3).

This emphasis on non-market factors does not imply a total neglect of the market. Markets are to be considered here as selective devices to penalize the worse and reward the best technological solutions. Policy aims towards the functioning of the market and still attempt to prohibit monopolies, but not in a static, allocative way but in a dynamic way, keeping in mind heterogeneity. Thus, innovation policy must be systemic and dynamic. A dynamic approach underlines the importance of analyzing policies in terms of their influence on dynamic processes and emphasizes the role of policy design. Consideration of policy objectives and also policy design make the diversity of actors in the innovation system very relevant (Llerena et.al., 2005). These actors are heterogeneous in terms of their strategic behavior and their competences so policy should take account of the diversity of these actors.

Policy instruments in the systemic approach are targeted mainly towards improving the knowledge flows in the national innovation systems. One of the most significant knowledge flows in the system is that stemming from technical collaboration among enterprises as well as their more informal interactions (OECD, 1997:8). Assessments of the importance of collaborative enterprise activities in national innovation systems show that such cooperation can contribute to firm innovative performance. Another primary knowledge flow is linkages between the public and private research sectors. The quality of the public research infrastructure and its links to the industry may be one of the most important assets for supporting innovation. The most traditional type of knowledge flow is however the dissemination of technology as new equipment and machinery (1997:5). The innovative performance of firms increasingly depends on putting technology to work by adapting and using innovation developed elsewhere. Transfer of tacit knowledge is also performed by personnel mobility among firms and between the public and private sector.

Policy measures are aimed towards these significant types of knowledge flows. Conditions and incentives are created to facilitate and sustain collaboration between actors as in the form of private/public collaborative research programs, incubators, science parks, clusters

and also schemes and programs are created to diffuse technology to industry, from manufacturing extension centers to demonstration projects to technology brokers.

All in all, the systemic policy approach differs from the market failure and mission paradigms of public intervention. It differs in its identification of problems that need to be solved through national policy but is also differs in its scope, aims and policy tools. Thus, while the market failure and the mission paradigm envisage a very limited role for the government in intervening in the innovation process due to their assumption that the market left alone would provide sufficient incentives for innovation, the systemic approach pleas for an extended role for policy which should provide a framework within which the innovation system can reinforce and organize itself. Policy in this case is focused not only on inputs and outputs to innovation but on the innovation process itself which requires conditions for permitting a good knowledge flow within the system and the creation of links and collaboration among the actors in the system. Innovation and the diffusion of innovation play a central role in the performance of modern economies.

The Lisbon Agenda and the Barcelona accord on R&D spending suggest how important this issue is for European governments. In the attempt to design better innovation policies, the systemic approach offers new perspectives on how innovation can be stimulated in Europe. This new approach argues that the traditional rationale for innovation policy, market failure, is flawed in its understanding of innovation processes. This because such processes depend on the emergence of innovation systems connecting the many actors involved in the innovation process. An understanding of these systems can help policy makers create approaches for enhancing innovative performance in the knowledge-based economies of today. An important step towards understanding innovation systems is to develop indicators to map knowledge flows and measure innovation within the system. So an important question is how can innovation be measured? This will be dealt with in the following section.

3.4 Indicators for Measuring Innovation

Government policies on innovation have played different roles such as the promoter, regulator and sometimes the referee between different competing private interests. In order to support these functions, increasing efforts have been made to understand the nature of innovation and to measure technological development. Innovation may be considered to be impossible to measure since it is a complex and multidimensional concept. While this may be the case for some facets of innovation, its overall characteristics do not impede measurement of its key dimensions and outputs. This section gives an overlook on the main developments of indicators for measuring innovation and the benefits of using these indicators for gaining a better understanding of innovation processes.

Measuring innovation is a complex process due to the complexity of the concept. Firstly, innovation is a process that involves the interaction of many resources. Secondly, its outputs are

very diverse and cannot be measured along any single-dimensional scale (Feldman&Link, 2001:73). Indicators of innovation provide nonetheless valuable information regarding different facets of the innovation process and assist those whom must formulate policy.

There have been substantial changes in the general understanding of the innovation process and these have caused important changes in indicators of innovation. Originally the early work on measuring innovation developed indicators providing data on inputs and outputs to innovation according to the prevailing linear model and were the only long term series of data at the time. Measures of innovative activity were divided into *"technology inputs"* measures and *"technology outputs"* measures (Fagerberg, 1990:56). Among the former type, expenditures on education, research and development and employment of scientists and engineers may be mentioned. Of the latter, patent activity was the main measurement. Regarding the input measures, these may be said to be related to the innovative capacity of a country to innovate but also to imitate since a certain scientific base is a precondition for successful imitation in most areas. Patenting activity, on the other hand, is more directly linked to innovative activities than to imitation (1990:57). New theoretical developments in innovation studies and a better understanding of the innovation process that occurred with the departure from the linear model and the development of the systemic model of innovation has led to the creation of new indicators of measurement. These recent developments in innovation studies revealed the limitations of traditional indicators focusing only on inputs and outputs of the process.

While it is recognized that traditional indicators such as R&D measurement and patents are important sources of information about the content and direction of technological endeavor, their ability to measure the general innovativeness of an economy is weak (OECD, 1997:9). Traditional indicators do not offer solid explanations of trends in innovation, growth and productivity and they present only a static snapshot of technology performance which neglects how the various actors in a country interact in the innovation process. Recent theoretical developments accentuate the significance of the interactions and linkages among the people and institutions engaged in technology development in translating inputs into outputs. Thus, measurement of the innovatory capacity of a country involves an assessment of its national innovation system.

According to this new approach, new indicators have been developed. The most important development has been the new survey-based indicators especially the *Community Innovation Survey* (CIS) which has been carried out several times in the EU members (Smith, 2004:148). CIS continues to evolve and provides new insights, especially when the data is analyzed at the firm level. Other series of initiatives regarding measuring innovation include the *Oslo* Manual to provide guidelines for measuring innovation activities, the 2002 revision of the *Frascati* Manual and a series of case-studies on knowledge intensive services (Earl&Gault, 2006:172). The development of indicators and related methodological issues are discussed in a series of studies made by the OECD including the *Science, Technology and Industry Scoreboard*.

Due to their neglect of inter-firm linkages and knowledge flow between actors in the innovation process, early indicators reflect a distorted understanding of innovation. Since a relatively small number of large firms accounted for the majority of R&D expenditures, it was assumed that they were responsible for almost all technological innovation (Feldman&Link, 2001:75). Policy was therefore directed towards large firms and not to small and medium sized companies which also develop important innovative activities without having a central R&D lab. As with the departure from the linear model, it became acknowledged that innovation may be carried out within the firm or may involve the acquisition of goods, services or knowledge from outside sources. A firm may also acquire external knowledge and technology in embodied or disembodied forms (OECD, 2005:89). Also, R&D is only one step in the innovation process as innovation includes a number of activities not included in R&D. So many firms may have innovation activities that do not involve R&D.

The recent studies on innovation and the systemic model of innovation process reveal the fact that in order to develop policies that appropriately support innovation, it is necessary to understand certain aspects of innovation activities other than R&D, such as the interaction among actors and the relevant knowledge flows in the national innovation systems (2005:10). The assessment of the innovation systems is focused on four main types of knowledge flows (OECD, 1997:7): interactions among enterprises, interactions among enterprises, universities and public research institutes, diffusion of knowledge and technology and personnel mobility. Attempts to link these flows to firm performance reveal that high levels of technical collaboration, technology diffusion and personnel mobility contribute to improve the innovative capacity of firms.

Methods of measuring technical collaboration within industry include firm surveys as well as literature-based surveys through reviews of newspaper and journal articles, specialized books and journals as well as corporate annual reports (1997:8). Knowledge flows between public and private sectors can be measured in various ways including: joint research activities which can be counted using data published by government funding agencies, universities and other sources; co-patents and co-publications developed by enterprises in collaboration with universities or public institutes; citation analysis; firm surveys that reveal the extent to which they consider universities and public institutes as sources of knowledge for their innovative activities and also they capture more informal networking between the private and public sector (see OECD 2005, 1997).

Future research will focus on indicators that can better capture interaction in the national innovation systems, namely to assess: human resources flows, institutional linkages, industrial clusters and innovative firm behavior. These indicators are in the process of development and do not approach the robustness of more traditional measures such as R&D expenditures.

All in all, together with the departure from the linear model of innovation and continuous theoretical developments in innovation studies, new indicators for measuring innovatory activity

within countries have been created. Traditional indicators focused only on inputs and outputs to innovation thus providing a distorted image of the innovation process by neglecting important facets of the process such as knowledge flows and interactions between the actors engaged in innovation. Recent indicators capture more dimensions of the innovation process even though they are still in the development phase and more studies need to be carried out to find improved ways of assessing national innovation systems. However, the new indicators based on a dynamic and systemic approach to innovation provide a better understanding of the innovation processes to all the parts engaged in the formulation of policy.

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The development of evolutionary theories on economic growth has led to the acknowledgement that only knowledge transposed in innovations that can benefit the economy can produce actual economic advancement. As innovation is the key to growth, many studies have been developed giving a new insight into the functioning of innovation processes. The transition from the linear to a systemic model marked the idea that innovation can stem not only from basic research but from various stages of knowledge (technology) diffusion which imply the development of connections between participants in innovation processes. The new approach on innovation suggests that a country can reinforce its innovatory capacity and trigger technological development through reshaping and strengthening its national innovation system. The concept of national innovation system rests on the premise that innovation and technical progress are the result of a complex set of relations among actors producing, applying and transferring different kinds of knowledge. The innovative performance of a country depends heavily on how these actors relate to each other as elements of a collective system of knowledge. The actors are mainly enterprises, universities and research institutes and the people within them.

The concept has led to the formation of new policy approaches on innovation. The main policy perspectives are the market failure and missionary that plea from a contraction of government intervention in innovation processes, not beyond the reparation of market failures or the missionary goals of its agencies. The systemic approach calls for an extension of government support for creation and development of linkages in the innovation system. The concept also led to a reformation of indicators used to measure innovation which are now focused not only on inputs and outputs to innovation but on the innovation process itself. Monitoring the knowledge flow and diffusion of innovation in the system, the new indicators offer a better image of a country's innovatory potential.

4 Romanian National Innovation System

The previous chapters offered a theoretical insight into the rationale and logic of the Lisbon Agenda finding explanations for its focus on research, innovation and knowledge as underlined policy targets for stemming economic growth at the EU level. The economic theories analyzed in this respect offer a good justification for the belief that by improving their innovatory capacity, European countries can underpin accelerated economic growth and the Lisbon Agenda designs specific guidelines for the design and implementation of, as it calls, *"better policies"* towards research and innovation.

However, in spite of the fact that there is almost unanimous consent about the necessity of an economic set of reforms at the EU level such in the form of the Lisbon Agenda, the program has been recently contested on the European political forum especially by the 2004 Wim Kok's report which raises up the problem of the high complexity and the multitude of contradictory goals and objectives of the agenda that could cause a great problem of implementation for the Member States. The report led to the initiation of talks about the *''Lisbon failure"* which in turn led to a reformation of the Agenda in 2005 giving the strategy a new impetus (for details see Verdun, 2006 and EURACTIV, Lisbon Agenda).

The complexity and multitude of conflicting goals led to a low level of achievement in terms of implementation by the Member States. Concerning the realization of the Barcelona Target, only Finland and Sweden qualify. This fact leads to an important question: *if most developed member states of the EU face difficulties in implementing the Lisbon targets, are these attainable by the new, less developed member states such as Romania?* Attempts to answer this question imply the necessity to study the national innovation system of Romania with special regard to the relevant indicators measuring innovation in the country and with attention given to the evolution of these indicators in the context of designed policy measures to support innovation. This analysis will be able to reveal not only the present characteristics of the innovation system, but also the progress of some indicators in alignment with the Lisbon prescriptions. The following chapters will thus analyze the innovation system in Romania, the relevant policy measures to support innovation and finally the measures designed to support the innovatory activities of the private sector. This analysis will provide an answer to the research question and reveal whether Romania is on the right track towards implementing the Lisbon Agenda and improving its innovatory capacity.

As this part of the paper is more an empirical research of the Romanian innovation system, diverse sources of information will be used. Besides relevant literature and journal articles, there is the need to contain, analyze and compare data from European and national surveys, reports and statistics and also information provided by national policy programs and strategies. Moreover, in order to complete the information from the official sources and to gain a

greater insight into the characteristics of the innovation system, secondary sources of information are used such as interviews and electronic correspondence with experts and professionals, data collected from specialized electronic forums of discussions and participation at national conferences organized on relevant topics for this paper.

4.1 Origins of the Technological Gap

Romania, as most of Central and Eastern European Countries (CEEC) has started from a very low point in the technological race due to its isolation during the communist regime from the global market. This separation has had serious repercussions on the formation and development of the innovation system in Romania which has undergone drastic institutional, economic, political and social reforms since the fall of communism in 1989. Therefore, before going to analyze the specific characteristics of the innovation system in Romania, it is necessary to have a look at the origins of the technological gap between this country and the more developed Western European states and observe the starting point of reforms in the field of research and innovation. Having made this observation, it is easier to observe how much progress has been made in time and how much is still to be done.

Romania, as other countries from CEEC, that have to deal with their communist heritage, is lagging behind in economic and technological progress compared to Western countries. These disparities have their origin in the period of isolation from the globalizing trends of the Western economies, isolation that prevented CEE countries from being involved in the global process of economic integration (Sporer, 2004:44). The process of globalization accelerated in 1970 when corporations reoriented their factories to areas of low wages and contributed to the international division of labor. The CEEC, due to their centralized planned economies, were left out of this process which means that their progress has been considerably stalled by isolation compared to the development in Western countries.

Romania's economy was not only centrally planned, but was also aimed at a high level of autarky. Thus, while the West saw an increase in living standards, Romanian population saw standards lowering significantly. Moreover, the economy was mostly directed to agriculture and the industrial sector had just one supplier and one customer, the government (Scrieciu & Winker, 2002:4). Thus, it could be said that in these conditions, research and innovation were meaningless in the situation where there is no competition and most of the government's attention is towards agriculture. Moreover, the severe restrictions on foreign trade that gained utmost importance in 1989 isolated the country from the international economic flow. The result was that in the absence of competition and incentives for innovation, technology remained outdated and left its mark on the composition of labor and quality of goods produced in the economy.

As mentioned in the previous chapter, innovation can stem from many sources and can take many diverse forms from a systemic view. During the communist period however, sources

of innovation had been drastically limited. Externalized research and engineering was the main source of innovation and the appropriation of innovation was generally no issue of concern as the belief was that technology is a *"public good"* (Radoisevic, 1999a:282). Other sources of innovation such as "*learning by using*" and *"learning by doing"* were less present compared to externalized research. Most technical change was induced by one institutional sector, which was basically a group of research institutes that was connected through vertical links with industrial enterprises. R&D activities were controlled through a separate chain of command, the whole system being "*production oriented"* thus affecting the attitude of the industrial enterprise regarding technical innovation. Thus the innovation process was structured in a linear model and being pushed from externalized R&D towards production (1999a:283). In this way the innovation process was seen just as the implementation of designs developed elsewhere. Consequently, enterprises during socialism had different characteristics than their counterparts in Western Europe. In the CEEC, enterprises were *"production*" and not business units as in the West (Radoisevic, 1999b). Businesslike functions such as finance, marketing and R&D were rudimentary.

Thus, R&D was not developed "*in-house*" or as R&D in industry but as R&D for industry meaning that much technological activity was developed for the industry but yet outside the industry. No feedbacks were considered coming from producers or users and the other facets of innovation such as learning, adaptability, diffusion were weak which deprived enterprises from their ability to accumulate knowledge. Innovation and production were two separate activities and further administrative barriers between the R&D system (research institutes) and the industrial production reinforced by the system of planning led to a reluctance to innovate (1999a:284). Indeed, being treated just as organizations that implemented designs developed elsewhere, enterprises could not be regarded as a demand pull for innovation. This type of centrally planned economic system left heritage serious problems for Romania even after the change of regime in 1989.

