Master Thesis:

The role of human capital and technological progress on regional development

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ABSTRACT

In the growth literature, considerable attention has been given to the definition of the factors that influence economic growth and development. This thesis examines the role of human capital and technological progress on regional development. To obtain a correct final conclusion, the issue is approached from different angles. Therefore, three main disciplines have been taken into account and analyzed; the theoretical background, a number of previous empirical studies, and the EU's regional policy. Finally, there is a reference to the problem of access to knowledge, and to some efforts and ideas that have been implemented in order to be tackled.

Key words: Human capital, Technological progress, Regional development

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ACRONYMS

EAGGF - Q/FEOGA: European Agricultural Guidance and Guarantee Fund

EMU: Economic and Monetary Union

ERDF: European Regional Development Fund

ESF: European Social Fund

EU: European Union

FIFG: Financial Instrument for Fisheries Guidance

FURs: Functional Urban Regions

GDP: Gross Domestic Product

GSP: Gross State Product

ICTs: Information and Communication Technologies

IT: Information Technology

NIH: National Institute of Health

NUTS: Nomenclature of Units for Territorial Statistics

OECD: Organization for Economic Co-operation and Development

OLPC: One Laptop per Child

OLS: Ordinary least squares

R&D: Research and Development

SEA: Single European Act

SMEs: Small and Medium Enterprises

TFP: Total Factor Productivity

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1. INTRODUCTION

In response to different economic performances that have been observed between European countries, many researchers tried to identify the determinant factors of regional development. There have been examined some elements such as technology, innovation, R&D effort, human capital, entrepreneurship, infrastructure etc. Differences in endowments of human capital and technological change are recognized by the theoretical growth literature as an important element in explaining growth and observed GDP gaps.

With regard to human capital and technological progress, over the last two decades, their analysis has taken on a progressively more central role in discussions regarding the growth and success of nations and regions. This is primarily because advanced societies have increasingly evolved towards what has been called a 'knowledge-based economy' (Faggian and McCann, 2009) and a 'globalised environment' or 'open-competitive market', whereby tertiary-level human capital and R&D activities are seen to be a crucial feature of economic growth.

Human capital is considered as the source of knowledge, which can be defined to comprise the abilities, capabilities, methods, creativity and persistency in identifying and solving problems by collecting, selecting, interpreting and applying existing knowledge and information (Marthur, 1999; Karlsson, et al., 2009). There is a distinction between knowledge as "an object" and knowledge as talents, skills, know-how, and understanding embodied in individuals (Karlsson, et al., 2009).

Marthur (1999), based on the modern theory of endogenous economic growth, gives the following definition for human capital: "Human capital is an accumulated stock of skills and talents, and it manifests itself in the educated and skilled workforce in the region. The stock of human capital can be increased through formal and informal education and/or on-the-job training of labour. Human capital, although itself produced by human capital and labour, is a significant input in the production of knowledge or ideas".

Keeley (2007) mentions the definition of human capital proposed by the OECD: "Human capital is defined as the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being". According to Sanromá and Ramos (2007), Rauch in 1993 proposed a spatial equilibrium model in which: "local human capital is considered as a territorial characteristic that has positive effects on productivity, but no effects as an amenity". Furthermore, Artelaris et al.

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(2006) mention that “the term of ‘human capital’ refers principally to workers’ acquisition of skills and know-how through education, training and experience”.

As regards technological progress, the term is very clear and as a result the definitions that have been given are just a few. One of them that tried to give a definition for technological progress is Molle (1983) who distinguishes three stages in technological change (R&D): invention, the new idea takes shape; innovation, the idea is materialized in a product or production process; and development, the product gets improved and adapted to market needs. The first two stages cover 'Research' and the third 'Development". Molle also constructs another definition which however is based on the relationship between regional development and technological progress; technological progress is a region's power to generate or adopt new innovations and to attract production plants within its borders. According to Malecki in 1980 and Thomas in 1981 the development of a region results from the activities of actors located in the region (Molle, 1983).

A very important issue is the way of measurement of these two factors. Due to data limitations, the number of years of education is normally used as the best proxy for human capital, with age adjustments and years of employment being incorporated into the earnings equations. However, while the traditional focus of the human capital literature tended to be on secondary education in advanced economies and on both primary and secondary education in developing economies, more recently the focus of education research and policy in the industrialized economies has moved towards tertiary education in response to the technological transformations that have been taking place (Faggian and McCann, 2009). On the other hand for technological progress, some of the measurement factors are the percentage of investment in research and development (R&D), the number of patents produced per inhabitant, etc (Pose and Crescenzi, 2006; Soukiazis and Cravo, 2008; Sterlacchini, 2008).

This study is comprised of five chapters, with which is attempted to present the subject as much understandably as possible and achieving with this way the acquisition of a relatively comprehensive view in order to end up with the right conclusions.

In the first chapter there is a presentation of the theoretical background. More specifically, there is a brief presentation regarding that particular part of the bibliography that is concerned with the role that human capital and technological progress play either in the economic or regional development. Following this, four models that are considered as the most important ones or those that have contributed the most in the development and

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improvement of the research regarding these two factors, both in theoretical and empirical level, are presented.

The second chapter is comprised of a row of empirical studies that have been conducted in order to test whether these two factors influence regional development positively in real terms. Every single empirical study is different, with different methodology and different results. Nevertheless, the differentiation in the results is identified mainly in the volume and the extent of influence, but not in the general conclusion.

The third chapter refers to the route of European Union's regional policy from the foundation manifest till now, the reasons of its establishment, the enhancement targets for the development of the member states that were created during its whole route, reaching the Lisbon 2000 strategy, where the priorities and targets of the European Union changed after the re-consideration of the opinions that were overmastered until then.

In the fourth chapter , four projects that are based on IT and Communication technologies and which have as main purpose the resolution of the problem of access to knowledge, are presented. Thus, it will become understandable how with the help of a technology sector, the technologies of Information and Communication, in combination with free access to data bases (scientific articles, magazines, e-books, lectures, etc), it is possible the creation of human capital as well as the familiarization in first stage, with the technology, and thereafter with its development. These two factors could potentially contribute to the enhancement of knowledge based economy, both for the developed and underdeveloped countries, and finally to regional development.

Thus, there is a presentation of the subject from the perspective of the theory and empirical research as well as from the perspective of the European Union's regional policy. Thereafter, some examples which have been applied in order to resolve basic problems that have been identified at different times in the past and mainly the problem of access are presented. After having an overall and complete picture of what is going on, in the fifth chapter there is the conclusion of this study.

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2. REVIEW OF THEORETICAL GROWTH LITERATURE

2.1. CONCISE REVIEW COMMENTS

In the growth literature, considerable attention has been given to the definition of the factors that influence economic growth and development. Despite the lack of a unifying theory, there are several partial theories that discuss the role of various factors in determining economic growth. Two main theoretical disciplines in growth literature are the neoclassical growth theory and the theory of endogenous growth (Arvanitidis et al., 2007).

Some of the determinants of economic growth are the investments, the economic policies, the macroeconomic conditions, the political environment, the openness to trade, the institutions, the infrastructures, the entrepreneurship, the human capital, the technological progress etc.

Human capital and technological progress are two of the main factors not only for endogenous growth theories, but also for the neoclassical model. Within the neoclassical model, technological change is interpreted as a purely exogenous phenomenon and thus no economic explanation of its evolution is put forward. On the other hand, endogenous growth interpret technological progress as either the by- product of other economic activities or the intentional result of research efforts carried out by profit seeking agents and therefore consider human capital and innovation as fundamental elements in the explanation of the process of economic growth (Magrini, 1998).

According to the traditional neoclassical growth model, as proposed by Solow and Swan in 1956, growth can be explained by the interaction between labour, capital and exogenously given technology. This model revitalized the study of economic growth by modelling it as the result of factor accumulation in the medium term as the outcome of technological progress in the long run (Capello and Nijkamp, 2009; Loayza and Soto, 2002; Artelaris, 2009). The modern theory of endogenous growth is built on the ideas first advanced by Theodore Schultz and later by Gary Becker. In 1961, Schultz felt that Solow's technical change should be replaced with a human capital variable given that technical change in large part resulted from an 'investment in man.' In 1962, Becker elaborated by arguing that human capital is a life-time investment that individuals make in themselves (Marthur, 1999; Stough, 1998).