The closed type economy has led to a *"re-inventing the wheel"* type of technology activity which deprived the country of serious possibilities for growth and openness which can be provided by foreign direct investment, global competition, contracting and alliances. The heritage also consists of an institutional system characterized by its *"inefficiency"* and "*inability*" to innovate in the long-run (1999b: 278), a weak developed technological infrastructure and a mentality reluctant to innovation and change.

After the fall of communism most of reform has been aimed at restructuring the economy and the transition from a centrally planned economy to a market economy. This involved severe transformations of institutions and the creation of private sector while public investments in R&D remained in a shadow. Expectations of speedy *"catch-up"* with the West was not fulfilled since the ageing industries, out-dated technological bases and absent institutional framework implied a painful and dramatic restructuring process (Sporer, 2004:45). The weak attention of the government towards research and innovation affected the progress in this field after 1990, and

also there has been maintained the perception of inutility of technical and technological conception (Stanciulescu, 2004:3). This perception in the private sector is due to the lack of private initiative and entrepreneurship up to 1990 and also to the lack of proper public policies towards R&D sector after 1990.

As underlined by Radoisevic (1999b: 352), research and innovation have been highly neglected in the transition period in all CEEC countries while the hope for change laid mainly in privatization and institutional reforms. The issues of restructuring the R&D and innovation activities were treated as marginal in transition period. Thus,

> *"The R&D system was perceived as liability or tax burden and not as an asset which might form the basis of economic recovery* (1999b:352)*".*

Nevertheless, forecasts can be optimistic in the case of CEEC countries including Romania, due to recent trends in economic growth in the region, the adherence of the countries to the EU and their alignment with the priorities of the European club (implicitly the Lisbon Agenda). In this context, R&D and innovation could play again an important role in these states and serious efforts for the creation and development of their national innovation systems are expected to be seen. In order to grasp the change and progress in Romania in this respect, attention needs to be given to the evolution of innovation indicators. These will be studied in the following section.

4.2 Evolution of Innovation Indicators

This section is aimed at studying the evolution of relevant indicators for measuring the innovatory activity of Romania, a study that is helpful in observing the pace of progress that has been realized so far in the fields of research and innovation in comparison with the CEEC and the EU average. In this respect, several European and national reports, surveys and studies will be analyzed and compared in order to grasp the innovatory capacity of Romania.

It is necessary to mention however the limitations of such research. As it was mentioned in Chapter 3, section 3.4., of this paper indicators for measuring innovation have been modernized and are in continuous development due to efforts to better grasp the flow of knowledge and the diffusion of innovation within national innovation systems. Traditional indicators measure the inputs to innovation such as: number of researchers, R&D expenditures, in-house R&D performed by industry etc and outputs in forms of patents. The development of the concept of innovation systems determined the creation of new indicators that can better measure the flow of knowledge, the diffusion of innovation and the interactions between actors participating in the innovation process. The limitations concerning a study of innovation indicators in the CEE countries is determined by a lack of cross-country comparable R&D and innovation data evaluating the transition period (Radoisevic, 1999b:352). Studies of innovation in this period which extends from 1990 up to 1999 rely mainly on OECD work on harmonization of CEEC R&D indicators.

Nevertheless as Radoisevic underlines, reliance on traditional indicators in the CEE countries does not suffice as they do not fully grasp the institutional transformation of the innovation systems nor the emerging forms of interactions between actors. He rightfully notices that there should be looked at the relationship between technical and institutional change if one is to understand the growth prospects of these countries (1999a:279). Thus, analysis of technical change should not involve only traditional indicators based on inputs and outputs but also an elaborate institutional analysis as it is through institutions that innovation processes are mediated. Such perspective in which technical and institutional changes are linked is that of systems of innovation. Unfortunately, there is a lack of studies analyzing the innovation capacity of CEEC based on the concept of national innovation systems.

Regarding Romania, present studies of innovation are still based on traditional indicators and do not offer much information on the interactions between actors nor the flow of knowledge or diffusion of innovation in the system. New indicators should target the flow of human resources between the private/public sectors, technology transfers, co-patenting, citations etc. (see more in Chapter 2), which could offer important information on the new forms of interactions and the dynamic of the innovation system. The difficulty rising in this situation is that the Romanian innovation system is still rudimentary and serious attempts to design and shape the system have been only recently made. As Ms. Marina Ranga, the specialist elaborating the 2006 report for *European Trend Chart on Innovation* regarding Romania, claims, the issues concerning using modern indicators are less represented in case of Romania considering the early stage of innovation in the country. More explicitly she underlines that:

> *"R&D is still massively concentrated in national R&D institutes and public R&D units and there is very little in-house business R&D as well as academic research.* (based on electronic correspondence with Ms.Ranga during June, July, 2007). "

In this context, relations between stakeholders in the innovation process are still very weak, there is a weak process of diffusion which makes it even more difficult to apply modern indicators specific to innovation systems. Thus, the present research is limited to the use of traditional indicators to measure innovation in Romania but nonetheless encourages future research to apply and develop indicators based on the concept of national innovation system.

4.2.1 Number of Researchers

Research capabilities are important in so far they create new knowledge which in turn being implemented emanates in innovation. Research is also important for creating new jobs and stemming economic growth. The number of researchers per thousand inhabitants is a useful way for determining the innovatory potential of a country. By comparing the number of researchers in Romania to statistics concerning old EU members and CEE countries would give an idea on the position and potential for research of the country.

Statistics available for the year 1999 reveal that the average number of researchers per thousand inhabitants in the CEEC is 1.89 while in the EU the average is 2.70. It can be observed that the ratio in the EU states is higher than in the CEEC (Sporer, 2004:51). Among the CEEC, the lowest number of researchers per thousand inhabitants is 1.25 in Hungary while the highest is 3.39 in Russia which inherited a large number of scientists from the technical and research institutes and their number is still high in the present. In the EU, the lowest number of researchers is in Greece namely 1.40 per thousand people, while the highest number is in Finland, namely 4.91 per thousand people. To be noticed, Finland is one of the countries that achieve the Barcelona target.

Even though the statistics from 1999 show that there is a large gap concerning the number of researchers between the CEEC and the EU countries, the gap is even larger concerning Romania and these countries according to more recent statistics in 2004. The human potential in the field of R&D has been drastically reduced being situated now at 1/6 of that in 1990, namely there are 20 000 researchers compared to 130 000 in 1990, among which around 8 000 are certified researchers which translates into 0.35 researchers per thousand inhabitants (Stanciulescu, 2004:4). Also the number of researchers/million population is in Romania 880.3 while in Western Europe is 3245.21 according to the studies of World Bank in 2004. The most stated reasons for the declining in the number of research personnel are the low attractiveness of careers in research and the very low salaries. As Ms.Gabriela Hrin, the Director General of the ICI Institute declares:

> *"The number of researchers in the institute declined in the period 1999-2004 determining an increase in the average age of researchers. This is due to the low attractiveness of careers in research resulting in serious losses at the qualitative and quantitative levels of human resources. It is very difficult to attract young university graduates in the research field, large number of students preferring to go abroad due to low levels of salaries in the country* (interview in Market Watch, 2007)."

This triggers the urgent need of increase in the number of researchers but also reveals a dark image of the innovatory potential in Romania. The number of researchers in a country reflects the degree to which businesses see the usefulness of R&D and how ready they are to finance it (Sporer, 2004:51). The number of researchers in planned economies of CEEC does not emanate from the direct needs of the economy. The private sector in Romania thus needs to be made aware of the importance of R&D so they are willing to invest in it.

4.2.2 Education

The number of researchers in a country can also be related to the quality of the educational system and its capability to create and train scientists. However, it is worthwhile mentioning that the educational system is one good indicator of a knowledge-based society and its capability of creating knowledge can tell us about the innovatory capacity of one country. Some indicators

about the shift of economy towards knowledge base are the number of students enrolled in higher education and the share of GDP spent on education. These are quantity indicators and of course it is important to consider the quality of the educational system in order to assess whether there are basis for knowledge base economy.

According to the European Commission, Education and Culture, 2002, the percent of population enrolled in higher education in CEEC is 3.47 while in the EU states is 3.97 (see Sporer, 2004:50). In the CEEC, the lowest percent is in Croatia namely 2.45 while the highest is in Estonia namely, 4.49. In the EU, the lowest percent of population in higher education is seen in Greece with only 2.25 compared to Finland with a 7.06 percent. It can be noticed that these percents correspond also to the number of researchers with Greece at the lowest mark and Finland in the top of qualifications. It can also be noticed that the gap between the CEEC and the EU countries is not that large which can reveal the inherited commitment to education in the former communist regimes.

Concerning Romania statistics show that 20% of the population constitutes of students and pupils plus over 300 000 persons that work in the educational system (Miroiu, 2001). Nevertheless, Eurostat figures of 2003 show that 41.3% of pupils have low reading literacy and 23.6% of students between 18-24 years old leave school and do not pursue other education. This compared to 20% respective 15% average in the EU. Moreover, 5% of children between 7 and 14 years old do not go to school the usual stated reasons are alcoholism, poverty and violence (Miroiu, 2001). Moreover, a large number of families in Romania are involved in subsistence agriculture and they give low value to education or don't have capabilities to secure their children's education (Ciutacu, 2001).

Regarding the expenditure on education, the shares of GDP spent on education in 2001 are 5.15 percent in the CEEC and in the EU 5.45 percent. Noticeably there is no large gap between these expenditures. In Romania, the public expenditure is slightly over 3 % even though the Law on education states that the minimum spent on education should be 4% of the GDP (GEA, 2004:33). The expenditure has been less than 4% during all years of transition and it is lower than the shares in the CEEC as well in the EU member states.

Moreover, even quantity indicators are important, the quality of the educational structure is also important and its response to the needs of the economy. In this respect the situation in Romania is worrying and this can be proved by the number of graduates and students living the country.

A recent study (2006) of the *Department of Economic and Social Policies* within the Presidential Administration reveals that annually only 2000 university graduates find a job through the job market while annually there are 100 000-120 000 graduates. According to unofficial estimations a large percent of graduates seek jobs abroad. The main problem is that in Romania, there is no correlation between the labor market and the large number of graduates.

Another problem is the low value given to graduates which are paid deplorable salaries around 300 Euros/month which lead for a lot of them seeking for jobs abroad. The estimated number of young people going abroad is 4 millions and they are most sought in domains such as IT and constructions. Another worry underlined by the study is the number of good students going to study in Western universities who are not coming back. Only 12% of students going to study abroad come back in the country. Most attractive foreign educational institutions for students are in USA, Great Britain and Germany. The stated motives for leaving are the guarantee for a quality education abroad, the recognition of qualifications, the superior material incentives, better possibilities for research and better chances to be selected for working in multinational corporations.

Beside students going abroad, the ones remaining in the country face a cold reality: most universities are not able to properly prepare students in order to get a job. The report of the Romanian Academic Society (SAR) in 2007 underlines the fact that:

> "*Graduates called upon to work in a knowledge-based economy owe few of their knowledge to universities* (SAR, 2007:38)."

The focus groups organized by SAR show that the knowledge necessary for students to obtain their first job are usually acquired individually by students and these consist mostly of computer knowledge and communication skills. The educational system is thus compared to a supermarket where the quality goods are taken by those leaving the system while those that remain do not produce sufficiently to refill it. Even a more drastic speech is used to describe the Romanian education system:

> *"Universities do not produce education and research but diplomas on a rolling band* (2007:39)."

As a conclusion to these figures, it can be stated that a large part of the human potential for innovation and research is draining to more developed countries. This has extremely negative consequences for the process of moving towards a knowledge-based economy. The education system does not respond to the demands of the labor market and moreover the private sector does not give value to graduates and their innovatory capabilities. .

4.2.3 R&D Expenditures

In order to see whether Romania is ready to implement the policy objectives in the field of R&D according to the Lisbon Agenda there is the need to analyze the level of expenditures in this respect and the tendencies of spending predict the possibilities of achieving the Barcelona target of three percent in 2010. This section will give an overlook on public, private and foreign expenditures on R&D.

4.2.3.1 Public Expenditure

The level of expenditure on R&D has been relatively low in comparison with the EU old and new member states. In the period 1998-2003 total expenditure on R&D effectuated both in the private and public sector has been rather low and never surpassed 0.40% of the GDP (MEC, 2005). Actually there was a decrease in expenditure from the level of 0.48% GDP in 1998 to the level of 0.38% in 2002 due to policies of readjusting the budget which implied a reduction in governmental expenditure. The level of expenditure in the EU however is much higher namely 1.98% and in new member states the average of expenditure represents 0.83 % of the GDP in 2001 (GEA, 2004:33). Observing the levels of expenditures in Romania in the period 1998-2003 there appears no important tendency of increase (see Table 1).

Table 1. Total expenditures on R&D in Romania

Total R&D expenditures	1998	1999	2000	2001	2002	2003
% GDP	0,48	0,40	0,37	0,39	0,38	0,40

Source: National Institute of Statistics, The Annual Statistic Report for Romania, 2004

The Governmental support of R&D activities has been also low: less than total R&D activities were financed by the Government in the last 4 years with the percent of 48.40% of GERD in 2002 (see Table 2). In comparison, the EU average was 34.25 % for 2001 and the average in the CEEC countries was 52.8% for the year 2000 (GEA, 2004:33). Thus, in comparison with EU and EEC countries, Romania is close to achieving the Lisbon target that state that 1/3 of total investment in R&D should be Government contribution. Also looking at figures representing the level of Government's share to support R&D activities for the period 1998-2003 there can be seen a positive progress.

Table 2

Governmental Expenditure on R&D in Romania

	1998	1999	2000	2001	2002
% GERD	52,91	46,66	40,80	42,96	48,40

Source: National Institute of Statistics, The Annual Statistic Report for Romania, 2003

The governmental expenditure on R&D takes generally the form of state aid in Romania, which nevertheless as a share of total state aid expenditure the support for R&D activities represent only 0.5% compared to the 20% in some EU member states (2004:33). The problem is that state aid is usually given to unproductive industries to help them with the huge debts but

there is the need of change of destination of state aid towards R&D and other horizontal objectives conforming to European trends.

4.2.3.2 Private & Foreign Expenditure

The level of private expenditure on R&D is not so low compared to the EU and CEEC average. In the EU the share of private expenditure was 55.94% of total expenditures in 2001 while the share in CEEC was 41.07% in 2000 (GEA, 2004:33). In comparison with these figures, in Romania the contribution of the private sector to R&D has been less than 50% of total expenditures in the period 1999-2003 with the share of 45.39% in 2003 (see Table 3).

Table 3

The share of private expenditure on R&D from total expenditure					
Private expenditure on R&D	1999	2000	2001	2002	2003
% of total expenditure	50,21	48,96	47,60	41,57	45,39

Source: National Institute of Statistics, The Annual Statistic Report for Romania, 2003

Nevertheless as it can be seen from the figures the progress of private expenditure has been negative so there has been a decrease in the contribution of the private sector to R&D activities. In terms of share of GDP, the statistics for 2004 show that Romania, Bulgaria have the lowest shares namely around 0.5% of the GDP while in the CEEC countries the level is 1.5% and the EU average is 1.86% of GDP (Stanciulescu, 2004:5). Considering this figures and the fact that there is a negative progress of private expenditure it can be concluded that Romania is yet far from achieving the Lisbon target of securing 3% of GDP for R&D of which 2% should be private expenditure.

Considering the structure of R&D expenditures the share of foreign expenditure is really low in Romania this representing only 7.0% of total expenditures in 2002 and only 5.5% in 2003 according to the studies of the National Institute of Statistics in 2004.