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According to Romer (1986), while exogenous technological change is ruled out, his model can be viewed as an equilibrium model of endogenous technological change in which long-run growth is driven primarily by the accumulation of knowledge by forward-looking, profit-maximizing agents (Molochny, 2009). Later on, Lucas (1988) introduces a model in which human capital plays a fundamental role in perpetuating economic growth and preventing diminishing returns to physical capital accumulation. An individual's human capital increases not only his or her own productivity but also the productivity of other workers with any given skill level. Finally, the model demonstrates that a higher level of human capital allows the economy to grow faster and the inputs to be better paid, as long as positive externalities are associated with the average level of human capital (Capello and Nijkamp, 2009; Loayza and Soto, 2002; Marthur, 1999). In 1990, Romer introduces a model similar to that of Lucas (1988) except with one major difference: Growth of knowledge depends on human capital and on the stock of knowledge (Marthur, 1999).

With regard to the effects of an educated workforce (human capital) to the economic growth, in 1962 and 1994, Arrow and Arthur, respectively, noted that an important component of human capital derives from learning-by-doing thereby enhancing the value of labor through knowledge that occurs without increased cost to the firm. It is in this way that endogenous closed economies with feedback can become self-sustaining and can experience the phenomenon of dynamically increasing returns and associated self sustaining growth and development (Stough, 1998). Shapiro in 2006 argues that human capital raises local productivity (Suedekum, 2006) and Suedekum, in 2006 adds that human capital can raise wages above the private returns to education even in the absence of any spillover or market-mediated concentration force. Barro (2001) says that since workers with this educational background would be complementary with new technologies, the results suggest an important role for the diffusion of technology.

Higher education is associated with both production of new knowledge and efficient adaptation and innovative use of established one. Moreover, an educated population tends to be technologically sophisticated. This gives rise to local quality sensitive demand for advanced goods, encouraging local firms to innovate and develop technologically sophisticated products and production techniques (Arvanitidis and Petrakos, 2007). Barro in 1991, Mankiw, Romer and Weil in 1992, Levine and Renelt in 1992 and Gould and Ruffin in 1993 among others, have found that a larger educated work force may increase growth either because of faster technological progress, as individuals build on the ideas of others, or by simply adding to the productive capacity of a country (Gould and Ruffin, 1993). Furthermore,

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similar findings were provided by Brunetti, Kisunko and Weber in 1998, Barro and Sala-i-Marin in 1995, and Hanushek and Kimko in 2000 (Arvanitidis and Petrakos, 2007).

According to Huallacháin (2007), Aghion and Howitt in 1992 considered ability to innovate a primary driver of economic growth. Howitt in 2000 proposed that underdeveloped countries should maintain some level of innovation activity, in order to achieve the standard of living of the developed world. Huallacháin (2007) also argues that Howitt's model relies heavily on Coe and Helpman in 1995, and Coe, Helpman, and Hoffmaister's in 1997 findings that trade in intermediate goods and capital equipment creates strong international R&D spillovers that lead to eventual technological catchup (Huallacháin, 2007).

As a result the complementarity between educational level and innovation (R&D activities) and their capacity to generate growth has occurred the interest of many theorists. Schumpeter in 1950 and Schmookler in 1966 have argued that technological progress takes place because innovators find it profitable to discover new ways of doing things (Gould and Ruffin, 1993). Nelson and Phelps in 1966 found that growth is positively affected by the rate of technological innovations and the rate of diffusion or adoption of existing innovation, and that the stock of human capital affects both of these rates. They argue that the role of education is to increase the individual's capacity to innovate and to adapt to new technologies, contributing, therefore, to the diffusion of technology (Soukiazis and Cravo, 2008). Finally, Lin supports that economic development is a process of continuous technical innovation leading to improved quality and/or lower production costs of the same goods; and a dynamic process of industrial upgrading and structural change with new and different goods and services produced continuously (Lin, 2009).

As it can be clearly seen from the analysis above, an important issue related to technology and human capital is the spillover effects that in turn contribute to economic growth. Several models of economic growth emphasize the importance of international spillovers as a major engine of technological progress. Coe and Helpman in 1995, Eaton and Kortum in 1996, and Caves in 1996 support that international spillovers result from foreign knowledge through international trade and foreign direct investment, Barro and Sala-i-Martin in 1997 and Howitt in 2000 argues that the main reason that triggers them is the technology transfers, while Lucas in 1988 and 1993 refers to the existence of human capital externalities (Ertur and Koch, 2007).

Human capital creates a body of specific and general knowledge that contributes to productivity directly and indirectly due to spillover effects. Knowledge spillovers across

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space are an essential feature of research activity aimed at designing and developing new products (Magrini, 1998). The specific knowledge, which is transferable at a positive price, is embodied in individuals; those who possess that specific knowledge or skill are more productive than those who do not possess the specific knowledge. The magnitude of spillover effects depends on the interaction of various inputs with human capital. At the regional level, the effect is expected to be larger, because in a subnational economy, we expect a greater degree of interaction among regions through trade and migration (Marthur, 1999).

Human capital also contributes indirectly to productivity growth and employment. Among the indirect effects of human capital accumulation are the expanded knowledge base, skills, and talents of other workers. The social aspects of human capital accumulation, characterized as spillover effects, generate an expanded knowledge base through time in those regions that have a large initial stock of human capital. These spillover effects in one sense contribute to the multiple expansion of the initial knowledge base, a kind of knowledge multiplier effect. So, this indirect effect refers to dynamic localization economies and urbanization economies (Marthur, 1999). Some other indirect effects, as Marthur (1999) mentioned, are capital accumulation and a positive feedback loop consisting of human capital, technology, and entrepreneurship.

In terms of entrepreneurship, as the stock of knowledge, in itself, is not sufficient to generate growth and development, the emergence of entrepreneurs is necessary in order to realize the economic potential of inventions and/or innovations. People with knowledge, ideas, and skills provide the pool from which innovators and entrepreneurs emerge. These entrepreneurs provide the link between inventions and innovations and the implementation and diffusion of those inventions and innovations. For the entrepreneurs to emerge in a region and engage in productive activities that enhance society's wellbeing there must exist a reward structure that provides the incentives to such entrepreneurial activities. The development of entrepreneurial activity depends on social, economic, legal, and political environment and on the significant role played by the incentive system in the allocation of entrepreneurial resources (Marthur, 1999).

A very good explanation for the disparities between regions was indicated by Magrini (1998). Those regions which are better able to innovate through the development of a superior technological competence in research will be characterized by a relative specialization in research activities and thus become 'knowledge creating' regions. Since research activities tend to make a more intensive use of human capital than manufacturing activities, the process

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of relative concentration of research in one location leads to a parallel relative concentration of human capital. Moreover, since wages for human capital tend to be higher than wages for unskilled labour, the relative concentration of human capital in one region implies that the average level of per capita income in this 'knowledge creating' regions will be higher than that in 'manufacturing' regions (Magrini, 1998). However he adds that less technologically advanced economies can benefit from the interaction with economies closer to the technological frontier due to the possibility of imitating technologies already developed elsewhere.

Moving on, four basic models will be presented. The firsts is the traditional growth model advanced by Solow and Swan (1956) as it is considered one of the most important of modern economic analysis not only for its simplicity but also because it reveals the function of growth mechanism. Then, follows one of the major extensions of the neoclassical model (Solow model), which is the study that Mankiw, Romer and Weil made in 1992. The other two models are parts of the endogenous growth theories. Those are the model of Lucas in 1998 and also the model of Romer in 1990.