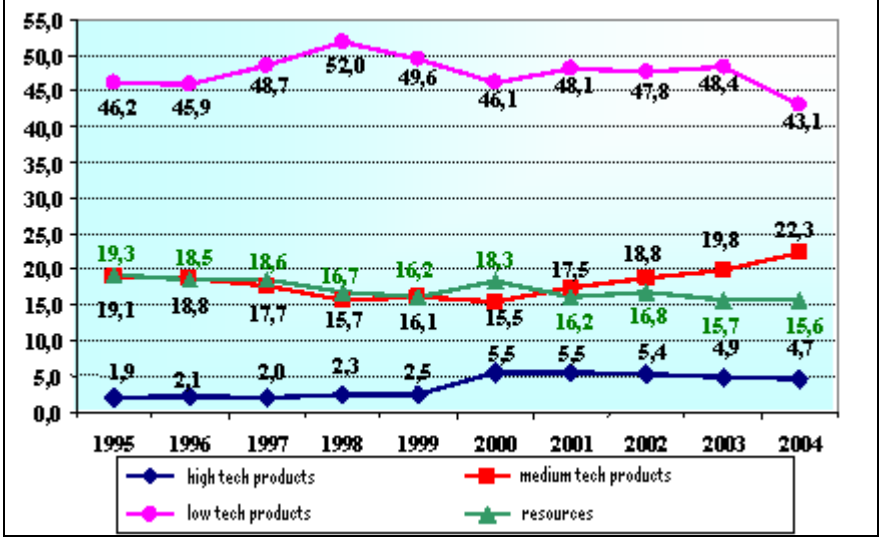
Moreover, it is worthwhile mentioning that having a look at the nature of expenditures on R&D is also important. Looking at sources of funding of R&D reveals the parts and actors involved and there is a relation between the sources of funding and the level of expenditure. Thus, in countries with more developed knowledge based economies such as Ireland, Denmark and Finland the business sector is the most important source of R&D funding. In these countries there is a close connection between industry and research is directly oriented towards industry producing innovation (Sporer, 2004:52). These are also countries with highest levels of expenditures on R&D. While in most EU countries the shift of R&D funding is towards the business sector, in CEEC the main source is the government. In these countries it is difficult to reorient the human resources with their accumulated scientific knowledge into an entrepreneurial force.

In Romania also, the main source of R&D funding is the government with the contribution of the private sector diminishing considerably. This goes against the Lisbon objectives which puts an emphasis on the importance of the private sector contribution to R&D. The EU wants most of the extra spending on R&D to come from the private sector and industrialists need to see that research is a good investment (Collins, 2005).

The innovatory activities of companies in Romania are weak. At the European level 51% of productive companies are technology innovators. At the Romanian national level, only 17% of companies are innovative among which 53.7% are small and 29% are medium (Societatea Romana de Economie, 2004). Important aspects of the situation of innovation in Romanian enterprises reveal that: small prices are the main source of competitiveness and not the innovatory added value; most of new technology is imported and not locally produced. This is reflected in the proportion of exports of high technology. According to the study of the Ministry of Economy and Commerce (MEC) in 2005, the level of exports of products of high-tech decreased after the year 2000 while the level of products of medium technology increased (see Figure 3).

Figure 3

The evolution of exports of industrial products according to the type of technology (shares in total exports)



Source: MEC, 2005

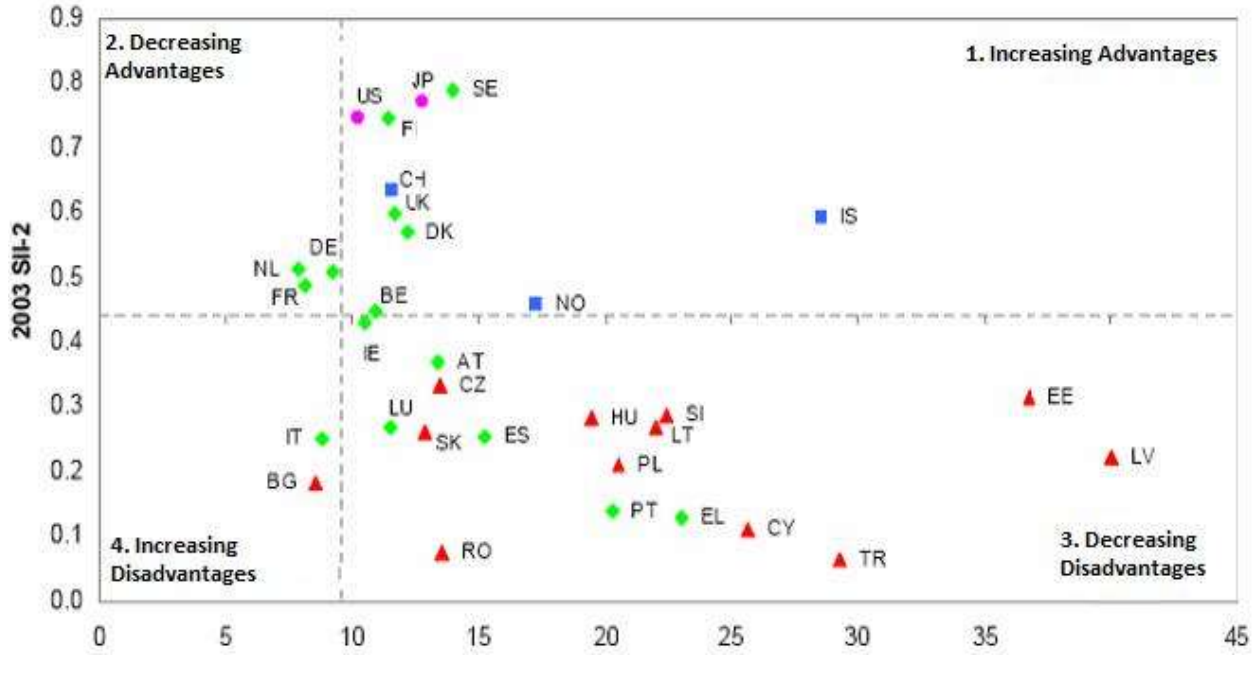
Nevertheless, an optimistic breath can be deducted from the most recent trends in Governmental commitment to increase total RDI expenditure from 2007 on. As it can be seen from the financial framework for the period 2008-2010 for the field of RDI, the Government commits to achieve an RDI expenditure of 3% GDP (of which 1% public, 2% private) in 2013. Budgetary estimations for the 2007-2008 period claim a 110% increase in expenditure compared to 2006 and around 75% increase in 2008 compared to 2007 (see Ministry of Education and Research, 2006). For the period 2009-2010, there is an estimated 60% increase in 2009

compared to 2008 and around 47% increase in 2010 compared to 2009. The estimations are based on the increase in the level of international cooperation with the R&D community, an increase in the participation of industry and the increase in the level of external funds including structural funds. In this context, the Government needs to elaborate coherent and viable policy tools towards the RDI field for a good administration and distribution of these funds.

4.2.4 European Innovation Scoreboard

The *European Innovation Scoreboard* in 2003 uses a set of indicators to position the EU and candidate states according to the progress of innovation. The indicators position Romania among countries where disadvantages are increasing namely the progress of catching-up with the EU states is negative (see figure 4).

Figure 4. The position of EU member states, associated and candidate countries in relation to the Innovation Index

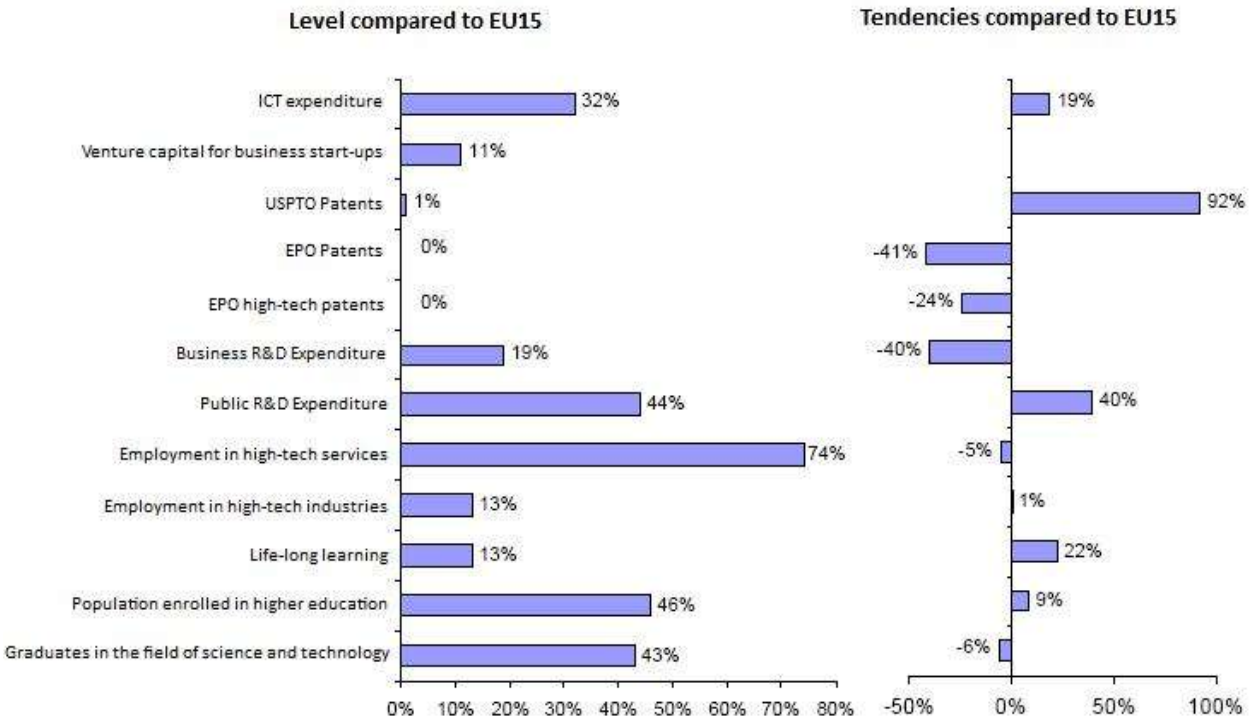


Source: European Innovation Scoreboard, 2003

Setting aside the debatable meaning of some indicators of innovation, the process of catching-up and diminishing the gap has a very low pace. Considering a stagnation of European values of indicators and a sustainable growth rate for Romania at the level of 2003 there will be necessary between 5 and 10 years to catch-up. On a more realistic tone, considering the period of assimilation of know-how and a greater dynamic of European values, the period of catching-up would be over 20 years (MEC, 2005). Analyzing the progress of each innovation indicator in comparison with the EU countries the results show that the strongest progress in Romania has been in education (number of students in secondary and higher education), public R&D and

human resources occupation in sectors of high-tech (see figure 5). The weakest points are the negative progress of R&D in the private sector and the number of registered patents.

Figure 5. *Levels of innovation indicators compared to EU average*



Source: European Innovation Scoreboard, Country Profile Romania, 2003

As it can be seen from the levels of indicators, Romania has 41% less EPO registered patents and also less 24% EPO high-tech patents than the EU average which shows the low intensity of innovative activities in the country. The Eurostat figures show that Romania sent only 1.2 applications for EPO patents/1 million inhabitants in 2003 while the EU average was 137.7 (Eurostat, 2003). Business R&D expenditure is diminishing with 40% than the EU average which reflects the weak participation of the industry in RDI. The values of indicators are a little ameliorated in the 2004 *European Innovation Scoreboard* where Romania is designated as a "*catching-up economy* "while in 2005 *Scoreboard* is yet again among the "*losing ground*" states. Hopefully, with the accession of Romania in January 2007 and the efforts to implement the Lisbon Agenda there will be an amelioration of these indicators in the context of seriously dedicated efforts of public intervention in the RDI field. This will be dealt with in the following chapter.

*

The value of innovation indicators show that the Romanian innovation system is still rudimentary and innovation activity is still at an incipient stage. Looking at the evolution of these indicators shows that the value of most of them is declining. In terms of the number of researchers and R&D personnel, the number has been drastically reduced since 1990 the stated reasons for such a decline are the un-attractiveness of careers in research, the lack of stimuli including salaries for researchers. The situation in education is also worrying as studies show that a large part of human potential in RDI is draining to more developed countries. The most worrying signs concern the participation of the private sector in RDI activities as looking at the low number of patents registered, the number of innovatory enterprises and the structure of exports shows that innovatory activities of the business sector are very weak and the Romanian products are thus competitive mostly through low prices and not their added-value elements. Positive progress can be noticed though in the trend of Governmental R&D expenditure and the level of occupation in high-tech and engineering sectors. These figures trigger the strong need of solid public intervention in the field of RDI through the creation of coherent, viable policies.

5 National Policies towards RDI

Previous chapter consists of an analysis of the main indicators of innovation in Romania and their development through time and the conclusion of the study shows a rudimentary innovation system and a decline of most of indicators. Positive signs can be noticed in terms of Governmental commitment to increase RDI expenditure, the speedy development of the IT sector and the increasing number of specialists in technical sciences. Alarming signs can be seen in the declining number of researchers and R&D personnel, the serious brain drain to more developed countries, and the low and declining participation of the private sector in innovation activities. The evolution of these indicators triggers the necessity of coherent and well designed policies towards the RDI field. This chapter is intended to make an assessment of the main policy measures on RDI in relation with the requirements set in the Lisbon Agenda and taking into consideration the fields where there is a drastic need for public intervention as the main indicators show. Important policy documents will be analyzed in this chapter such as the *National RDI Strategy 2007-2013*, the *Sectoral Operational Program "Increasing Economic Competitiveness"* and other programs that have been designed in conformity with the Lisbon targets and the *National Development Plan 2007-2013.*

5.1 The National Strategy for RDI, 2007-2013

For the first time, Romania has a *National Strategy* in the field of Research, Development and Innovation, which was elaborated with the participation of many experts in the field as well as every entity interested in innovation. The Strategy refers to the period 2007-2013 and was adopted by the Government on 28th February, 2006.

It is the first strategic document on national level targeted towards the field of RDI. It is also the first political strategy to encompass the results of an ample exercise of foresight, involving communication and negotiation among the main actors interested in the RDI system, an exercise unique until now in Romanian society (ROST, 2005). Moreover, the Strategy integrates both Romanian and European interests in the field of RDI, in alignment with the priorities set in the Lisbon Agenda. As it appears from the central and local press, as well from the specialized forums of discussions, the *National Strategy* is a welcomed effort to stimulate economic development in Romania by giving special attention to the field of RDI as considered an engine of growth and employment.

The necessity of a national strategy for RDI is imperative in the context of the Governmental commitment to increase public funds for R&D up to 1% of GDP in 2010, which triggers the need of a good administration and distribution of these funds in order to achieve real progress. The Strategy presents also special attention for the stimulation of private investment in the field, measures that are salutary in the context where there has been detected a serious diminishment of private contribution to RDI in Romania and where the Lisbon Agenda puts

strong emphasis on the importance of the innovative private sector in triggering economic growth.

The Romanian national innovation system has been undergoing an extremely difficult period after 1989: the under financing and belated restructuring in this field voided Romania from the chance of aligning to European and global tendencies in science and technology and the weak enterprise sector couldn't develop a real demand for innovation. The National Strategy is the first real effort in the post-communist era to restructure the national innovation system or better said to design a veritable innovation system having the model of Western European Countries but also based on a serious assessment of the situation in the field of RDI in Romania.

The Strategy targets the maximization of the impact of public investment in the field of RDI. In this sense, clear objectives have been set among which the main are (Government of Romania, 2006a):

- To increase ten times the number of European patents registered by Romanians in 2013 compared to 2003.
- To triple the number of patents on national level, registered at OSIM in 2013 compared to 2006.
- To double the number of innovative firms in 2013 compared to 2004.
- To double the number of researchers until 2013 as well as a targeted decrease in the average age of researchers, under 40.