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2.2. NEOCLASSICAL GROWTH THEORIES

2.2.1. THE SOLOW – SWAN MODEL

The traditional growth model advanced by R. Solow and T. Swan (1956) is one of the most famous and simple. The key idea of this framework is that growth is caused by capital accumulation and autonomous technological change.

$$Y = A \times F(K, L)$$

Where K is the physical capital stock, L is the labor force and A is the level of technology in economy. The basic assumptions of the model are the following:

This model refers to a closed economy

The economy produces a single good

Labor input is equal to population (as in neoclassical model there is full participation and employment is equal to total population)

Technological progress is exogenous

Population grows exponentially

$$N = n \times N(t) \ \ where\ n > 0\ is\ constant$$

The production function displays constant returns of scale

$$F[\lambda K_t, A_t(\lambda L_t)] = \lambda F(K_t, A_t L_t) \ \ where\ \lambda > 0$$

The marginal product of each input is positive and declining

$$\frac{\partial Y_t}{\partial K_t} > 0 \quad , \quad \frac{\partial Y_t}{\partial L_t} > 0$$

$$\frac{\partial^2 Y_t}{\partial K_t^2} < 0 \quad , \quad \frac{\partial^2 Y_t}{\partial L_t^2} < 0$$

Savings is a fixed proportion of total income

$$S = s \times Y$$

$$where\ S\ is\ per\ capita\ savings\ and\ s\ is\ the\ marginal\ propensity\ to\ savings$$

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The aggregate gross investment is equal to the aggregate net investment plus depreciation

$$I_t = K + \delta K_t \text{ where } K = \frac{dK(t)}{dt} \text{ and } \delta > 0 \text{ is the depreciation rate}$$

In the Solow - Swan growth model, where technological progress is exogenous, income will rise with the level of physical or human capital (accumulated human knowledge), but the rise will not generate ever-increasing growth rates. Skilled workers increase the level of income, just like any other productive factor, but they do not increase growth in the long run because technological progress does not depend on the presence of a skilled work force (Gould and Ruffin, 1993).

The basic conclusion of the model is that the rate of growth of the economy in the long run simply equals the rate of growth in the labor force plus the rate of exogenously determined technological progress. The rate of savings affects only the level of GDP, not the long-run rate of growth. A larger rate of savings will cause the rate of growth to increase temporarily because greater capital accumulation increases the productivity of labor and the level of GDP. But in the long run, the rate of growth will settle down to the rate of change in the labor force plus the rate of technological progress (Gould and Ruffin, 1993).

The Solow – Swan model implies that if rates of growth differ among countries, it is only because the countries are at different stages of movement toward the steady state. Rich countries should grow at a slower pace than poor ones. Accordingly, over time, the per capita incomes of the rich and poor countries should converge (Gould and Ruffin, 1993).

Although the Solow – Swan model is considered one of the most important of modern economic analysis not only for its simplicity but also because it reveals the function of growth mechanism, there are some drawbacks.

The two main model's weaknesses are the assumption of diminishing returns and the approach of technological progress as an exogenous factor.

The existence of diminishing returns on physical capital is an impediment to economic growth as the accumulation of physical capital at a rate higher than the growth rate of labor force has resulted to reduction in yield of physical capital. When the growth rate of physical capital stock is becomes equal to the growth rate of labor, GDP per capita of economy remains constant and economic growth will stop (Kalaitzidakis and Kalibitis, 2002).

Therefore, without technological progress, capital accumulation may not lead by itself to economic growth, according to the model. Even though interpretations are given by the

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model with exogenous technological progress, cannot be considered satisfactory as they cease to rely on an exogenous factor. Also technological progress is the result of an activity that requires significant financial resources and therefore it can be determined by economic criteria (Kalaitzidakis and Kalibitis, 2002).

In addition, some other weak points of the model are that neoclassical model, in its original form, assumes the existence of a closed economy and also of full employment. Both these two assumptions are highly restrictive and unrealistic (Artelaris, 2009).

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2.2.2. THE MANKIW – ROMER – WEIL MODEL

The Solow and Swan growth model was based on the assumption that the economy's capital set by the stock of physical capital. This consists of infrastructure, machinery, equipment and any other good that are not consumed, but added in economy's wealth through investments. However, it is a fact that two workers with different education level, doing the same job, have different performance. This issue stimulates the interest of economists, so they start to consider the contribution of "Human Capital" in economic growth (Kalaitzidakis and Kalibitis, 2002).

One of the major extensions of the neoclassical model (Solow model), is the study that Mankiw, Romer and Weil made in 1992. This paper examines whether the Solow growth model is consistent with the international variation in the standard of living. They argue that although the model correctly predicts the directions of the effects of saving and population growth, it does not correctly predict the magnitudes. In the data the effects of saving and population growth on income are too large (Mankiw et al., 1992).

Mankiw et al (1992), augment the Solow model by including accumulation of human as well as physical capital. In order to test the augmented Solow model, they include a proxy for human-capital accumulation as an additional explanatory variable in our cross-country regressions. Trying to implement the model, they restrict their focus to human-capital investment in the form of education, ignoring in this way, investment in health, among other things.

Despite this narrowed focus, they support that measurement of human capital presents great practical difficulties. In more details, they use a proxy for the rate of human-capital accumulation that measures approximately the percentage of the working-age population that is in secondary school. They admit that this variable, which they call SCHOOL, is clearly imperfect because it does not include the input of teachers, and it completely ignores primary and higher education.

Therefore, in this model, output is produced from physical capital, human capital, and labor, and is used for investment in physical capital, investment in human capital, and consumption. One production function that is consistent with the empirical results is:

$$\boldsymbol{Y = K^{1/3} H^{1/3} L^{1/S}}$$

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After Mankiw et al (1992) made a brief presentation of the Solow growth model, then developed their own augmented model and through the comparing of those two emerged the final results/conclusions, which aiming to give the answer to the fundamental question they have made "whether the Solow growth model is consistent with the international variation in the standard of living". These conclusions/results are summarized below.

Firstly, in this model there are not substantial externalities to the accumulation of physical capital. Also, despite the absence of externalities, the accumulation of physical capital has a larger impact on income per capita than the original Solow model implies. A higher saving rate leads to higher income in steady state, which in turn leads to a higher level of human capital, even if the rate of human-capital accumulation is unchanged. More specifically, the Solow model with a capital share of one third indicates that the elasticity of income with respect to the saving rate is one half. Their augmented Solow model indicates that this elasticity is one (Mankiw et al, 1992).

Furthermore, population growth has a larger impact on income per capita than the Solow model indicates. In the augmented model human capital also must be spread more thinly, implying that higher population growth lowers measured total factor productivity. In the original model, they report that, with a capital share of one third, the elasticity of income per capita is -*V2* while in their augmented model this elasticity is -2. Moreover, Mankiw's et al (1992) model has implications for the dynamics of the economy when the economy is not in steady state. While the Solow model implies that the economy reaches halfway to steady state in about 17 years, on the contrary the augmented Solow model implies that the economy reaches halfway in about 35 years (Mankiw et al, 1992).

Mankiw et al (1992), finally conclude that the simple exogenous growth model, does not interpret adequately the data. Contrarily, the augmented Solow model that includes accumulation of human as well as physical capital provides an excellent description of the cross-country data. According to their model, differences in saving, education, and population growth should explain cross-country differences in income per capita. The examination of the data indicates that these three variables do explain most of the international variation, providing in this way an almost complete explanation of why some countries are rich and other countries are poor.

The criticism that have been made to this model, concern both the approach of Human Capital (the participation level in secondary education), something that also admit themselves, and the assumption that all countries have the same rate of technological progress

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(Kalaitzidakis and Kalibitis, 2002). Nevertheless, the contribution of their work to highlight the importance of human capital in the process of economic growth is undeniable.

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2.3. ENDOGENOUS GROWTH THEORIES

2.3.1. THE LUCAS MODEL

After Robert Lucas (1998) has reviewed the now- standard neoclassical model; following the work of Robert Solow, Edward Denison and many others in order to understand whether this model as it *stands* is an adequate model of economic development, he concluded that it is not. The reasons why he believe that this theory is not, as it stands, a useful theory of economic development are those two: its apparent inability to account for observed diversity across countries and its strong and evidently counterfactual prediction that international trade should induce rapid movement toward equality in capital-labor ratios and factor prices.

Then he has tried to create his own model, which consists of two parts, by considering an alternative engine of growth to the 'technological change' and by adding to the neoclassical model the factor of “Human Capital”. The first retains the one-sector character of the original model and focuses on the interaction of physical and human capital accumulation. The second examines a two-good system that admits specialized human capital of different kinds and offers interesting possibilities for the interaction of trade and development.

The first model is a system with a given rate of population growth but which is acted on by no other outside exogenous forces. There are two kinds of capital, or state variables, in the system: physical capital that is accumulated and utilized in production under a familiar neoclassical technology, and human capital that enhances the productivity or both labor and physical capital, and that is accumulated according to a 'law' having the crucial property that a constant level of effort produces a constant growth rate of the stock, independent of the level already attained (Lucas, 1998).

Lucas says that as individual’s 'human capital' he means, a general skill level, so that a worker with human capital h(t) is the productive equivalent of two workers with ½h(t) each. He also stresses that the way an individual allocates his time over various activities in the current period affects his productivity, or his h(t) level, in future periods. According to him, introducing human capital into the model, then, involves spelling out both the way human capital levels affect current production and the way the current time allocation affects the accumulation of human capital (Lucas, 1998).

In this model, the marginal product of physical capital tends to a constant, given essentially by the rate of time preference. This fact, which with one kind of capital defines the long-run stock of that capital, in the two-capital model, defines a curve in the “physical capital

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+human capital plane". The system will converge to this curve from any initial configuration of capital stocks, but the particular point to which it converges will depend on initial conditions. Economies that are initially poor will remain poor, relatively, though their long-run rate of income growth will be the same as that of initially (and permanently) wealthier economies. A world considering of such economies, then, each operating autarchically, would exhibit uniform rates of growth across countries and would maintain a perfectly stable distribution of income and wealth over time (Lucas, 1998).

Concluding, Lucas emphasize that human capital accumulation is a *social* activity, involving groups of people in a way that has no counterpart in the accumulation of physical capital. With regard to his theory an efficient economy, on a balanced path, will have a higher level of human capital for any given level of physical capital and if an economy begins with low levels of human and physical capital will remain permanently below an initially better endowed economy. So wealthier countries have higher wages than poorer ones for labor of any given skill but workers in wealthy countries are typically also more skilled than workers in poor countries. Finally if labor mobility is introduced, everything hinges on whether the effects of human capital are internal affecting the productivity of its 'owner' only or whether they have external benefits that spill over from one person to another. Only in the latter case, the wage rate of labor at any given skill level will increase with the wealth of the country in which he is employed. Then if labor can move, it will move, following in general from poor countries to wealthy ones.

The second model of a two-good system composes another, quite different, example of a system in which human capital plays a central role. In response to the remark made by many economists, Lucas, at this part of his model consider the job- training or learning-by-doing to be at least as important as schooling in the formation of human capital. In order to carry out this analysis, he assumes that *all* human capital accumulation is learning-by-doing.

According to Lucas (1988), learning by- doing in any particular activity occurs rapidly at first, then more slowly, then not at all. Yet as in the preceding discussion, if diminishing returns will be incorporated into human capital, it will lose its status as an engine of growth. What he tries to explain is the existence of an environment in which new goods are continually being introduced, with diminishing returns to leaning on each of them separately, and with human capital specialized to old goods being 'inherited' in some way by new goods.

In this model, there is a prediction of constant, endogenously determined real growth rates. In addition, it offers the possibility of different growth rates across countries, through

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differences that are not always related to income levels. In the equilibrium of the model, production patterns are dictated by comparative advantage: each country produces goods for which, its human capital endowments suit to it. Given a learning technology, countries accumulate skills by doing what they are already good at doing intensified whatever comparative advantage they begin with. This aspect of the theory will tend to lock in place an initial pattern of production with rates of output growth variable across countries but stable within each country (Lucas, 1998).

Concluding, Lucas (1988), in this second model presume that human capital accumulation is taken to be specific to the production of particular goods, and is acquired on-the-job or through learning-by-doing. If different goods are taken to have different potentials for human capital growth, then the same considerations of comparative advantage that determine which goods get produced where will also dictate each country's rate of human capital growth. The model thus admits the possibility of wide and sustained differences in growth rates across countries, differences that one would not expect to be systematically linked to each country's initial capital levels.

The engine of growth, for both two models that Lucas provides, is human capital. He refers that in both cases, the accumulation of human capital involves a sacrifice of current utility. In the first model, this sacrifice takes the form of a decrease in current consumption. In the second, it takes the form, of a less desirable mix of current consumption goods than could be obtained with slower human capital growth. In both models the equilibrium growth rate falls short of the efficient rate and yields lower welfare. Moreover, he report that with a fixed set of goods, this account of cross-country differences does not leave room for within-country changes in growth rates. The comparative advantages that dictate a country's initial production mix will simply be intensified over time by human capital accumulation.

Finally, Lucas (1988) conclude that for a successful theory of economic development, there is a clear need to involve the continuous introduction of new goods with learning potentials on any particular good declining with the amount produced, into a model, achieving in this way the introduction of a factor which continuously shaking up an existing pattern of comparative advantages, and offer some interesting possibilities for shifts over time in a country's growth rate.

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2.3.2. THE ROMER MODEL

Growth in Romer's model (1990) is driven by technological change that arises from intentional investment decisions made by profit-maximizing agents and the equilibrium is one with monopolistic competition. So the model presented here resembles the Solow model (1956) with technological change.

This model is based on three premises. The first is that technological change lies at the heart of economic growth. Technological change provides the incentive for continued capital accumulation and together capital accumulation and technological change account for much of the increase in output per hour worked. The second premise is that technological change arises in large part because of intentional actions taken by people who respond to market incentives. Thus the premise here is that market incentives nonetheless play an essential role in the process whereby new knowledge is translated into goods with practical value. The third and most fundamental premise is the defining characteristic of technology. Once the cost of creating a new set of instructions has been incurred, the instructions can be used over and over again at no additional cost. Developing new and better instructions is equivalent to incurring a fixed cost (Romer, 1990).

The four basic inputs in this model are capital, labor, human capital and an index of the level of the technology. Capital is measured in units of consumption goods. Labor is measured by counts of people. Human capital is a distinct measure of the cumulative effect of activities such as formal education and on the job training. Finally, about the level of technology, each new unit of knowledge corresponds to a design for a new good, so it is a count of the number of designs (Romer, 1990).

Romer's model (1990) of the economy has also three sectors; the research sector, the intermediate–goods' sector and the final–goods' sector. The research sector uses human capital and the existing stock of knowledge to produce new knowledge. The intermediate sector uses the designs from the research sector together with the forgone output to produce the large number of producer durables that are available for use in final- goods production at any time. Finally, the final- goods sector uses labor, human capital and the set of producer durables that are available to produce final output. Output can be either consumed or saved as new capital.

Although human capital allocates either in research or in manufacture, this model emphasizes the importance of human capital in the research process. Devotion of more human capital to research leads to a higher rate of production of new designs. Also the larger the total

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stock of designs and knowledge is, the higher the productivity of a worker in the research sector will be. The research has positive externalities. An additional design raises the productivity of all future individuals who do research. However, this benefit is non-excludable and as a result it is not reflected at all in the market price for designs (Romer, 1990).

So, according to Romer (1990), the output of new designs produced by researcher j can be written as a continuous, deterministic function of the inputs applied. If the researcher possesses an amount of human capital H^J and has access to a portion A^J of the total stock of knowledge implicit in previous designs, the rate of production of new designs by researcher j will be $\delta H^J A^J$, where δ is a productivity parameter. Here, growth in *A* by itself increases the productivity of human capital in the research sector. Anyone engaged in research has free access to the entire stock of knowledge. All researchers can take advantage of A at the same time. The output of researcher j is therefore $\delta H^J A$. If we sum across all people engaged in research, the aggregate stock of designs evolves according to:

$$\boldsymbol{A = bH_A A},$$

where $\boldsymbol{H_A}$ *has the obvious interpretation of total human capital employed in research.*

This analysis also suggests why population is not the right measure of market size. If access to a large number of workers or consumers were all that mattered, having a large population would be a good substitute for trade with other nations. The model here suggests that what is important for growth is integration not into an economy with a large number of people but rather into one with a large amount of human capital. The growth rate is increasing in the stock of human capital, but it does not depend on the total size of the labor force or the population. Many of the details of trade between different economies of this kind remain to be worked out. However, since growth seems to be correlated with the degree of integration into worldwide markets but not closely related to population size or density, the results offer one possible way to explain the wide variation in growth rates observed among countries and the fact that in some countries growth in income per capita has been close to zero. If the stock of human capital is too low, growth may not take any place at all (Romer, 1990).