Based on a serious assessment of the current situation in the field of RDI in Romania, the strategic document underlines clear directions for action in the long-run. The document prescribes responses to the present challenges among which: the development of quality human capital to increase competitiveness in RDI; to increase the attractiveness of careers in research; to reduce fragmentation by encouraging cooperation in a highly competitive environment; the focus of public investment on research; solving serious problems of national interest with direct application in the socio-economic sphere; the development of an adequate RDI infrastructure; to increase the success rate in international projects; to increase international visibility and international cooperation.

These responses are grouped according to three main strategic objectives:

1. Creation of knowledge: namely obtaining quality scientific and technological responses which can contribute to the development of the international stock of knowledge, increase international visibility and assure the transfer of results in the socio-economic sphere. To attain this objective, the strategy prescribes the integration in international networks and the promotion of excellence in research. It is also envisaged the creation of poles of excellence with financial support given to excellent researchers especially young ones. Special measures are to be created to increase the attractiveness of careers

especially for young researchers and improve research capabilities in schools and universities. Clear targets are set according to this objective: the increase in the number of patents on national and European level, the increase in the number of researchers, the offering of approx. 2000 PHd. scholarships annually, the increase in the number of PHd students and PHd's with 50%, the increase in the number of innovative firms.

2. Increasing economic competitiveness: through innovation at the level of economic agents. Measures are to be designed targeted to obtain quality technological results, problem-solving type of research, of local, regional and national interest as well as the development of innovative products, services and technologies with direct applicability. Centers of Competence and Technological Platforms are to be created with financing or co-financing aid offered on mid-time periods of 5-7 years (with consideration to legal implications of state aid regulations). Moreover, measures are to be created to encourage partnerships among universities, research institutes and economic agents. Clear targets in this respect are: the increase in private contribution to R&D to 1.5% of GDP until 2013, increasing the participation of the private sector in R&D activities, assimilation of results of research, increase in the number of public\ private partnerships through the creation of scientific parks, technological platforms, centers of competence etc., the simplification of financing and co financing schemes for innovative firms.

3. Increasing social quality and cohesion: through the creation of technological solutions with beneficial effects for society. Solutions are to target social cohesion and dynamic, to increase the efficiency of policies, problems concerning health, environment, infrastructure, etc. Targets set in this respect envisage: the increase in international participation in projects and programs, a better representation of Romania at the institutional level, the participation of scientific Diaspora in the promotion of RDI system.

The strategy attributes an entire chapter to innovation which reflects the acknowledgement that innovation, besides research requires serious investment and public support. While before 1989 as well as in the transition period the main focus of public policies has been on basic research and scientific knowledge, the present strategy designs measures to support innovation through the lenses of a systemic model. Namely, it recognizes that:

> *"Research is just one of the sources of innovation next to other factors like experience, communication, marketing etc. Therefore there is the need for coherent policies towards innovation which are to be coordinated on the national level* (2006:20)*".*

In the center of the measures designed to support innovation are those co-financing research projects initiated by firms especially those that involve cooperation with research institutes and universities. To increase the capacity of firms to participate at these programs measures are

envisaged to simplify the financing schemes, a portal for SMEs will be created as well as a training system in the field of management of innovation. Innovation will be also sustained through the transfer of research results, namely the transfer from patents and know-how to the creation of products and services. In this respect, it will be encouraged the creation of centers of technologic transfer, especially within universities. Through the relations and interactions that these centers develop, they represent key elements towards the formation of scientific and innovation clusters. They can also create possibilities for innovation and spin-offs within universities.

Entrepreneurship based on innovation receives also special attention in the Strategy. In this sense, measures are to be set for the creation of a venture capital fund, for creation of incubators of innovation and the reduction of barriers to the formation of spin-offs. Also fiscal incentives are envisaged to support innovative firms with special attention towards SMEs. In order to improve the access of firms to information regarding the support for RDI activities and access to research, special services will be created in this respect.

The strategy contains measures targeted to establish and develop interactions, partnerships and cooperation between actors in the innovation system thus a special attention is directed towards increasing the cohesion between innovative entities through the development of innovation networks, technological platforms and the creation of scientific and technological parks.

Looking at these measures to support RDI designed by the *National Strategy* for the 2007-2013 period and considering the fact that all programs in the RDI field will be based on this document, it is interesting to analyze the type of measures from the policy paradigm perspective. The analysis will help to conclude whether the policy perspective towards research and innovation is changing in Romania from a centrally planned, hierarchic, missionary type persisting in the communist and most of the transition period, to a market failure or a systemic model. The analysis is represented by Table 4 and is based on the theoretical insight into the main policy paradigms towards innovation presented in Chapter 3 section 3.3, and these are: the market failure paradigm, the mission paradigm and the systemic paradigm.

Table 4. *National Strategy for RDI from a policy perspective analysis*

Systemic Perspective		**Market Failure Perspective**	
Objectives	**Measures**	**Objectives**	**Measures**
Support for creation and development of relations between actors in the system.	Support for partnerships among universities, institutes, industry.	Repairing market failures through non discriminatory measures.	Creation of venture capital funds, fiscal incentives, incubators of innovation, reduction of barriers for start-ups and spin-
	Centers of competence, technological platforms, innovation networks, scientific & technological parks.		
Enhancing international cooperation.	Participation in international projects, networks.		
		Mission Perspective	
Strengthening links between R&D institutes and industry.	Centers of technologic transfer, spin-offs.	**Objectives**	**Measures**
	Encourage mobility of human resources		
Increased support for the private sector.	Through public funds to increase R&D infrastructure, stimuli for innovation, counseling services.	Development in R&D fields where Romania has comparative advantages.	Priority support in research fields with tradition: biology, genetics, medicine, chemistry, mathematics, physics, geology.
Increased emphasis on innovation.	Special measures designed in a separate chapter for innovation.	Still more emphasis put on scientific research than	
Extension of support for innovation in other policy domains.	Industrial Policy, Regional Policy, Fiscal policy etc.		
Policy –making: less centralized, more cooperation.	Foresight exercises, negotiation, communication.		

All in all it could be said that from the type of policy perspective, the *National Strategy for RDI 2007-2013* is designed from a systemic view on innovation. It aims at the establishment and development of interaction and cooperation between the main actors in the innovation system namely, universities, research institutes, private enterprises and public authorities. It is the first serious attempt in post-communist Romania to design the national innovation system through creation of institutions and services, design and coordination of policies towards RDI, and measures targeted to develop and transform relations among actors in the system. Although the strategic document includes market-failure type of policy tools, it is mainly designed from a systemic view on innovation processes and it envisages efforts to strengthen the innovatory capacity of Romania. This attempt is in alignment with the trend in Western European countries where innovation is growing in the attention and content of national policies, where the decline of explicit technology policies is widespread while instruments to support innovation are more and more diverse and mobilize *"other"* policies to the benefit of economic competitiveness. The strategy is an important political document that explicitly correlates innovation to technological growth and economic competitiveness in Romania.

5.2 Operational Program "Increasing Economic Competitiveness"

The main two instruments for the implementation of the *National Strategy for RDI* are the *Regional Operational Program* (ROP) and *Sectoral Operational Program* 2007-2013 (SOP) for increasing economic competitiveness which are based on the administration and application of structural funds due to Romania as a new member state: the European Regional Development Fund and the European Social and Economic Cohesion Fund. While ROP includes instruments for support of RDI activities in disadvantaged and less developed areas in order to reduce disparities between regions in Romania, SOP focuses explicitly on measures to support RDI with the aim of improving economic competitiveness of the country, therefore this section will pay attention to the prescriptions of this program.

The SOP is derived from the *National Development Plan 2007-2013* which is targeted to strengthen the focus of strategic Economic and Social Cohesion policies in Romania, and to set appropriate linkages to European policies and the Lisbon Agenda for growth and job creation. The Program addresses two priorities among which the first one*: "to increase the competitiveness and development of the knowledge-based economy"* and second *"to increase the long-term economic competitiveness of Romanian economy"*. SOP is under the coordination of the National Authority for SOP within the Ministry of Economy and Finance with the collaboration of other ministries and intermediary bodies.

One of the directions set by the program in order to reach the objective of increasing economic competitiveness in Romania is by increasing R&D capacity, stimulating the cooperation between RDI institutions and enterprises and improving the access of enterprises to RDI. Several Priority Axes are set in accordance to the identified possibilities for improvement of competitiveness of Romanian enterprises that need to respond to the challenge arising from

operating in the Internal Market. The following priority axes are underlined (Ministry of Economy and Finance, 2007):

Priority Axis 1: An innovative and eco-efficient productive system

Priority Axis 2: Research, Technological Development and Innovation for Competitiveness

Priority Axis 3: ICT for private and public sectors

Priority Axis 4: Increasing energy efficiency and security of supply

Priority Axis 5: Technical Assistance

Measures that support progress in the field of RDI are grouped under Priority Axis 2 and take over chapter 1.3.4. in the Program's document. As it was mentioned in the previous chapter, innovation indicators analyzed in the European Innovation Scoreboard in 2004 and 2005 show that the innovatory capacity of Romania is deteriorating in this period. In fact, Romania is presented in the 2005 Scoreboard as a country "*losing ground"* instead of a catching-up economy. This triggers immediate and seriously thought measures to ameliorate the situation in the RDI sphere and to help achieve the EU average for most of indicators for innovation. These measures are also imperative in relation with the commitment of the Government to implement the Lisbon Agenda and achieve Barcelona targets. While the Government seems to be committed to increase public contribution to RDI fact proved by recent growth in public expenditure, measures are to be set to stimulate private contribution in Romania and to assure a good and effective spending of public and EU funds. The present SOP is a response to these challenges and diverse measures are designed in this respect.

These measures are set to stimulate demand and target well the private sector. These are:

- Providing direct financing to innovative enterprises.
- Supporting partnerships triggered by demand and not by supply, while the direct application of research results in the productive sector is a key criteria for selection.
- Improving the research infrastructure in order to allow the development of poles of excellence and clusters and encouraging the migration of researchers to the private sector.

So, there are three key areas of intervention underlined in the program namely: R&D partnerships between universities, research institutes and enterprises; investments in RDI infrastructure; RDI support for enterprises.

In the first area of intervention, namely support for public/private partnerships, financial support will be given to industrial research and pre-competitive development activities that will generate important results and will incorporate these results into improved products, processes

and services. There will be supported different kinds of collaboration between R&D institutes and enterprises that enhance RDI activities and foster technology transfer.

Concerning investments in RDI infrastructure, these interventions are to contribute to increase efficiency of R&D activities in universities and research institutes. The infrastructure in these institutions is quite obsolete and financial aid in support of procuring modern equipment, instruments and software are to improve research activities. Moreover, support will be given to the creation of new infrastructures like laboratories and research centers and the valorization of clustering potential in areas with competitive economic advantages. Partnerships will be supported in dynamic economic fields which will be identified by specialized economic studies. The aim is to develop research-driven poles of excellence grouping together enterprises, research institutions, training centers performing activities with the same market objective. Support will also be given to the development of networks of RDI centers, nationally coordinated and linked with European and International networks. This will help increasing international visibility of Romanian researchers and international cooperation.

In the operational area of support for enterprises, the following initiatives will be taken:

- Support for high-tech start-ups and spin-offs: this operation will support the innovation activities of high-tech start-ups and spin-offs (based on research results obtained in institutes and universities) in order to ensure the transfer of knowledge and technology. Assistance will be given in marketing the products and services.

- Development of R&D infrastructure in enterprises: measures are designed to support the research capacities of enterprises with the aim of improving their innovatory capacity and competitiveness. Financial aid is given for the procurement of computers, equipment, instruments, software necessary for R&D activities.

- Promoting innovation in enterprises: this operation will finance the acquisition of R&D services and application rights of R&D results in order to stimulate the R&D activities within enterprises and their incorporation into products, services and technologies.

All these measures under this operational area are configured to boost the private expenditure on R&D thus contributing to the achievement of *National Strategy for RDI* in line with Lisbon targets. Nevertheless, consideration needs to be given to other measures that are in place or should be in place that could be more effective and beneficial for the private sector. These measures such as fiscal incentives, tax credits, state aid regulation, venture capital etc. and their (possible) effects will be analyzed in detail in the following chapter.

5.3 Other National Programs in Support of RDI Field

Important developments in the RDI system in Romania, as it can be seen from the *National Strategy for RDI* and the SOP and ROP programs as well from the programs that are to be presented in this section, are the increased focus of policies and policy instruments on the consolidation of human resources and infrastructures for RDI. Also there is an increased orientation towards strengthening university-institutes-enterprise institutional links, increasing the participation of the private sector in R&D activities and the international visibility of researchers. Moreover, in terms of policy design and implementation, important developments are to be noticed. Thus, attempts have been made to strengthen communication and collaboration between the main stakeholders in the RDI system and their relations with local, regional and central authorities. Discussing RDI policies in a larger forum and the establishing of an enhanced communication with various stakeholders led to a more emphasis to be put on the role of the private sector in the RDI system and the acknowledgement of the importance of innovation as a key driver of economic growth. This can be exemplified by the development of several policy programs and strategies such as the *Action Plan* for 2005-2008 Industrial Policy, the R&D section of the *2005-2009 National Export Strategy, the 2007-2013 National Development Plan* which involved a large collaboration between several Ministries, agencies, intermediary bodies and diverse stakeholders. A more recent vivid example is the elaboration of the *RDI Strategy 2007-2013* which involved an ample exercise of foresight namely negotiation and communication among a large diversity of actors. This is a welcomed transformation in the policy making process concerning the RDI field.

Besides the development measures prescribed by SOP and ROP, the two most important programs for the first post-accession period defined in accordance with the Lisbon objectives on growth and economic competitiveness, several programs have been put in place (details of these programs on the National Authority for Scientific Research (NASR website, Operational Programs).

The *IMPACT* program that was launched in 2006 and runs until 2010 is to support projects derived from the *"increasing economic competitiveness through R&D and innovation"* component of the *National Development Plan 2007-2013*. The program is dedicated to support the preparation of RDI projects that will be funded by structural funds. The program is to stimulate the development of viable RDI projects that respond to the objectives of the Lisbon Agenda and contribute to the reduction of regional disparities.

Other programs that were put in place are aimed at encouraging the development of partnerships between universities, R&D institutes and industry. One program is *Partners for Excellence* launched in 2004 by the National Agency for Partnership between Universities and the Socio-Economic Environment (APART) and has the aim of fostering university-industry partnerships in Romania. The program supports contacts and joint projects between academics and business representatives. Another program in this respect is *Universities for Society Program*

initiated in 2002 by APART with the aim of fostering regional university-industry linkages and raising awareness on the role of entrepreneurial universities in society.

As these programs and other programs reveal (for details see Table 5 presenting policy responses to main challenges), in recent years there has been a more pronounced attention on innovation which led to a more visible differentiation between R&D and innovation orientations. This can be exemplified by the new financial instruments that have been put in place in important programs such as *Core Research Program, Sectoral R&D Programs, INFRATECH, and Research for Excellence Program* which support both research and innovation activities (see European Commission, 2006). Programs with a clear focus on innovation have been elaborated by the Ministries and government agencies such as the Industrial and Software Parks, Ministry of Home Affairs, National Agency for SMEs etc. Although financial instruments still target mostly research activities, recent programs are likely to attract higher levels of funding towards innovation.