Finally, Romer (1990) concludes that his model presented here is essentially the one-sector neoclassical model with technological change, augmented to give an endogenous explanation of the source of the technological change. The most robust welfare conclusion from the model is that because research projects exchange current costs for a stream of

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benefits in the future, the rate of technological change is sensitive to the rate of interest. Although all the research is embodied in capital goods, a subsidy to physical capital accumulation may be a very poor substitute for direct subsidies that increase the incentive to undertake research. In the absence of feasible policies that can remove the divergence between the social and private returns to research, a second-best policy would be to subsidize the accumulation of total human capital.

He adds that, the most interesting positive implication of the model is that an economy with a larger total stock of human capital will experience faster growth. This finding suggests that free international trade can act to speed up growth. It also suggests a way to understand what it is about developed economies in the twentieth century that permitted rates of growth of income per capita that are unprecedented in human history. The model also suggests that low levels of human capital may help explain why growth is not observed in underdeveloped economies that are closed and why a less developed economy with a very large population can still benefit from economic integration with the rest of the world (Romer, 1990).

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2.4. CONCLUDING REMARKS

Concluding, all the above direct and indirect effects that human capital and technological change occur, take place when all the benefits of investment in these resources stay within the region. Comparing the intraregional with the interregional spillovers, the spillover benefits within a region will be greater than between regions, as it is expected more intraregional, as opposed to interregional, interaction between people and firms (Marthur, 1999). Nevertheless, even in an open and competitive economy, there will be significant payoffs to a region in the long run.

So, in the second case (in an open economy) human capital and technological change still remain significant factors for the economic growth. However, especially for the less developed country, there is not only a need for education or accumulation of human capital, but also they should adopt technologies that are consistent with their comparative advantage and their level of economic development.

As competitive industries and firms grow, they claim a larger market share and create the greatest possible economic surplus, in the form of profits and salaries. Over time, this strategy allows the economy to accumulate physical and human capital and upgrade the factor endowment structure as quickly as possible (Lin, 2009). However, as capital accumulates and as the endowment structure is upgraded and the economy climbs up the industrial and technological ladder, many other changes must take place (Lin, 2009). For example the technology needed by firms becomes more sophisticated as they move closer to the global frontier. Also, a flexible process of industrial and technological upgrading requires simultaneous improvements in education, in infrastructures, etc (Lin, 2009).

The weakness identified at this point of economic growth is the following: as individual firms cannot internalize all these changes cost- effectively, the only entity that can coordinate the desirable investment or change and as a result to play a facilitate role in dealing with market externalities, is the state (Lin, 2009). The underlying theme of endogenous growth theories is that the rate of economic growth can be affected by public policies and institutions. One of the areas of structure policies is education and human formation (Loayza and Soto, 2002). The policies can increase the human capital by ensuring for example the enrollments in higher education in advanced countries and in the primary and secondary education in developing countries (Faggian and McCann, 2009). About the field of technology, policies should motivate the research of new technological achievements (mainly

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in advanced economies or regions) or the adoption of the facilitate technology according to the level of the economy (mainly in the developing countries or regions), which in turn will lead to the production of new products.

However, improvements in human capital must be part of the overall strategy to accumulate physical capital and upgrade the industrial structure. For developing countries, to make full use of human capital resources, human capital policies must be an integral part of the overall development policy (Lin, 2009). I believe that the same applies for the technological change.

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3. REVIEW OF EMPIRICAL GROWTH STUDIES

3.1. CONCISE REVIEW COMMENTS

Besides the theoretic interest shown on the factors which can lead to economic enlargement and growth, the empirical studies realized are not insignificant in number. Various economists have established econometric models, where they incorporated some factors which they regarded as the most likely reasons for the economic growth. Using these models they could verify or disprove their initial assumptions, but they could also check the validity and the stability of the various economic theories on development. There are empirical studies which focus on the role played by human capital and technological advances either on growth or on regional development, but also others which study both these factors among others.

Stefano Magrini (1998), in his paper analyses the growth process of European Functional Urban Regions (FURs) during the period 1979-1990. His theoretical model guides the empirical analysis and pays particular attention to the role of human capital, research activity and spillovers of technological knowledge. In more details, the main aim of the model developed by Magrini is to describe the role of formal research organization, firms, R&D laboratories, government laboratories, universities, etc., in shaping the spatial distribution of wealth within a two - region economic system. The main predictions of this model are then tested using OLS on a database of 122 major European FURs.

The results can be summarized as follows. Firstly, research activities appear to play an important role in the process of regional growth. Secondly, by considering different specifications of the spatial interaction between researchers, it has been possible to find evidence supporting the existence of spatial spillovers of knowledge. The effects of inter-regional spillovers of knowledge are maximized if interactions are assumed to extend to a distance determined by about 2 hours travelling time. Thirdly, several factors affecting the regional growth rate of per capita GDP by shaping the local level of technological competence in research have been identified. One of these factors appears to be the existence of universities. These contribute to the regional research effort both directly, in their role of centres of research, and indirectly, as that part of the regional infrastructure that provides new human capital. Nonetheless, the empirical analysis suggests the conclusion that one or both of these effects have a significant positive impact on regional growth. Finally, another interesting outcome concerns the controversy on the relative importance of intra-regional

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dynamic spillovers, which appear to have been more successful than inter-regional dynamic spillovers in fostering regional economic growth.

Later on, Kaldewei and Walz (2001) observed that many aspects and factors influencing regional growth in Europe have attracted little attention, while the theoretical and empirical research on regional growth processes has been almost exclusively focused on the convergence-divergence-debate and its various aspects. So against the traditional background, and in order to fill this gap, in this paper they try to analyze the factors affecting regional growth in the EU from an empirical perspective by using the OLS method and data from the Eurostat's Regio data base at the NUTS-II regional level in the EU for the 1980-1996 period.

In their analysis, human capital can be shown to have an important positive influence on the average growth rates of regions with a high human capital level while local knowledge spillovers seem to be too informal to capture in a quantitative indicator in this cross-regional dataset in order to produce significant results in growth regressions. In more details, Human capital turns out to be a significant growth motor, especially in regions with higher human capital levels. This can be interpreted as a typical case of cumulative causation: In regions with a high human capital level, more human capital leads to even higher growth rates. For the above-median regions, the results are not as clear-cut; they run into more difficulties when testing for the influence of the regional knowledge base, as measured in patent rates. The proxy for the technological base in the regions is always insignificant and sometimes even has a negative sign. According to Krugman in 1991, the fact that there are no significant results, can be interpreted as one more indication of the fact that "knowledge spillovers leave no paper trail", at least at an aggregate level.

In early 2003 the OECD published a major report entitled *The Sources of Economic Growth in OECD Countries* that summarized the main findings of the OECD growth project initiated in 1999. The objective of the project had been to explain the reasons for different growth experiences across OECD countries and to identify policies, institutions and other factors that could contribute to enhancing long-term growth prospects. Baily (2003) in his review article provides an overview of the report and comments on the key findings.

The first broad conclusion is that there have been widening disparities across the OECD countries in rates of growth in GDP per capita in the 1990s. The study finds that some fraction of overall growth was the result of "labour upskilling" (a shift to a more experienced or better educated workforce), but notes that in the slow- growing countries this was partially due to the fact that the low-skilled were kept out of work. So investments in physical and in

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human capital were important to growth. The study does find some support for the view that R&D contributes to growth. R&D activities by the business sector had high social returns, and hence contributed to growth, but there was no evidence in this analysis of positive effects from government R&D. The data set does not provide very clear guidance as to the role or importance of R&D to growth but there is one intuitive result that is linked to innovation, however.

Andres Rodriguez-Pose & Riccardo Crescenzi (2006), in their paper try to fill another gap in the literature by combining in one model R&D, spillovers, and innovation systems approaches. A multiple regression analysis is conducted for all regions of the EU-25, including measures of R&D investment, proxies for regional innovation systems, and knowledge and socio-economic spillovers. Research results obtained by the OLS method and the empirical model was estimated for the period 1995-2003, including all the EU-25 members for which regional data are available.

The empirical results highlight how the interaction between local and external research with local and external socioeconomic and institutional conditions determines the potential of every region in order to maximize its innovation capacity. They also indicate the importance of proximity for the transmission of economically productive knowledge, as spillovers show strong distance decay effects. It is generally accepted that innovation contributes to regional development, and that how innovative an area is, depends on the human capital and the level of R&D of its disposal. The results of the empirical analysis uncover the importance not only of the traditional linear model local R&D innovative efforts, but also of the local socio-economic conditions for the genesis and assimilation of innovation and its transformation into economic growth across European regions.

Finally, the proposal about how the issue should be approached politically, indicating that the data are quite different between developed and developing regions. For example regarding the developing regions, these policies will need to rely less on R&D investment and much more on tackling the local social and economic barriers that prevent the reception and assimilation of external innovation. Any incentive for local innovative activities would have to be complemented by the reinforcement of the local endowment in terms of education and skills in order to guarantee the greatest returns from innovation policies. The emphasis on skills is also likely to set the foundations for a future transformation of these regions into innovation prone societies, in which the returns of any investment in R&D will yield substantially higher results than at present.

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Moving on, Arvanitidis, Petrakos and Pavleas (2007) wrote also about the determinants of economic growth. This paper draws on a questionnaire survey addressed to various experts, to explore their views on the factors underling economic dynamism. Specific issues raised in the questionnaire include an evaluation of the World's most dynamic areas, the factors that advance or delay economic growth, the significance attached to a number of elements in terms of their influence to economic performance, the combination of characteristic that are expected to promote economic dynamism and an evaluation of the ability of each theoretical background and methodological technique to explain economic dynamism and to study growth.

The two factors that people regarded as the most important in terms of their role to economic growth are the high quality of human capital (54% of responders) and high technology, innovation and R&D (50% of responders). Similarly the two main obstacles of economic dynamism, as voted by more than half of the people surveyed, are the unstable political environment (57%) and the low quality of human capital (51%), while the low technology, innovation and R&D is in the 5th place (38%). Additionally, responders deemed that each factor influences at a different degree the economic dynamism of places depending on whether they belong to the developed or the developing group of countries. The two factors that are regarded as the most influential for the developed countries are high technology, innovation and R&D (7,9) and the high quality of human capital (7,8). On the contrary, these two factors regarding the developing countries are in 16th and 12th place respectively.

So the results of the survey provide empirical support to a number of important research hypotheses, contributing in this way to existing literature. Also, the survey identified a number of important determinants of economic dynamism at a global scale. These determinants are consistent with the relevant mainstream literature, but also with its most recent developments, highlighting the increasing influence of political and institutional factors. Finally a very important observation is that the determinants of economic growth do not have the same influence in advanced and less advanced countries. For the first ones, the responders adopt parameters with more economic, high tech and specialized features, whereas for the second ones, matters related with socio – political framework, the level of foreign direct investments and the formal institutions seem to prevail.

Ertur and Koch (2007), in their paper present a theoretical growth model which explicitly takes into account technological interdependence among economies and examines

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the impact of spillover effects, by using a sample of 91 countries over the period 1960 – 1995. According to them, the stock of knowledge in one country produces externalities that may cross national borders and spill over into other countries with an intensity which decreases with distance. They also found the importance of technological interactions in the economic growth process as well as in the world income distribution. However, in contrast to the MRW (1992) model, their result shows that the coefficient of human capital is low and not significant when it is used as a simple production factor. According to Benhabib and Spiegel in 1994, Bils and Kleenow in 2000, and Pritchett in 2001, this is consistent with the human capital puzzle raised in the literature (Ertur and Koch, 2007).

Soukiazis and Cravo (2008) examined the convergence process of income per capita across a set of 77 countries for the period 1980–2000, giving special attention to the role of human capital as the conditioning factor to growth. Different levels of human capital were used to control for differences in the steady states among the countries. They found that different levels of human capital have different growth effects depending on the countries' stage of development. Their evidence shows that higher levels of human capital expressed by the patent ratio or patent/publication ratio explain better the convergence process of the set of the more advanced OECD countries, while intermediate levels of education expressed by the average years of school attainment, and to some extent by the publication rate, control better the steady states of the less developed countries (Latin American countries).

These additional results reinforce the previous findings that lower levels of human capital explain better the growth performance of the less developed countries, and higher levels of human capital are more appropriate to control differences in the long-term path of real income of the advanced countries. Finally they support that the fact that higher levels of human capital are found to have negative or insignificant effect on growth in the less developed countries, suggests that improvements in human capital must be gradual, investing primarily in basic school structures before going on to develop higher levels of education and activities related to research and development. For the more advanced OECD countries it is shown that higher levels of human capital related to research and innovation are more growth-enhancing.

Baici and Casalone published their article in 2005. The aim of this work is to analyze the impact of human capital on Italian regional growth. Through the use of usual human capital proxies, as well as some other measurements that should be able to get to the heart of

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the quality of human capital and its interrelation with R&D sector, the work helps to explain regional growth between the years 1980 and 2001.

The results of their analysis give emphasis to a progressive conditional convergence process among the levels of labour productivity of Italian regions. According to Baici E. and Casalone G., a primary role in obtaining such results is played by the human capital of a medium/high level. A result not as strong seems to emerge from the more qualified human capital or the human capital more geared towards the technological-scientific sectors. Lastly, both a regional disposition toward the service sector or an evolution in this sense seem to strongly contribute to the productivity rise.

Additionally, they argue that the growth of Italian regions, in the last years, has been driven by the development of sectors that need a human capital capable of adapting to existing production techniques rather than able to implement new ones. The development of a tertiary sector and the greater availability of a labour force with lower and upper secondary school diplomas seem to have allowed certain regions to reach good performances. This development model, however, presents the evident limit of being short of breath. The fact that the growth of productivity was higher in the 1980's than in the 1990's points out how it is probably necessary to modify the development strategies in order to move Italian regions as close as possible to a hypothetical technological frontier. As a result, they support that it is apparently not sufficient to have a qualified human capital in order to favor technological innovation. It is also necessary to stimulate the R&D activity, so as to be able to more profitably use the human capital that is already available.

According to Coulombe and Tremblay (1999), the key contribution of their paper is to show that convergence across the Canadian provinces could be explained by the dynamic accumulation of human capital as predicted by the open-economy version of the neoclassical growth framework à la Barro, Mankiw, and Sala-i-Martin in 1995.

Their findings suggest that the effect of human capital accumulation is not a minor factor, among others, that could explain the relative evolution of regional economies in Canada. They support that, by itself, the human capital catch-up process, based on the advance education indicator, explains roughly 70% of the relative evolution of per-capita income since 1951 across the Canadian provinces. This paper, explains the slow process of convergence across the Canadian provinces observed since 1951, despite the well integrated financial networks, the mobility of physical capital, and the interregional redistribution of resources. Despite the relative scarcity of physical capital in the poorer regions, capital did not

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flow to these regions because the availability of a well-educated population is a necessary requirement for the productivity of machines. Since a subset only of the total population, the young, has a clear incentive to invest in education, the catch up process of human capital is slowed down by the stock effect of the less-educated older people who remain in the poorer provinces. Finally, one of the findings of this paper is that the convergence speed might have been two to three times faster if all people had invested in education at the same rate as the young did and also that if investment in education is the driving force of regional convergence, governments have a role to play in promoting regional development since the financing of education is constrained by institutional factors.

The importance of human capital as a key source of value added, innovation and economic growth, is widely acknowledged by both economists and policymakers. However, as Justman and Thisse have pointed out, the public benefits of human capital investment "do not always accrue where it is funded". Coniglio N. and Prota F. (2006), investigated the challenges that migration flows pose on policymaking aimed at fostering human capital accumulation in peripheral regions. The focus of their analysis is on the micro-level location decisions of a sample of highly educated and skilled individuals residing in Basilicata, an Italian Mezzogiorno region, who have benefited from a locally funded human capital investment policy.