Table 5. *Policy responses to main challenges in the RDI field*

Challenge 1: Developing RDI infrastructure, improving international visibility.	**Challenge 2: Increasing transfer of technology to economy, improving innovation infrastructure.**
Research of Excellence Program (CEEX) National Plan for RDI Nucleus programs for RDI (since 2003) Grants for scientific research (since 1996) Sector Program Mec-ANCS (2004) POS, Priority Axis 2 Participation at the Framework Program FP7 (EU) Participation in European Research Area (ERA)	National Plan for RDI CEEX INFRATECH (since 2004) POS, Priority Axis 2 IMPACT (since 2006)
Challenge 3: Support for industry-universities-research institutes partnerships.	**Challenge 4: Stimulate the innovative potential of SMEs.**
Industrial & Software Park Program TRANSINO program for technology transfer Partners for Excellence Universities for Society CEEX	RELANSIN Program for economic revival through RDI Industrial & Software Parks Program Multi-annual programs for SMEs

Sources: Ministry of Education and Research, 2006, European Commission, 2006, NASR website

All in all, it can be noticed that several programs and policy tools have been created in Romania in the past few years that are intended to strengthen and consolidate the RDI system. Consultancy and communication with different stakeholders captured attention on serious issues such as the role of the industry in RDI activities, the role of public/private partnerships in technology transfer, diffusion and innovation and the acknowledgement of the role of innovation

as a key driver of growth. In the context of an increase in public expenditure on RDI and the receipt of large financial contribution from the EU through the structural funds, the programs analyzed in this chapter are necessary for a good administration and distribution of these funds towards RDI activities. Nevertheless, further challenges remain: the simplification of financial schemes for these grants and the creation of new instruments to support RDI activities for enterprises. Furthermore, issues such as technology transfer mechanisms and infrastructure and RDI capabilities of domestic firms need to be tackled.

In other words, more emphasis needs to be put on technology diffusion and its absorption by the business sector. It is known that for countries that are catching-up like developing economies, diffusion can be the most important part of the innovation process (Smith, 2004:459). Diffusion of technology is accompanied by learning about their use which feeds-back to improvements in the original innovation. For this the absorption capacity of firms is important. R&D has an important role in favoring the absorption of new technologies, increasing productivity and stimulating product innovation (Parisi&Schiantarelli, 2006). So it is worrying that Romania is characterized by low business R&D intensity. In this respect, it is important for policy makers to shape an environment that is conducive to innovation.

5.4 Assessment of National Policy towards RDI

The national measures and programs towards the RDI field presented in this chapter reflect the increased attention towards the necessity of designing effective policy tools in support of RDI activities in Romania. The Government shows serious attempts to align its policies and priorities to those prescribed by the EU through the Lisbon Agenda, attempts that are intended to boost economic competitiveness and growth in Romania. After a long period of transition and a fastened and chaotic process of restructuring and reform, the RDI field is for the first time set as a priority in the plan of governance of the present Government. The reorientation of priorities where RDI has a top position now was induced by the accession of Romania to the EU and the implicit necessity of aligning to the priorities of the European club. Reform in the RDI field was also acknowledged as necessary due to the high economic and technological gap between Romania and most EU countries and the recognition that research and innovation are key elements to economic growth.

While the former technology policy in Romania characteristic to the transition period was focused mainly on basic research with slight attention to innovation, the new *National Strategy for RDI* reflects a modern, evolutionary view on the role of research and innovation in triggering economic growth, where innovation is seen from a systemic view and it can be managed from an innovation system perspective. As modern, evolutionary economic theories show (see Chapter 2, section 2.4.), innovation is an unpredictable, risky and expensive process which is competitive but at the same time requires cooperation and communication between several actors in the innovation system in order to reduce the risks and costs. The National Strategy for RDI designs measures to establish and develop interactions and relations between actors in the innovation

process and also targets a stronger link between research and industry with the aim of applying research results and incorporating them into new or better services and products.

From the range of measures designed in this respect, attention is given to the support for the creation of public/private partnerships in RDI activities. As experience in most European countries shows, public/private partnerships are important as they offer a framework for the public and private sectors to join forces in domains where they have complementary interests but cannot act as efficiently alone (OECD, 2004 also Ishibashi&Matsumura, 2006). They are increasingly popular in the R&D field as they can effectively fill gaps in innovation systems and increase the efficiency of public policy in addressing market failures that affect innovation processes. They also have an important role in technology transfer, diffusion and assimilation of innovations.

The *National Strategy* also makes use of the concept of clusters and designs measures in support of their creation and development. The concept of clusters responds to the paradox of innovation that uses cooperation to enhance competition by linking diverse actors in the innovation process. In knowledge-based economies, clusters of innovative firms form around sources of knowledge and they are characterized by highly concentrated and effective links between entrepreneurs, investors and researchers. Studies show (see OECD, 1999) that dynamic clusters are becoming key elements in a country's capacity to attract international investment that generates new technological expertise, to attract investors in innovation (e.g. venture capital), and to make advantage of the international mobility of skilled personnel. In case of Romania, clusters present opportunities both for firms, keen to improve their competitiveness and Government, keen to explore new sources of economic growth.

Other measures are designed to support the interaction and cooperation between actors in the innovation system, namely measures to support the formation and development of technological platforms, innovation networks, scientific and technological parks, spin-offs within universities etc. Members of the community of researchers, academics and also business agents respond well and in a positive manner to the approach of the National Strategy for RDI. Concerning research institutes, these might modernize their development strategy implying more orientation towards innovation and applicative research which can be absorbed by the industry. For example, Dr. Eng. Gabriela Rodica Hrin, the General Director of ICI, the main RDI institute in the field of ICT in Romania, underlines that the institute will have a new strategy in conformity with the National RDI Strategy where accent will be put on *"innovation through research"*. Thus, she states that:

> *"the priority of my management strategy will be the increase of innovation in the R&D activities we develop, while the participation of the institute in business with partners from the private sector for the valorization of research results is imperative for the following period*" (interview in Market Watch, 2007).

Hopefully, there will be an increased orientation of the main research institutes in Romania towards applicative research and enhanced cooperation with the private sector.

Researchers in Romania have also shown a positive respond vis-à-vis the National RDI Strategy. In the memo presenting its opinion regarding the *National Strategy*, the *Association of Researchers in Romania*, Ad Astra, salutes the creation of a coherent national strategy towards the long time neglected field of RDI (memo requested via email to office@ad-astra.ro , July 2007). It states that:

> *"the National Strategy sets a series of basic principles in the field of RDI, that were them to be followed, they could lead to a real development of the innovation system in Romania, and can create the premises for its alignment to the European levels. It is important that the Strategy sets some clear, quantifiable objectives (…) against which it can be evaluated in the future".*

Researchers are pleased with the vision of the Strategy namely that the demand corresponding to the need to innovate in the economy will be realized through mechanisms where the initiative will belong to private enterprises but nonetheless criticizes the fact that important mechanisms to apply research results are given less importance namely the creation of start-ups and spin-offs. This aspect should receive great importance in the context where the industry presents weak interest to innovate. Another important criticism addressed regards the methods of evaluation for the implementation of the Strategy. There are many informative indicators (number of researchers, number of funded programs) while the use of indicators for results would be more appropriate to assess the success (like number of patents, articles etc).

Besides the commentary of Ad Astra and in the light of the research made in this paper (see Chapter 3 section 3.4. regarding innovation indicators)), also considering the fact that the Strategy was designed from a systemic view on innovation, it can be recommended the use of modern indicators characteristic to the innovation system approach. As the Strategy targets the formation and development of relations between actors in the system specific indicators should be used to measure the diffusion of innovation like co-patenting, citations, mobility of human resources, clusters, technological parks etc. These indicators reflect the formation and transformation of the Romanian innovation system.

Last but not least, the *RDI Strategy* is also welcomed by the private sector. The measures designed to increase private participation in RDI activities can create a boost in innovatory activities of enterprises and orient their attention towards R&D. In this respect, Stefan Vlasko, the General Director of Electro-Sistem, Baia Mare, one of the largest firms specialized in electric equipment and products in the area of Maramures, reveals that the development strategy of the firm has been highly influenced by the new policy measures in the field of RDI:

"Serious financial tools are in place now to support firms develop their R&D infrastructure. As we have recently joined the EU, our products need to be very competitive not only through prices but also through their added-value innovatory elements. Due to this fact, I developed a project this year for the creation of a R&D laboratory to improve our products and also create new ones and it was accepted for Governmental funds through the SOP Priority Axis 2. Now I am currently preparing to establish a partnership with a university to develop a new series of products based on advanced research. I am preparing to finalize the project for receiving grants in this respect also. The financial aid we receive for our projects is very important in the sense that there would have been slight chances to invest in these large activities alone" (interview held on 12th July, 2007).

All in all, even these are only few responses from diverse stakeholders in the innovation system in Romania and even though there are some skeptical opinions vis-à-vis the success of the RDI Strategy, the general opinion as it is reflected on the civil-society forums (see www.strategie-cdi.ro) and the mass-media (see Market Watch, Revista Stiinta si Tehnica, Ziua, Topbusiness, 2007) is a positive one regarding the new policy tools and measures. The national RDI policy is reoriented towards an increased focus on innovation, the reconfiguration of the innovation system and making the private sector the initiator of innovativeness.

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Several programs and policy tools have been created in Romania in the past few years that are intended to strengthen and consolidate the RDI system. Consultancy and communication with different stakeholders captured attention on serious issues such as the role of the industry in RDI activities, the role of public/private partnerships in technology transfer, diffusion and innovation and the acknowledgement of the role of innovation as a key driver of growth. In the context of an increase in public expenditure on RDI and the receipt of large financial contribution from the EU through the structural funds, the programs analyzed are necessary for a good administration and distribution of these funds towards RDI activities. While the former technology policy in Romania characteristic to the transition period was focused mainly on basic research with slight attention to innovation, the new *National Strategy for RDI* reflects a modern, evolutionary view on the role of research and innovation in triggering economic growth, where innovation is seen from a systemic view and it can be managed from an innovation system perspective. It is the first serious attempt in post-communist Romania to design the national innovation system through creation of institutions and services, design and coordination of policies towards RDI, and measures targeted to develop and transform relations among actors in the system.

6 Support for the Innovative Private Sector

The analysis of the Romanian innovation system presents a situation where innovatory activities are yet at an incipient phase, the system is still rudimentary and the RDI field has been for a long time outside the scope of public policy. Nevertheless, considering the recent tendencies and progress in the design and implementation of viable policy measures towards RDI and also the serious Governmental commitment to increase RDI expenditure, it could be said that there is a high potential for Romania to induce accelerated growth in this sector. The new policies that are in place recognize the importance of the industry as a major initiator of innovativeness and an important source of employment and economic growth. As evolutionary economic theories on growth show, only research results (scientific knowledge) transposed into innovations that can benefit the economy induce real economic progress and in this respect, the private sector has the greatest potential to innovate and create bridges between research units and the market. The Lisbon Agenda sets great importance on the private sector as stimuli of innovation especially on small and medium sized (SME) companies as they are the major source of employment and growth in Europe. This chapter analyses the supportive measures designed for Romanian innovative enterprises in national policy that can reveal the potential of the business sector to innovate and induce economic development in the country. As the previous chapter focused mainly on financial support in the form of direct funds (Governmental grants and the application of structural funds), this chapter will concentrate on other supportive measures for SMEs such as fiscal incentives, micro credits, state aid regulations and the role of venture capital. Hopefully, this analysis will offer a clear picture on how stimulating is the environment for SMEs to innovate.

6.1 Romania as a Catching-Up Economy

This section intends to explore the theories of economists interested in *"catch-up*" or "*late-comer"* countries that make efforts to reduce the economic and technological gap with the more developed states. These theories can reveal whether Romanian firms as *"late-comers"* can gain important economic advantages by imitating technologies developed elsewhere and what measures need to be taken to secure the position of Romania in the technological race.

The main catching-up theories are presented and explored by C. Freeman (1995 and 2002) and they are based on important assessments of the behavior of developing countries and the advantages and disadvantages they obtain from such behavior. He presents the study of Gerschenkron (1962) who analyzed the behavior of catching-up German and Russian firms in 19th century in the steel industry. The observations were that the new late-comer firms could acquire the latest technology with considerably lower costs than those in pioneering countries (2002:201) with the use of skilled people, inward investments and transfer agreements. Even more important for these firms was that the more developed countries had already established

world markets so the catching-up firms could avoid all the risks and costs involved in opening entirely new markets. Gerschenkron describes this as the late-comer advantage as these firms could move rapidly to large-scale production while the pioneer countries are faced now with obsolete technology.

Freeman unveils some critics to the Gerschenkronian theory presenting the argument that the theory needs to be complemented by a national system of innovation explanation as neither the steel nor other industries could have achieved a successful catch-up without many institutional changes, especially in education, training and R&D.

Thus, as Bell and Pavitt (1993) point out:

> *"A country that simply installs foreign technology (...) with foreign assistance will not experience the build-up in technological capability over several decades, which has been characteristic of the leading countries* (in Freeman, 2002:202*)."*

Moreover, the costs of imitation could be rather high in the absence of an infrastructure which is taken for granted in more developed industrialized countries. Thus for catching-up countries it is not sufficient to imitate, assimilate, active learning policies need to overcome disadvantages.

As Keith Smith (2004:515) points out, several countries managed to catch-up by merely imitating the more advanced technologies already in use elsewhere, but rather did so by developing ways of organizing production and distribution by innovating. Successful catching-up has been associated not merely with the adoption of existing techniques but also with innovation especially of the organizational kind and with inroads into nascent industries. So there are some "*windows of opportunity*" in the assimilation of technologies, provided the catch-up countries established appropriate social, industrial and technology policies.

Some conclusions can be drawn from these theories regarding the situation of Romania as a catching-up economy. There are some advantages offered by imitative behavior nevertheless, domestic firms need to develop their own in-house R&D and adopt an active policy towards learning about new technologies, their characteristics and use, in order to improve them through innovation. Learning about technology can also create sources of knowledge leading to the creation of new products thus strengthening the innovatory capacity of firms. For a successful catch-up, Romania needs to develop its own innovatory capacity and strengthen its innovation system through better policies towards the RDI field.

On the same token, Ms. Hanne Hoeck, Expert Government Office West Midlands, gives some advises to Romanian firms and raises attention to the actual aim of Structural Funds:

"*RDI has become a priority field in the EU and in Romania. At the level of private enterprises, it is important to acknowledge that simple acquisition of technology is not sufficient to induce development but needs to be complemented with own R&D efforts. Imitation is not the key to development as Romania needs to contribute through its own efforts to the development of the European knowledge-base. The EU does not allocate funds for firms to make competition to products that already exist in the Internal Market. Better and original products are the competition* (based on discussions during the seminar *State Aid and Structural Funds* on 19th April 2007 organized by the Competition Council in Baia Mare)."

Private enterprises need to be offered enough stimuli for research and innovation as to give real added-value to their products in order to gain economic competitiveness. As Michael Porter (1990) underlines, there are four pylons of national economic competitiveness: the existence of resources (human resources, research, and informational infrastructures), a business environment that stimulates innovation, the structure and quality of internal demand and the presence of *"support*" industries. Thus public policies need to carefully follow an attentive allocation of resources, the performance of the business sector and social progress.

6.2 The Innovatory Capacity of Romanian SMEs

In the European countries nowadays, there is a strong emphasis on conditions for technological competitiveness. There is even a stronger emphasis than on competitiveness itself, which is considered the responsibility of firms themselves. Measures such as intellectual property, sources of finance (particularly legislation on risk capital), taxation, the functioning of universities as links between the economy and society are among the renewed policy approaches to RDI (Laredo&Mustard, 2001:499). Moreover, there is no longer rely on technology policies as such, but there are measures that mobilize other policy domains to the benefit of technological competitiveness of the industrial fabric. The focal point of all these measures towards RDI is the SMEs. If there is one point shared by all EU member states, it is clearly the priority given to SMEs (2001:500). All governments agree nowadays with recognizing their importance in creating employment and their role in the development of new activities. As the SMEs receive the main focus of national policies towards RDI and they are also recognized as a major source of innovatory activities in the Lisbon Agenda, this chapter is concentrated on exploring the supportive measures targeting the innovative SMEs in order to reveal the (potential) input of this sector to improving the national innovatory capacity of Romania.