The regional policymakers, in recognition of the importance of human capital as a key ingredient for regional growth, have given generous subsidies since the beginning of the 1990s to young graduates who want to attend a postgraduate course either inside or outside the region. This analysis is an interesting case study for assessing the ability of the regional system in a peripheral region not only to generate human capital but also to maintain it.

The existing migration literature points out that the propensity to migrate of highly skilled and educated individuals is high when compared to the rest of the population. Also, it was a common acceptance that if migration is a sequential decision-making process, individuals will first make the decision whether or not to move and then (for the movers only) decide to which destination to relocate. However in a recent study, Davies et al. in 2001 have argued that the decision to move and that of the destination choice cannot be considered as separated (Coniglio and Prota 2006). Individuals jointly decide whether and where to move. Two authors found that this behavioural assumption is more close to reality also in their study.

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Among other things, their analysis suggests that policy interventions aimed at improving quality of citizens' life should be regarded as very attractive. Diffused criminality discourages potential location choices by talented individuals and investors. They believe this is a quite important factor explaining the poor economic performance for some areas of the Italian Mezzogiorno, which otherwise should be considered particularly attractive given the high quality and large quantity of human capital available. This consideration is not intended to discount the importance of regional economic performance, which should be considered as a prerequisite for attracting highly skilled and talented individuals. We want to emphasize that improving quality of life can lead to a substantial pay-off in terms of future growth and prosperity of peripheral regions.

Finally, they are able to assess the relative importance of the availability of information on potential destinations for the individuals' migration decision process. Lack or poor quality of information on local economic opportunities represents a market failure that can be corrected, at least partly, by adequate policy measures. Therefore, actions aimed at this purpose might be considered as strategic in trying to maintain and attract human capital.

Suedekum J. (2006), having reflections similar to those of Coniglio N. and Prota F., studies the relation between human capital externalities and the growth of high- and low-skilled jobs. He argues that skilled cities grow faster than unskilled ones, on aggregate. However, his paper casts doubts on whether this positive relation is due to human capital spillovers at a local level. He found that a large initial share of high-skilled workers significantly reduces subsequent growth of high-skilled jobs. According to Suedekum, this emphasizes the importance of a "neoclassical" mechanism, under which human capital should grow stronger in locations were it is initially relatively scarce. Finally, he concludes that some evidence for a positive cross industry effect of human capital on subsequent high-skilled employment growth is found for modern manufacturing and advanced service industries. Still, there is no indication that human capital externalities lead to a self-reinforcing process of spatial human capital concentration in these cases.

Moving on in 2007, Ó hUallacháin B. studies regional growth in a knowledge -based economy. He states that because of the "explosion" in the sector of technology, the two components of the accumulation of knowledge, formal education and invention, are the driving force for the development of a nation. According to the results of his survey, knowledge accumulation through invention is a significant driver of real per capita GSP growth and also has a positive influence on population expansion. The results also confirm the

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positive relationship between educational attainment and per capita GSP and average wage growth while the fastest population growth does not occur in states with the best-educated populations. He concludes that the IT-driven boom in labour productivity has changed the pace of interstate convergence as growth increasingly associates with states' knowledge-based characteristics and also that the results support Aghion and Howitt's in 1992, Glaeser, Scheinkman, and Shleifer's in 1995, and Sachs and Warner's in 2001 claims that places with well-educated and inventive populations fare better than those lacking knowledge resources and those heavily dependent on primary production (hUallacháin, 2007).

Another interesting empirical study has conducted by Stimson, Robson and Shyy in 2008. In this paper an exploratory model is developed to measure the determinants of spatial variation in regional endogenous growth and decline. This is applied to an analysis of the performance of the non–metropolitan regions (LGAs, or Local Government Areas) of the five mainland states of Australia over the decade 1991–2001.

According to the results, human capital factors did have a significant impact on regional endogenous growth (and decline), but in different ways across the States. In more details, the impact of the incidence of people with university and technical qualifications was particularly evident in New South Wales and in Queensland, but to a lesser degree in Victoria and the other States. The incidence of people with university qualifications at the beginning of the decade had a negative impact, but the change in that incidence over the decade was clearly a positive impact factor in New South Wales and Western Australia where the change in incidence of people with technical qualifications also had a positive impact.

When talking about human capital, we mostly mean the skilled manpower, while one of the most basic ways which contributes to the creation of a skilled manpower is education. As with other factors included in the various empirical studies, so with education results differ, and there is no common view on whether its role in economic growth is important or not.

It is generally accepted that more education may improve the productivity, or quality, of workers (Bosworth and Collins, 2003). An alternative formulation, adopted by Mankiw, Romer, and Weil and by Klenow and Rodriguez-Clare, specifies human capital (education) as an independent factor in the growth process, one that can augment labour, physical capital, and TFP. The relationship with TFP reflects the view that an educated workforce is better able to implement new technologies and to generate ideas for improving efficiency (Bosworth and Collins, 2003). However, there is a strong correlation between manpower and technology.

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The creation of skills offers no benefits if the technology and infrastructure do not exist to make use of them (Bosworth and Collins, 2003).

Early studies, including those of Mankiw, Romer, and Weil and of Barro and Xavier Sala-i-Martin, found a significant positive association between cross-country differences in the initial endowment of education and subsequent rates of growth. Barro has explored the link between growth and a variety of schooling level indicators. However, later studies that examined the relationship between changes in years of schooling and changes in average incomes failed to find a significant association (Bosworth and Collins, 2003). A factor which may be causing problems and lead to the divergence of the results is, undoubtedly, the way of measurement. The quality of education within a country might be relatively homogeneous. This, however, is not the same among the countries. Despite general agreement that the quality of education varies substantially across countries, obtaining quality measures for a large number of countries is difficult (Bosworth and Collins, 2003).

The following table is highly aggregated and reflects very clearly everything mentioned above.

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Table 1: The Impact of Education Expenditure on Long-Run Growth

Author	Year	Impact	Analysis	Data/Yr	Data	Dependent Variable	Independent Variable	Notes
Landau	1983	Significantly Positive	Cross-Section Regression	1960-1977	World Bank 104 Countries minus oil exporting countries	Avg. annual percentage Growth rate of per capita GDP (Changes)	Total investment in education (Levels)	Shows education is always significant to growth
Barro	1991	Significantly Positive	Cross-Section Regression	1961-1985	Var. Sources includes 118 1,2,3rd world countries	Per Capita Growth Changes in (Levels & Changes)	Enrollment Rate: (Levels & Changes)	The enrollment rate may be a proxy for human capital investment
Moomaw & Williams	1991	Significantly Positive	Cross-Section Regression	1954-1976	US Census, from all 50 states	Total Factor Productivity Growth (Levels)	% change in proportion of workers w/12 or more years in education (Levels)	Education Positively effects productivity growth
Hansson & Henrekson	1994	Significantly Positive	Cross-Section Regression	1970-1987	14 industries in 14 OECD countries	Change in total factor productivity (Levels)	Change in government spending on education (Levels)	A lag is used to determine influence of government spending on productivity
Evans & Karras	1994	Significantly Positive	Pooled cross-section/Time-series	1970-1986	48 US states	Change in Gross state product (Changes)	Current educational services (Changes)	Educational services are the only productive current government service
Baffes & Shah	1998	Significantly Positive	Pooled cross-section/Time-series	1965-1984	21 countries w/ low or medium income	GDP (Levels)	Public investment in education (Levels)	Education also includes other human resource development capital stock
Sala-IMartin	1994	Significantly Positive	Convergence definitions	1960-1985 1870-1990	WB/IMF & Barro's Data	GDP (Levels)	Educational expenditures (Levels)	Analyzed the Barro and Levine studies
Glomm & Ravikumar	1977	Significantly Positive	Review of Literature	1949-1992	WB/IMF & Barro's Data	GDP (Levels)	Educational expenditures (Levels)	Review of the other Literature
Levine & Renelt	1992	Inconclusive	Cross-Section Regression	1960-1989	WB/IMF 119 Countries minus oil exporters	Growth of real per capita GDP/ (Changes)	Enrollment Rate: level of education attained (Levels & Changes)	Schooling has a Positive impact, but diff explanatory variables are used in each study thus results inconclusive

Source: Bartik et al, (2003)

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3.2. CONCLUDING REMARKS

Concluding this section, we find that, as it happened on a theoretic level, so empirical studies show that both human capital and technological advances have a positive impact on growth. Another finding is, nevertheless, as important, according to which economic growth depends on positive interaction between human capital and technological progress.