Before analyzing the measures that are or need to be in place to support the activity of SMEs, it is necessary to gain some insight into the degree of intensity of their RDI activities and the major problems they are facing in the present.

Even though the SMEs sector is expanding in Romania and the level of employment they offer is also increasing, most of "*entrepreneurship*" indicators are very low compared to the EU average. Thus, the number of SMEs innovating in-house is only 44% of the EU average, the

number of collaborations among SMEs on innovation is 29 % of the EU average, and the early stage venture capital is 10% of the EU average (European Commission, 2006:6). Moreover, the study of the National Institute of Statistics in 2003 shows that only 13 percent of small firms and 2 percent of medium-sized firms are innovative, shares that are considerably lower than 41 percent of innovative large firms. Around 50 percent of innovative firms implemented non-technological changes such as marketing, organizational, strategy and leadership, with SMEs being more intense in implementing marketing and design changes. These figures go against the fact that SMEs proved very dynamic, capable to adapt to market demands and to absorb workforce (see ANIMMC, 2003).

As regards to RDI activities of Romanian SMEs, Ms. Marina Ranga, expert that prepared the 2006 report on Romanian Innovation System for the *European Trend Chart on Innovation* (see European Commission, 2006), underlines the weak intensity of domestic business R&D:

> "*There is very little in-house business R&D in Romania while most R&D activities are concentrated in national R&D institutes. This is one of the causes for little business demand for domestic R&D and low absorption by the market of R&D results. Most of the technology renewal and modernization comes from foreign acquisitions and FDI, and the internal market for R&D is underdeveloped. In this context, all aspects related to industry as the <receiving end> or the <private partner> in R&D, are quite weak* (based on electronic correspondence with Ms. Ranga during June, July, 2007)."

The weight of sales of new or improved products (new for the company and new for the market) is an important indicator to characterize the innovation state. In this respect Romania is on better place as regards new products both in manufacturing industry and services (Ministry of Economy and Finance, 2007). The situation is less good when it comes to exports and the weight of high-tech products in total exports. The high-tech products represent only 3.3% of total exports which is very low compared to the EU average, 18%.

An analysis of the structure of exports shows that Romanian products are mostly competitive through prices and not their innovative value. As the report of the *Romanian Academic Society* (SAR) for 2007 underlines:

> "*Romanian firms will not be able to compete internationally only based on natural resources, cheap workforce and low prices, as they need to orient their activities towards diversification, productivity, quality, innovation in production, design and services* (SAR, 2007:54)."

As regards to the economic development in Romania so far, the report concludes:

"The integration of Romania in the global economy following the strategic partnership with the EU was realized mainly through cheap labor and exports of products of small and medium technology. Many serious social problems have been resolved this way, through creation of employment. Anyway, the low added-value of these exports has had a modest contribution to an increase in living standards through the intermediation of high economic growth rates in the long run (2007:49)."

As regards intellectual property rights, SMEs are much less willing to adopt protective measures compared to large companies (ANIMMC, 2003). Concerning industrial innovative companies, the mostly used methods of protection are the registration of industrial models and designs/trademarks namely 17% of the companies, but regarding the application of at least one domestic patent, 13% were large companies and 87% were SMEs.

What can be deducted from all these figures regarding the activities of SMEs is that the level of R&D and innovation activities in enterprises is very low. The Ministry of Economy and Finance (2007:43) states at least three reasons for this weak intensity:

- Public research base is not oriented to the demands of the economy.
- Enterprises hesitate to undergo RDI activities due to high market risks and uncertainties.
- The financial markets are not supportive.

While the first two reasons have been reasonably tackled in the main political strategies and programs towards the field of RDI (see for details Chapter 5), through measures designed for the development of linkages between the private and public sectors and more diverse linkages between the stakeholders in the innovation process in order to reduce the costs and risks if innovatory activities, the financial problem is still one of the greatest concerning the private sector as underlined by many studies (see Romanian Government, 2006b, Ministry of Economy and Finance, 2007, SAR 2007, ANIMMC 2003, European Commission, 2006).

6.3 Access to finance

As it appears from many studies, most Romanian SMEs are severely undercapitalized and the main reasons for the low rate of business survival, lack of growth and competitiveness are: the shortage of finance, lack of business support services, limited entrepreneurial skills, and insufficient knowledge of how to enter new markets. Studies show that around 20.8% of entrepreneurs consider that public intervention should focus more on facilitating the access to credits, grants and other financing instruments (Ministry of Economy and Finance, 2007:34). This section will focus on analyzing the accessibility to the capital market with attention on bank credits and venture capital, fiscal incentives for the activities of SMEs and the changes in state aid regulations. These policy tools can be effective in tackling market failures in the field of RDI.

6.3.1 Financial Factors: Bank Credits and Venture Capital

Commercial banks do not offer sufficient business development support to SMEs and their exposure to risk is very low. Difficulties lie in access to capital due to the guarantees required by commercial banks which are often beyond the means of entrepreneurs. A survey carried on in 2006 shows that around 78% of all enterprises financed themselves through their own resources compared to only 47% that used bank credits (2007:35). As a response to this problem, *the National Program of Reforms* (2006) envisages measures to facilitate the access of firms to credits (see Government of Romania, 1996b). In this sense, institutions for guarantee of credits and those of risk capital are important in the development of enterprises. In the present, many segments of SMEs encounter great difficulties in financing their development (e.g. innovative businesses with rapid development, start-ups in the field of high-tech etc). The degree of using the crediting system by innovative SMEs shows that the market is partially un-functional in this respect (2006:22). Interventions are necessary to promote innovative financial instruments in the type of venture capital funds. Measures are envisaged to create investment and venture capital funds. To reduce the costs of crediting and to support the investments of SMEs, instruments in the type of credit guarantee institutions have been set in place. Currently there are four credit guarantee institutions in Romania, providing services for SMEs.

It is known that capital market imperfections affect investment in fixed capital and many studies conclude that similar problems can arise for investment in research and development (Jaumotte&Pain, 2005: 18). Thus, if borrowers and lenders have asymmetric information about the risk of investment projects, there will be a gap between the private rate of return and the cost of external finance. Consequently external investors will require a premium to make up for agency costs arising from: the risk of financing an inherently uneconomic project and moral hazard, namely the inability to monitor perfectly the allocation of the funds by the borrower. Difficulties of obtaining external finance for R&D activities are usually higher than other forms of investments as R&D projects are inherently more risky and the probability of asymmetric information is likely to be high.

Financial constraints are even higher for new entrants in research activities as they have no history of successful research and don't have sufficient means of internal finance. This has led to the creation of policy tools in many European countries targeting fiscal support directly at small firms and also to measures encouraging the development of venture capital markets (2005:19). Regarding venture capital, studies show that increases in venture capital activity in an industry are associated with noticeable higher patenting rates (see Kortum and Lerner, 2000). This may reflect a greater incentive to patent ideas in order to attract financial support but there is also proof that patents of companies backed with venture capital are more cited subsequently than are other patents.

All in all, as data presented in this section shows, Romanian SMEs face great constraints in accessing external sources of finance while most of SMEs finance their activities through their

own resources. RDI activities are even more unlikely to attract external funding due to their high degree of risk and uncertainty which can imply serious costs for the lender agency. Access to finance is even more difficult for innovative start-ups which due to limited internal resources and lack of RDI history present a higher degree of risk and lower credibility. The mortality of business start-ups is very high in Romania in their first year, due to a shortage of finance and lack of business support services. Due to all these difficulties faced by innovative SMEs, new financial instruments need to be set in place in Romania in order to support the development of this sector. Measures are needed to be created in the form of venture capital funds and credit guarantee institutions in order to reduce the costs of crediting and support the investments of SMEs. These measures are currently in development in Romania, such as the creation of a National Risk Capital Fund for RDI based on state capital and further developed by private funds which is foreseen in the *2005-2008 Government Program* but has not yet been implemented. Moreover, firms need to acquire entrepreneurial skills and knowledge about the markets but also information about possible sources of finance for their activities. In this respect, business support services need to be put in place to offer information and counseling.

6.3.2 Fiscal Incentives: Tax Breaks and Tax Credits

Fiscal incentives in the form of tax breaks and tax credits have gained in importance as policy tools designed to stimulate private innovatory activities. Studies show that the instruments that have gained importance in the implementation of RDI policies are characterized by their automatic attribution and by the simplicity of their implementation linked to the existence of simple criteria or to the greater proximity of the actors targeted (Laredo&Mustard, 2001:500). They also have the advantage of corresponding to the new focal point of industrial policies: the SMEs and examples in this respect are the ANVAR and the tax credit for research in France and fiscal support for investment in Italy. Indeed, over time, the use of direct grants to institutions and private firms has become less prominent in most economies while greater emphasis has been put on tax measures and the targeting of public funds towards specific projects (Jaumotte&Pain, 2005).

Compared to direct government funding, fiscal incentives are a simpler, wider in scope and automatic instrument to stimulate the development of the private sector. In this respect, Mr. Toncea Zoltan, counselor for the *Center for elaboration of EU projects* in Targu Mures, refers to the difficulties of public funding (through structural or Governmental funds):

"*Direct funding is targeted towards activities which are considered to offer the highest social marginal returns from research expenditures. In fact it is very difficult to identify such projects, to assess the capacity of organizations that are to undertake them and also the best means through which they should be funded. The process of evaluation also requires difficult judgment in the sense of estimating the wider range of social benefits that are to be generated* (based on an interview held on 5th July, 2007).

Currently, tax incentives have grown to become one of the major instruments used by EU Member States to stimulate business R&D. It is considered that tax incentives have the advantage of being timely, predictable and transparent. They also have the ability to attract more companies to invest in R&D and can create behavioral changes to the way they plan and take part in R&D activities. The European Commission presents also serious efforts to create a more favorable fiscal environment for RDI activities. Thus, it has adopted a Communication on a more effective use of tax incentives in favor of R&D in order to boost R&D creation and enhance job creation (European Commission website, Taxation Customs). The Communication encourages Member States to improve the use of tax incentives on specific R&D issues. "*We have identified tax incentives as way of encouraging more private investment in R&D*," said European Science and Research Commissioner Janez Potočnik in a press release. He said in addition:

"*We want to break down the barriers that prevent companies and researchers working together across internal borders and so create a European Research Area. A common approach to tax incentives would be a good step in the right direction* (on EU website, Press Release).

So, there is a great importance attached to the use of tax incentives to stimulate more private R&D and are progressively used more than other instruments such as public funding. Studies comparing the effects of public funding with those of tax incentives conclude that direct funding can produce crowding-in effects if firms face financial constraints that prevent them from otherwise undertaking projects that are expected to offer high returns, but also crowding out if diminishing marginal returns to R&D leads grant holders to reduce their own funding for R&D expenditure (Jaumotte&Pain, 2005:9). Thus for some firms, government funding may be just a cheaper source of funding. In comparison, tax incentives are less likely to lead to an increase in crowding out effects, as they reduce directly the marginal cost of R&D. Some studies show that direct funding and tax incentives are substitutes. Direct Government funding of business R&D is found to create significant additional amounts of private R&D, but once tax incentives are allowed for, the effect of this funding is significantly reduced.

Moreover, some studies also show that Government subsidies have a noticeable positive impact on company financed R&D expenditures of small firms which means that grants to small firms enables projects to be undertaken that would not otherwise been financed (2005:10). Regarding large firms, the grant is most likely to be used to finance activities that would have been undertaken in any event.

As these studies show, tax policies cannot be effective in all circumstances. Among important disadvantages of this instrument is research duplication when support is given by means of tax reliefs, rather than by grants, and there is high chance of expenditures occurring in areas of low private returns than in areas of high social returns. Small firms can also be at disadvantage when support is given only through the tax system, as these firms have small taxable incomes.

All in all, it can be concluded that tax incentives are effective only in some circumstances and need to be combined with other instruments in support of RDI activities. Direct public funding is more beneficial for small firms with little income while tax incentives are more effective in the case of large firms as public funding can be ineffectively used here to finance activities that would have been undertaken anyway. Direct funding requires difficult judgment to identify successful projects and rather complicated processes while the tax instrument is automatic, transparent and predictable but nevertheless can create serious research duplication. Thus every instrument of public policy towards RDI has advantages and disadvantages and there is the need to carefully assess the effects of these instruments in different circumstances. Financial instruments such as public funding may be indispensable for start-ups and small firms which are in great need of external finance while tax incentives are more convenient for large firms with large taxable incomes.

Initiatives to reform the Fiscal Code and create a favorable fiscal environment for businesses in Romania are just at an incipient phase and in course of development. Recently, several laws have been adopted to modify the Fiscal Code like the one adopted on 28th February 2007 by the Parliament configuring the exemption of tax for the reinvested profit. According to this law, firms do not have to pay taxes for the profit they reinvested, possibly effective from year 2008. This is a welcomed measure that stimulates SMEs to invest and make savings. The *Association of Businessmen in Romania* (AOAR) claims in a press release:

> *"AOAR has been constantly claiming that fiscal measures need to sustain the development of enterprises which are key elements for job creation. In this context, the new regulation can contribute to an increase in the volume of investments of private firms, to the modernization and development of productive and commercial sectors* (Rompress, 2007)*."*

Also AOAR claims the necessity of adopting new fiscal measures intended to allow an important development of financial intermediations and the access to capital markets in order to attract funds necessary for investments. The Association sees premises for opening a public discussion around the creation of a new Fiscal Code. Other important new fiscal measures are the introduction of the unique tax base of 16% for profits and there are currently discussions around reducing taxes on salaries with a minimum of 8 %.

As it can be noticed, the fiscal environment in Romania is changing towards being more favorable for the development of small and medium size enterprises. The most recent measures allow the private sector to grow, develop and invest and also can constitute an element of attraction for foreign companies to invest in Romania. Even the private sector is expecting more fiscal measures, it is to be remarked that the modification of fiscal policy is not an easy process as each new measure needs to be evaluated in terms of its effects on the state budget. Regarding the tax break for the reinvested profit, the Government is showing signs of worry claiming that this measure could generate losses for the state budget of around 1.2% of GDP in 2009 (Rompress, 2007).

6.3.3 State Aid Regulations

The EU gives increased attention to state aid regulation and has refocused its policy towards creating a friendlier environment for research and development. Thus, the European Commission adopted on 22nd November 2006 the *New Community Framework for State Aid for Research, Development and Innovation* which entered into force on 1st January 2007.

The European Commission, through its *State Aid Action Plan* aims to reduce state aid gradually while refocusing it on activities that have the most beneficial effect on competitiveness, jobs and growth, such as RDI (on European Commission website, Competition, State Aid). Thus, as figures show, in 2005 12% of state aid in EU-25 was devoted to R&D amounting to 5.4 million EUR, nonetheless member states are invited to increase this proportion through the new *Community Framework on State Aid*.

As it is known, research and innovation generally develop best in open and competitive markets nevertheless market failures may hamper the delivery of optimal levels of research and innovation. State Aid is a useful policy tool to tackle market failures and create incentives for market participants in this way facilitating research and innovation. State aid targeted towards specific sectors can distort competition in a higher degree than horizontal objectives such as R&D, environment protection, regional development and the development of SMEs sector (GEA, 2004).

Until recently, Romania did not have a global, systematic approach on the issue of state aid. Especially in the first years of transition, state aid focused mainly on allocating subventions to state enterprises, social protection given directly or through state enterprises. Therefore, more often than not, public funds did not fulfill their targeted objective as they were sporadically allocated and many times on ad-hoc basis. The most recent attempt to change the rules in the domain of state aid and to align regulations to EU standards has been the *Policy in the field of State Aid for the period 2006-2013* adopted through Government Decision No.651/2006 (see Government of Romania, 2006c).

Studies such as the *State Aid Scoreboard* (2004) of the European Commission and the reports of the Romanian Competition Council (2006) show that the average value of state aid allocated by Romania in the period 2002-2004 has been 981 millions EUR a value lower that in Poland (2902 mill EUR) and higher than in Hungary (808 mill EUR). As a percentage in GDP, the total amounts of state aid in Romania represented 1.86% a value considerably higher than in the EU-25 (0.49% GDP) and even higher than the average in the new member states (1.35% GDP). This high level of state aid is mainly due to ample process of reforms in the transition period, privatization and the restructuring of companies in difficulties.

In the period 2002-2004, Romania allocated 13% of total state aid to horizontal objectives this value being very low in comparison with the EU-25 namely 68% (Competition Council, 2006:21). In contrast, the state aid allocated towards sectors which are more distorting

for competition especially in sectors such as naval constructions and automobiles represented 87% in Romania compared to 32% in the EU and 77% in the new member states. The differences can be explained by the strong support given to some industries before the accession in the context of their privatization or assuring their viability (e.g. steel industry, mining industry, etc.).

Regarding the structure of state aid, in Romania in the period 2002-2004 the most used state aid instruments have been the postponement of the payment of fiscal obligations (45.4%) followed by tax exemptions (29.4%) and subventions (23.7%) (2006:22). In the EU the rapport is reversed namely subventions are predominant in the structure of state aid while in Romania most of measures consist in tax breaks and tax reliefs mainly for large companies (some state owned).

In the future, and especially due to the accession of Romania to the EU and the implementation of the Lisbon Agenda, Romania has to reorient its state aid policy to more horizontal objectives such as research and development, environmental issues, training the human capital. State aid towards regional development has already increased in the recent post-accession period, to eliminate development discrepancies between Romania and different European regions. The process of giving state aid under political and social pressure to "*economic mastodons*" is coming to a halt. The *European Council* from March 2005 giving a new impulse to the Lisbon Agenda asked the member states to reduce the state aid under 1% of GDP. The new *Community Framework on State Aid* 2006 encourages member states to focus on the field of RDI by sustaining measures such as promoting cross-border research, public/private research partnerships, dissemination of research results and major research projects (European Commission website, Policy, State Aid). Romania started in the framework of the new *National RDI Strategy* to finance such projects through the application of structural funds and increased Governmental allocations. Moreover, the new *Policy in the field of state aid for the period 2006-2013* is an important attempt to align rules to EU requirements. Although the implementation of such rules is a much slower process, the Competition Council and other responsible agencies are closely monitoring the development of state aid regulations and try to raise public awareness in this respect.

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The Lisbon Agenda sets great importance on the private sector as stimuli of innovation especially on small and medium sized (SME) companies as they are the major source of employment and growth in Europe. Unfortunately, figures show that the innovatory activities of Romanian SMEs are very weak, there is a high mortality of business start-ups and enterprises face many difficulties especially in terms of access to finance. RDI activities present a high degree of risk and uncertainty therefore there are constraints regarding accessibility to external finance. Supportive measures (financial and fiscal) such as facilitating access to bank credits, creation of venture capital funds, tax credits and tax breaks and the re-orientation of state aid towards the field of RDI are effective tools to tackle market failures and encourage private

investment in R&D. Nevertheless, each policy tool has its own advantages and disadvantages and a careful assessment of their effects on RDI activities needs to be made. Usually, there is a mix in the use of these policy tools depending on the targeted segments (SMEs, large companies, state-owned companies etc) and the objectives of the policy (reduce regional disparities, support for the SME sector etc.). Romania can make use of these policy tools to realize its objectives in the RDI field and create a more favorable environment for business.

7 Conclusions

7.1 Results

The Lisbon Agenda is the main political strategy consisting of an important set of economic reforms aimed at triggering economic growth in the EU and improving economic competitiveness. The Agenda sets important guidelines intended to support national governments undertake economic reform and design policies that can assure the transition to knowledge-based economies, improve productivity and increase technological development. The corner stone of the Agenda are measures targeting research, development and innovation that are designed to support the member states in the creation of better policies in these fields and in efforts to increase investments in R&D. There are, however, important implementation problems as member states, both old and new, face important difficulties in the achievement of the Lisbon targets. Problems such as the complexity of the Agenda, the multitude of objectives and a lack of clear set of priorities represented obstacles for the success of the strategy. The objectives of the Lisbon Agenda proved to be over-ambitious for even highly developed member states context which raises an important question: *if even developed old member states face serious difficulties in achieving the Lisbon targets, are these attainable for less developed, new member states such as Romania?*

Answering such question has multiple utilities. Firstly, it can provide answers about the viability of the Lisbon Agenda and the degree of support it offers to member states in their efforts to induce economic development. Secondly, it can provide answers on the state of economic development in new member states and the type and intensity of efforts that the states undertake to carry economic reform. Thirdly, it can provide answers regarding the degree to which new member states can contribute to strengthening the European knowledge-base and improving economic competitiveness in the EU. The present paper represents an attempt to answer the question by offering an insight into the rationale of the Lisbon Agenda and its focus on research and innovation and an accurate, comprehensive study of the Romanian RDI system.

The first two chapters of the paper (Chapter 2 and 3) are intended to give important insight into the objectives and rationale of the Lisbon Agenda, to explain why it gives special attention to the RDI field by analyzing main theories on economic growth and important studies on innovation processes, research and technological development. Chapters 4, 5 and 6 represent a more empirical research which offers a clear image on the characteristics and transformations of the Romanian innovation system as well as the progress that has been made especially in the post-accession period in the RDI field. The results of the research indicate the capacity and efforts on the domestic level to implement the Lisbon Agenda and improve economic competitiveness of Romania.

In the attempt to explain the focus of the Lisbon Agenda on RDI, Chapter 2 consists of an analysis of the neoclassical and the evolutionary theory on economic growth and the role they attribute to knowledge, research and innovation in stemming economic growth. It shows that advanced countries have moved towards a knowledge economy in the post industrial era as a result of a transformation in the understanding of knowledge as it has become used and applied to work. Knowledge is seen now as a resource, an investment and product that can increase productivity and stem economic growth. In the neoclassical approach, technological progress is driven by production of knowledge (basic research) which is supported by the government and is made by a community of researchers not seeking profit therefore economic growth is considered to originate outside the economic system. In contrast with neoclassical assumptions, the new growth theory claims that technological progress is not exogenous but stems inside the economic system and is not induced only by science and basic research but also by processes of learning and problem-solving (knowledge diffusion) undertaken by various organizations among which firms are the focus of attention. In this assumption, firms are seen as innovative entrepreneurs that interact with various actors in processes of knowledge production and diffusion. Thus, research produced inside the economic system and transposed into innovation can trigger economic growth hereto the focus of the Lisbon Agenda on RDI in its plans of economic reform is validated by evolutionary theories.

Chapter 3 offers a good insight into the functioning of innovation processes. It shows that the transition from the linear to a systemic model (of innovation) marked the idea that innovation can stem not only from basic research but from various stages of knowledge (technology) diffusion which imply the development of connections between participants in innovation processes. The new approach on innovation suggests that a country can reinforce its innovatory capacity and trigger technological development through reshaping and strengthening its national innovation system. The concept of national innovation system rests on the premise that innovation and technical progress are the result of a complex set of relations among actors producing, applying and transferring different kinds of knowledge. The innovative performance of a country depends heavily on how these actors relate to each other as elements of a collective system of knowledge. The actors are mainly enterprises, universities and research institutes and the people within them.

The concept has led in turn to the formation of new policy approaches on innovation. The main policy perspectives are the market failure and missionary paradigms that plea for a contraction of government intervention in innovation processes, not beyond the reparation of market failures or the missionary goals of its agencies. The systemic approach calls for an extension of government support for creation and development of linkages in the innovation system. Policy in this case is focused not only on inputs and outputs to innovation but on the innovation process itself which requires conditions for permitting a good knowledge flow within the system and the creation of links and collaboration among the actors in the system. Innovation and the diffusion of innovation play a central role in the performance of modern

economies. The concept of innovation systems also led to a reformation of indicators used to measure innovation which are now focused not only on inputs (number of researchers, R&D expenditures etc.) and outputs (patents etc.) to innovation but on the innovation process itself. Monitoring the knowledge flow and diffusion of innovation in the system, the new indicators offer a better image of a country's innovatory potential.

Chapter 4 consists of an analysis of the innovatory capacity of Romania by looking at the evolution of main indicators for innovation. The research is nevertheless limited to the use of traditional innovation indicators, as there are few innovation studies regarding Romania based on the application of modern indicators. Romania, as most of Central and Eastern European countries (CEEC) is in process of re-shaping its inherited RDI system from the former communist regime which was hierarchical and centrally planned. Reliance on traditional indicators in the CEE countries does not suffice as they do not fully grasp the institutional transformation of the innovation systems nor the emerging forms of interactions between actors. Studies should look at the relationship between technical and institutional change if one is to understand the growth prospects of these countries. Thus, analysis of technical change should not involve only traditional indicators but also an elaborate institutional analysis as it is through institutions that innovation processes are mediated. Such perspective in which technical and institutional changes are linked is that of systems of innovation. Studies on technological change in the CEEC need to be based on the concept of national innovation systems, this being the reason why Chapter 4 is called "*Romanian National Innovation System*".

Traditional indicators offer nevertheless a good picture of Romania's capacity to innovate although they slightly capture aspects of institutional changes and knowledge diffusion. The value of innovation indicators show that innovation processes are still rudimentary in Romania and innovation activity is still at an incipient stage. The evolution of these indicators shows that the value of most of them is declining. In terms of the number of researchers and R&D personnel, this has been drastically reduced since 1990 the stated reasons for such a decline are the un-attractiveness of careers in research, the lack of stimuli including salaries for researchers. The situation in education is also worrying as studies show that a large part of human potential in RDI is draining to more developed countries. The most worrying signs concern the participation of the private sector in RDI activities as looking at the low number of patents registered, the number of innovatory enterprises and the structure of exports shows that innovatory activities of the business sector are very weak and the Romanian products are thus competitive mostly through low prices and not their added-value elements. Positive progress can be noticed though in the trend of Governmental R&D expenditure and the level of occupation in high-tech and engineering sectors. These figures trigger the strong need of solid public intervention in the field of RDI through the creation of coherent, viable policies.

Policy responses to the main challenges in the RDI field are analyzed in Chapter 5. As it is presented, several programs and policy tools have been created in Romania in the past few years that are intended to strengthen and consolidate the RDI system. Consultancy and communication

with different stakeholders captured attention on serious issues such as the role of the industry in RDI activities, the role of public/private partnerships in technology transfer, diffusion and innovation and the acknowledgement of the role of innovation as a key driver of growth. In the context of an increase in public expenditure on RDI and the receipt of large financial contribution from the EU through the structural funds, the programs analyzed are necessary for a good administration and distribution of these funds towards RDI activities. While the former technology policy in Romania characteristic to the transition period was focused mainly on basic research with slight attention to innovation, the new *National Strategy for RDI* reflects a modern, evolutionary view on the role of research and innovation in triggering economic growth, where innovation is seen from a systemic view and it can be managed from an innovation system perspective. It is the first serious attempt in post-communist Romania to design the national innovation system through creation of institutions and services, design and coordination of policies towards RDI, and measures targeted to develop and transform relations among actors in the system such as development of technological platforms, innovation networks, scientific and technological parks, clusters, innovation incubators, spin-offs, spin-outs etc.

Among measures put in place in the RDI field, special policy tools need to be created in support of the business sector. The Lisbon Agenda sets great importance on the innovatory capacity of the private sector and its capacity to induce economic growth through creation of employment and new fields of activities. Innovative and effective policy tools are needed to be created to support the development of Romanian enterprises and their innovatory capacity especially in the context of a significant diminishment in private RDI contribution in the country.

Chapter 6 consists of a study of policy measures targeting the private sector that are or need to be in place. Figures show that the innovatory activities of Romanian SMEs are very weak, there is a high mortality of business start-ups and enterprises face many difficulties especially in terms of access to finance. RDI activities present a high degree of risk and uncertainty therefore there are constraints regarding accessibility to external finance. Supportive measures (financial and fiscal) such as facilitating access to bank credits, creation of venture capital funds, tax credits and tax breaks and the re-orientation of state aid towards the field of RDI are effective tools to tackle market failures and encourage private investment in R&D. Nevertheless, each policy tool has its own advantages and disadvantages and a careful assessment of their effects on RDI activities needs to be made. Usually, there is a mix in the use of these policy tools depending on the targeted segments (SMEs, large companies, state-owned companies etc) and the objectives of the policy (reduce regional disparities, support for the SME sector etc.). Romania can make use of these policy tools to realize its objectives in the RDI field and create a more favorable environment for business.

All in all, the research in this paper offers a good insight regarding the capacity of Romania to improve its economic competitiveness through developments in the RDI field in alignment with the Lisbon Agenda. So, how far is Romania from attaining the Lisbon targets? Implicitly, how far is Romania from attaining similar levels of technological and economic development as

in the EU and to what degree does Romania contribute to the development of the European knowledge-base?

Looking at the static snapshot offered by innovation indicators the answer becomes worrying. Looking at the context, progress and changes, the answer becomes more optimistic. Thus, observing the level of innovation indicators compared to the EU average, the proper reasoning is to conclude that Romania is far from achieving the Lisbon objectives, is far from becoming a knowledge-based economy and unsuccessful in reducing the technological gap with most of EU member states. The indicators show that innovation processes are rudimentary, innovation activities are at an early stage, most R&D is concentrated in public institutes while the RDI contribution of the private sector has diminished considerably. Thus, aspects regarding the private sector as the receiving-end or the private partner in innovation activities are less represented.

Also, processes of transferring research results to economy, technology diffusion and technology absorption which are very important for stemming technological development in a country are less represented in the case of Romania due to weak linkages between the private and public sectors and on a larger scope, weakly established linkages between stakeholders in innovation processes: universities, R&D institutes, industry and public authorities. The inherited RDI system from the communist regime has not undergone considerable change as the RDI field has been severely neglected during the period of transition. R&D is still massively concentrated in public research institutes, RDI activities are mainly supported by the government with a slight contribution of the private sector, the education system does not respond to the needs of the economy and the technological infrastructure is weakly developed.

Looking at the recent developments and efforts, especially in the post-accession period, it can be noticed that there are high possibilities for Romania to improve its innovatory capacity and economic competitiveness. The context is really favorable to undergo serious reform in the RDI field. The macro-economic stability and recent trends in economic growth has allowed a significant increase in Governmental R&D expenditure. Additional substantial financial support is received from the EU through the allocation of structural funds. The increase in public funding of RDI can attract larger investments in this respect from the private sector. Without a serious increase in private RDI contribution, the Government has weak chances of realizing the Barcelona target: 3% of GDP should be public expenditure from which 2 % private expenditure, in 2013 as it is estimated.

In terms of policy-making, the process has been improved. Especially in the policy formulation stage, there is now a larger forum for consultation, negotiation and communication between various stakeholders in innovation activities as proved by creation of several political programs especially the *National RDI Strategy* that used an ample exercise of foresight. The collaboration with various actors, representatives from the industry, R&D institutes and universities has determined an increased focus of public policy towards the private sector,

innovation and the necessity to create linkages between the public and private RDI actors. The new RDI policy reflects a modern, evolutionary view on innovation with serious efforts to reshape, transform, and consolidate the Romanian innovation system. The renewed policy perspective can be very effective not only in terms of attracting more investments in the RDI field but also in terms of improving innovation processes, diffusion of innovation thus increasing the overall capacity of the country to innovate.

Increased economic competitiveness cannot be realized without the contribution of the business sector which needs to create new and improved products with real added-value innovatory elements. In this respect, important policy tools have been put in place in support of the private sector. Access to finance has been recognized as a serious constraint for enterprises to undergo RDI activities, therefore measures to facilitate access to bank credits and institutions for guarantee of credits have been created. Also important fiscal incentives have been created encouraging enterprises to invest and expand their activities. State aid regulation have been as well reformed and aligned to the European requirements. All these policy tools are in course of development in Romania although a careful assessment needs to be made in terms of their effectiveness and also disadvantages.

Thus, in the context of all these developments it could be said that Romania is closer to achieving the Lisbon objectives than in the estimations based on looking only at the level of innovation indicators. Of course, it may be too soon to make predictions due to the early stage of reform and transformations of the RDI system but considering the strong political will, the favorable macro-economic situation, the considerable financial support from the EU, and the application of new, modern policy perspectives based on the concept of national innovation systems, the potential of Romania to innovate and improve its competitiveness appears in an optimistic light. If serious reform efforts are continued, the successful implementation of the Lisbon Agenda is not so farfetched from becoming reality.

7.2 Further Studies

Studying the process of implementation of the Lisbon Agenda with a focus on RDI field in new member states of the EU is important in several respects. As it is known, the states from the Central and Eastern European are less developed than old member states from Western Europe. These countries are in process of undertaking strong economic reforms and reshaping their RDI systems in order to stem technological development that can lead to significant economic growth. Monitoring the implementation of the Lisbon Agenda in these countries can offer important information about the type of reform they undertake in restructuring their RDI systems, the success they have in reducing the technological gap with old member states and the contribution that these new member states can make to the development of the European knowledge-base.

Innovation studies based on the concept of national innovation systems and the application of modern innovation indicators reveal important aspects of change, transformations and progress in the RDI sector. They provide a clear insight into the institutional changes, namely the linkages and interactions that are being transformed, developed or created also a clear image on the state of the diffusion, production and absorption of knowledge and innovation. As numbers and figures offer just a static snapshot of a country's innovatory capacity, studies based on the concept of national innovation systems capture better the process of technological change and institutional changes and transformations inside the innovation system. So, further studies based on this new approach on innovation need to be carried regarding the new members states. The use of modern innovation indicators is highly recommended in the case of Romania where the policy perspective in the RDI field has changed to reflect a modern, systemic view on innovation. As the new policy tools target the creation and development of connections among participants in the innovation process, proper methods of measuring knowledge flow, diffusion of technology and innovation need to be applied.

8 References

Literature:

1. Aghion Phillipe & Howitt Peter (1998), *Endogenous Growth Theory*, Cambridge, the MIT Press.

2. Balcerowicz, L. (2006), *Enlargement, The Lisbon Agenda, and The Economic Development of Member States*, Atlantic Economic Journal, Vol.2006, No. 34, pp: 261-273.

3. Bell, Daniel (1974), *The Coming of Post-Industrial Society: A Venture in Social Forecasting*, London, Heinemann.

4. Bielgebauer Peter S. & Borras Susanna (2003), *Innovation Policies in Europe and the US. The New Agenda*, Hampshire, Ashgate Publishing Ltd.

5. Borras, Susanna (2003), *The Innovation Policy of the European Union: from government to governance*, Cheltenham, Edward Elgar Pub.

6. Cantner, Uwe & Pyka, Andreas (1999), *Classifying Technology Policy from an Evolutionary Perspective*, University of Augsburg, Economics Institute.

7. Collins, Luke (2005), *Commission Impossible? Plans to Double European Research Spending*, IEE Review, Issue March 2005, pp: 49-51.

8. Competition Council (2006), *O tema si un deziderat de permanenta actualitate: ajutoare de stat mai putine si eficiente*, Profil Concurenta, Vol.IX, No. 3, pp:16-14.

9. Ciutacu Constantin (2001), *Romania in fata unor dileme. Societatea informationala in conditiile suprapopulatiei agrare si a unei economii de subzistenta*, Academia Romana, IEN, Bucuresti.

10. Dosi, Giovanni (1990), *Sources, Procedures and Microeconomic Effects of Innovation*, in Freeman, C. (ed.), op.cit., pp: 106-153.

11. Drucker P. (1966), *The Effective Executive*, New York, HarperCollins Pub. Inc.

12. Drucker F. Peter (1969), *The Age of Discontinuity. Guidelines to our changing Society*, London, Heinemann.

13. Drucker P. (1993), *Post-Capitalist Society*, Oxford, Heinemann.

14. Earl, Loiuse & Gault, Fred (2006), *National Innovation, Indicators and Policy*, Cheltenham, Edward Elgar Pub.

15. Edquist, Charles (2001), *The Systems of Innovation Approach and Innovation Policy: An Account of the state of the art*, Lead paper presented at the DRUID Conference, Aalborg, June 12-15, under theme F*: 'National Systems of Innovation, Institutions and Public Policies'*.

16. European Commission (2004), *European Innovation Scoreboard*, Country Profile Romania.

17. European Commission (2005), *European Innovation Scoreboard*, Country Profile Romania.

18. European Commission (2006), *Annual Innovation Policy Trends and Appraisal Report (Romania), European Trend Chart on Innovation*, published by Enterprise Directorate General.

19. Fagerberg Jan (1990), *A Technology gap approach to why growth rates differ*, in Freeman C. (ed.), op.cit. pp: 55-68.

20. Fagerberg, Jan (2004), *Innovation: a Guide to the Literature*, in Nelson et.al. (eds.), op.cit. pp: 1-28.

21. Feldman Maryann P. & Link Albert N. (2001*), Innovation Policy in the Knowledge-Based Economy*, Boston, Kluwer Academic Publishers.

22. Freeman, Cristopher (ed.) (1990), *The Economics of Innovation*, Vermont, USA, Edward Elgar Publishing.

23. Freeman C. (1990), *Neoclassical vs. Evolutionary Theories of Economic Growth: Critique and Prospective*, in Freeman C. (ed.), op.cit., pp: 3-23.

24. Freeman C. (1995), *The National System of Innovation in Historical Perspective*, Cambridge Journal of Economics, No.19, pp: 5-24.

25. Freeman, C. (2002), *Continental, National and Sub-National Innovation Systems-Complementarity and Economic Growth*, Research Policy, No.31, pp: 191-211.

26. Fromhold-Eisebith, Martina (2007), *Bridging Scales in Innovation Policies: How to Bridge Regional, National and International Innovation Systems*, European Planning Studies, Vol.15, No.2, pp: 217-233.

27. Government of Romania (2005), *2005-2008 Government Programs.*

28. Government of Romania (2006a), *National RDI Strategy, 2007-2013.*

29. Government of Romania (2006b), *National Plan of Reforms.*

30. Government of Romania (2006c), *Policy in The Field of State Aid for The Period 2006-2013.*

31. Groenendijk, Nico (2006), *The Revised Lisbon Agenda: Flawed but Not Yet Failed*, EUSA Review Forum, fall edition, pp: 1-4.

32. Grossman Gene & Elhanan Helpman (1991), *Innovation and Growth in the Global Economy*, Cambridge, the MIT Press.

33. Grossman, Gene M. (1994), *Endogenous Innovation in the Theory of Growth*, the Journal of Economic Perspectives, Vol.8, pp: 23-44.

34. Grupul de Economie Aplicata (GEA) (2004*), Romania si Agenda Lisabona. Aderarea la UE si competitivitatea economica*, Centrul Roman de Politici Economice, Bucuresti.

35. Hagemann, Harald & Seiter, Stephan (2003), *Growth Theory and Growth Policy*, London, New York, Routledge.

36. Ishibashi, I. & Matsumura, T. (2006), *R&D Competition between public and private sectors*, European Economic Review, Vol. 50, Issue 6, pp: 1347-1366.

37. Jaumotte, Florence & Pain, Nigel (2005), *An Overview of Public Policies to Support Innovation*, OECD Economic Department Working Papers No. 456, OECD Publishing.

38. Jones, Graham (1971), *The Role of Science and Technology in Developing Countries*, London, Oxford University Press.

39. Kortum, S. & Lerner, J. (2000), *Assessing the Contribution of Venture Capital to Innovation*, RAND Journal of Economics, vol. 31, pp: 674-692.

40. Laredo Philippe & Mustar Philippe (2001), *Research and Innovation Policies in the New Global Economy. An International Comparative Analysis*, Cheltenham, Edward Elgar Pub.

41. Lazonick, William (2004), *The Innovative Firm*, in Nelson et.al. (eds.), op.cit. pp: 29-56.

42. Leydesdorff, Loet (2006), *The Knowledge-Based Economy. Modeled, Measured, Simulated*, Boca Raton, Florida, Universal Publishers.

43. Lipsey, Richard (2001), *The Conceptual Basis of Technology Policy*, Simon Fraser University, Vancouver, Canada.

44. Llerena Patrick, Matt Mireille, Avadikyan Arman (2005), *Innovation Policy in a Knowledge-Based Economy. Theory and Practice*, New York, Springer.

45. Lundvall B.A. (1992), *National Innovation Systems: Towards a Theory of Innovation and Interactive Learning*, London, Pinter.

46. Martin S. & Scott J.T. (2000), *The Nature of Innovation Market Failure and the Design of Public Support for Private Innovation*, Research Policy, Vol. 29, pp: 437-447.

47. Meeus, Marius & Oerlemans, Leon (2005*), National Innovation Systems* in Casper, Steven & van Waarden, Frans, *Innovation and Institutions. A Multidisciplinary Review of the Study of Innovation Systems*, Cheltenham, Edward Elgar Pub., pp: 51-71.

48. Metcalfe S. (1995), *The Economic Foundations of Technology Policy: Equilibrium and Evolutionary Perspectives*, in P. Stoneman (ed), *Handbook of the Economics of Innovation and Technological Change*, Oxford, Blackwell Pub.

49. Ministry of Economy and Commerce (MEC) (2005), *Program operational sectorial: cresterea competitivitatii economice*, Bucuresti.

50. Ministry of Education and Research (2006), *Document de politici sectoriale pentru fundamentarea propunerilor de buget pe anul 2007.*

51. Ministry of Economy and Finance (2007), *Sectoral Operational Program "Increase of economic competitiveness".*

52. National Agency for SMEs (ANIMMC) (2003), *National Strategy of the Romanian Government for the support of the development of SMEs, 2004-2008*, published by ANIMMC.

53. National Institute of Statistics (2003), *The Annual Statistic Report for Romania.*

54. National Institute of Statistics (2004), *The Annual Statistic Report for Romania.*

55. Nelson R (ed) (1993*), National Innovation Systems. A Comparative Analysis*, Oxford, Oxford University Press.

56. Nelson R.R., Fagerberg J., Mowery D. (eds.) (2004), *The Oxford Handbook of Innovation*, Oxford, Oxford University Press.

57. OECD (1996), *The Knowledge-Based Economy*, Paris, OECD Publishing.

58. OECD (1997), *National Innovation Systems*, Paris, OECD Publishing.

59. OECD (1999), *Proceedings Boosting Innovation: The Cluster Approach*, Science & Information Technology, Vol.1999, No.10, pp: 1-418.

60. OECD (2000), *A New Economy? The Changing Role of Innovation and Information Technology in Growth*, Science & Information Technology, Vol.2000, No.4, pp: 1-89.

61. OECD (2004), *Public/Private Partnerships for Innovations*, Science & Information Technology, Vol.2004, No.16, pp: 255-336.

62. OECD, (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Technological Innovation Data*, Paris, OECD Publishing.

63. Pavitt, Keith (2004), *Innovation Processes*, in Nelson et.al. (eds.), op.cit. pp: 86-115.

64. Porter, Michael (1990), *The Competitive Advantage of Nations*, Macmillan, London.

65. Powell Walter & Stine Grodal (2004), *Network of Innovators* in Nelson et.al. (eds.), op.cit. pp: 56-86.

66. Radosevic, Slavo (1999a), *Transformation of science and technology systems into systems of innovation in central and eastern Europe: the emerging patterns and determinants*, Structural Change and Economic Dynamics, Vol.1999, No.10, pp: 277-320

67. Radosevic, Slavo (1999b), *Patterns of restructuring in research, development and innovation activities in central and eastern European countries: an analysis based on S&T indicators*, Research Policy, Vol.1999, No. 28, pp: 351-376.

68. Romanian Academic Society (SAR) (2007), *Annual Rapport of Analysis and Prognosis*, SAR publishing services.

69. Romanian Office for Science and Technology in Brussels (ROST) (2005), *The Elaboration of the National RDI Strategy Within the National Exercise of Foresight*, published by UEFISCSU.

70. Rooney, David (2003), *Public Policy in Knowledge-Based Economies. Foundations and Framework*, Cheltenham, Edward Elgar Pub.

71. Salvadori, Neri (2003), *The Theory of Economic Growth: A "Classical" Perspective*, Cheltenham, Edward Elgar Pub.

72. Schiantarelli, F. & Parisi, M.L. (2006), *Productivity, Innovation and R&D: Micro Evidence for Italy*, European Economic Review, Vol.50, pp: 2037-2061.

73. Scrieciu, Serban & Winker, Peter (2002), *The Romanian Economy in Transition. Developments and Future Prospects*, School of Business Administration, International University in Germany.

74. Smith, Keith (2000), *Innovation as a Systemic Phenomenon; Rethinking the Role of Public Policy*, Enterprise and Innovation Management Studies, Vol.1, No.1, pp: 73-102.

75. Smith, Keith (2004), *Measuring Innovation*, in Nelson et.al. (eds.), op.cit. pp: 148-180.

76. Societatea Romana de Economie (2004), *Romania. An Assessment of the Lisbon Scoreboard*, Bucuresti.

77. Sporer, Zeljka (2004), *Knowledge-Based Economy and Social Capital in Central and East European Countries*, Eastern European Economics, vol. 42, no. 6, pp: 39–71.

78. Stanciulescu, Ion (2004), *Riscuri Economice si sociale generate de restrangerea Cercetarii Stiintifice Proprii*, Institutul National de Studii si Cercetari INSCC, Bucuresti.

79. Verdun, Amy (2006), *Taking Stock of the Lisbon Agenda: Is Lisbon Flawed, Necessary, Window Dressing or All the Above*?, EUSA Review Forum, fall edition.

Internet Sources:

80. Department of Economic and Social Policies within the Presidential Administration, study *The situation of Romanian Education*, conclusions of the study on: www.business.rol.ro , downloaded, 14 February 2007

81. Miroiu, Adrian (2001), *Invatamantul romanesc la inceputul noului mileniu*, Consiliul National al Partidului National Liberal on: www.pnl.ro , downloaded on 14 February 2007

82. NASR (National Authority of Scientific Research), Operational Programs: http://www.mct.ro/ancs_web/index.php, downloaded May, 2007

83. European Commission, Taxation Customs: http://ec.europa.eu/taxation_customs/index_en.htm, downloaded June 2007

84. European Commission, State Aid Policy: http://ec.europa.eu/invest-in-research/policy/state_aid_en.htm , downloaded June 2007

85. EU, Taxation Customs, Press Release: http://europa.eu/rapid/pressReleasesAction.do?reference=IP/06/1598&format=HTML&aged=0&language=EN&guiLanguage=en, downloaded June 2007

86. EURACTIV, Lisbon Agenda: www.euractiv.com/en/future_eu/lisbon-agenda/article-117510 , downloaded May, 2007.

87. Rompres, *Scutirea de impozit pe profitul reinvesti*t article on: http://www.bloombiz.ro/article , downloaded July 2007

88. Market Watch, Cresterea inovarii, dezvoltarea parteneriatelor cu mediul privat si remodelarea relatiilor de munca, article on: http://www.marketwatch.ro/articles.php?ai=2020 , downloaded on July 2007