In more details, whether human capital acts directly in favouring growth because of a better educated and therefore more productive labour force, or whether its effect is indirect or limited to its use in activities which generate technical progress, for the past twenty years human capital has undoubtedly played a primary role in growth analysis. However, a recent analysis by Aghion and Cohen in 2004 put in evidence that high-level human capital has a positive effect on economic performance only if a country is close to the technological frontier: countries that are far from this frontier, specialized in traditional sectors, can grow, almost in the short run, even exploiting medium-level human capital (Baici and Casalone, 2005).

Two other important points emerge from the above analysis. The first concerns the important role which education plays initially to the creation of human capital and then to the evolution of technology. The second concerns the fact that there is not a clear consensus on the exact number of growth determinants that must be considered when growth equations are estimated, and most importantly, growth determinants are found to influence differently developing and developed countries. Temple (1999), reviewing previous work on economic performance, argues that the main sources of growth are: investments in physical and human capital, as well as in research and development. Other factors, such as population growth, financial sector, macroeconomic environment, income distribution, and political and social arrangements, are more important in explaining the economic performance of developing countries.

So, according to Soukiazis and Cravo (2008) as the less developed countries have lower levels of human capital, they need to improve more the basic levels of schooling before attaining higher levels of education. Based on Aghion's and Howitt's article issued in 1998, they claim that an elitist education policy that benefits few individuals to acquire higher educational levels and ignores the rest may be inefficient because the unskilled workers are unable to utilize new innovations. Thus, the education policy must take into account the complementary nature of different forms of human capital and not concentrate heavily on a

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specific form. Benhabib and Spiegel (1994) claim that the excessive emphasis given to higher education and basic research at the expense of basic education in Latin American countries may partly explain the low growth performance in these countries compared to East Asian countries.

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4. HUMAN CAPITAL AND TECHNOLOGICAL PROGRESS AS COMPONENTS OF REGIONAL POLICY

4.1. HISTORICAL REVIEW OF THE EU REGIONAL POLICY

What is today called the European Union was, at its outset, a particularly dubious and hopeful step. Despite the difficulties that existed and still exist, its course has been successful so far in general. The European Union, not only as a constitution but as a set of interrelated policies, developed in parallel with the processes of widening and deepening (Argiris, 2006). According to Argiris (2006), up until 1973 the European Union was relatively homogeneous, with the exception of some regions of southern France and southern Italy; however every step towards European integration had and still has its own regional influence in the territory of the European Union. Therefore, this course has expanded regional economic disparities within the European Union, affecting the central regions different than the peripheral ones (Argiris, 2006).

In the map of the European Union there are developed regions, which are mostly located in the central section, but also less developed regions, mainly in its core-periphery. Although each region has its own special characteristics, which makes more complex the issue of regional planning policies, the main features of developed regions are that they are points of convergence of the main transport networks, they bring together high technology activities, their economies are dominated by the tertiary sector, and also have expertise and skilled workforce. In contrast, less developed regions may face problems such as deindustrialization, urban degradation, high unemployment, inadequate infrastructures, inadequate workforce skills, while some of them might be disadvantaged rural areas or border regions which are often located far from centers of economic activity (Petrakos and Psycharis, 2004).

The fact that the European Union comprises of 27 member states which differ both on an economic and social level, makes the existence of all these differences mentioned above, normal and expected. However, bearing in mind the two key EU policies, the policy of the single market and the monetary policy, created a fear that if there was no intervention (EU regional development policy), the gap between developed and less developed regions would grow. This need, therefore, for cohesion within the European Union, led to the Union's regional development policy.

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Despite the fact that the founding Treaty of Rome in 1957 explicitly stated commitment by the European Community to reduce the regional economic disparities, in the 1960s regional development policy of the Community had been essentially nonexistent, as the states which the European integration initially consisted of were quite homogeneous (Argiris, 2006; Kamchis, 2007; Petrakos and Psycharis, 2004). The first expansion in the 1970s led to the formation of a regional development policy framework for the community, in order to reinforce the lagging - behind regions during the period 1975 to 1980, as well as the establishment of the European Regional Development Fund (ERDF) (Argiris, 2006).

Then there was another review of the European Regional Development Policy in 1984, which broadened the possibilities for intervention by the community, and as a result, the regions entitled to development assistance were those which faced problems of underdevelopment, as well as those affected by industrial decline (Petrakos and Psycharis, 2004; Kamchis, 2007). As far as the period 1975-1980 is concerned, therefore, while the first steps towards building a Regional Development Policy were made, that was until then an exogenous and additional involvement in regional politics which individual countries shaped (Petrakos and Psycharis, 2004). The funded projects were mainly in the industrial sector and infrastructure, while, finally, a major problem, among others, was also the rivalry between the European Commission and the member states, about who will have a leading role in implementing regional policy but also on what the content will be (Petrakos and Psycharis, 2004).

The first major reform of the Structural Funds took place in 1988 (ERDF, ESF, EAGGF - Q/FEOGA, and in 1989 the FIFG). This reform was a key event for the future of regional policy. The Single European Act in 1986 provided for the removal of obstacles involving the movement of capital and labour, in order for the Single European Market to be created in 1992. The unequal distribution of benefits was, however, expected, particularly at regional level, within the "new market", as already developed regions would benefit most from free market forces, having more comparative advantages (Petrakos and Psycharis, 2004). Four main reasons, the already existing inequality (both between states and between regions), the new data resulting from the "new market", the enlargement of the Community with Spain and Portugal, as well as the desire for cohesion within the community made, not only such a reform but also the pursuit of a substantial regional development policy, imperative.

The great change that was realized with the reform of the Funds was that the Union's regional policy changed from a policy of supporting the national regional development

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policies to a truly European regional development policy (Kamchis, 2007). The regional policy of the Community is directly linked to regional policy in each country and the planning of regional development is part of the framework of development of the European space (Petrakos and Psycharis, 2004). The targets were set under European rather than national criteria, involving the entire population, all regions and all member states, while, at the same time, multi-annual programming was introduced and the respective long programs were reached, which identified the following sub- periods: 1989-1993, 1994-1999, 2000-2006 (Petrakos and Psycharis, 2004; Kamchis, 2007).

For the first period, five goals were set, the fifth of which had two dimensions. Three of them were geographic (1, 2 and 5b) and the other three were thematic (3, 4 and 5a). Apart from the five targets, it was decided that a part of the sources of the funds would be disposed in support of the Community Initiatives. The Community Initiatives were intervention programs designed by the European Commission and concerned areas of particular interest (Petrakos and Psycharis, 2004). Some of these initiatives concerned the sector of development and technology (Kamchis, 2007). Finally, regarding the sources of structural funds, they doubled from 5 to 13 billion Ecus for the period 1989-1993 (Kamchis, 2007).

Table 2: Priority goals for EU s' regional policy: 1989-1993

Priority goals for the period 1989-1993	**Geographic/Thematic**
Goal 1: Encourage the development and structural adjustment of regions whose development is delayed	Geographic: ERDF, ESF, EAGGF-O/FEOGA
Goal 2: Converting the regions affected by industrial decline	Geographic: ERDF, ESF
Goal 3: Addressing the long-term unemployment	Thematic: ESF
Goal 4: Reintegration of young people into the labour market	Thematic: ESF
Goal 5a: Improvement of agricultural structures under the Common Agricultural Policy	Thematic: EAGGF-O/FEOGA
Goal 5b: Developing rural areas	Geographical: ERDF, ESF, EAGGF-O/FEOGA

Source: Argiris, (2006)

As for the second programming period 1994-1999, it was influenced too by two very important events. The first refers to the new enlargement, with the accession of three countries, Austria, Sweden and Finland. The latter refers to the creation of the Single

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Monetary Area, according to the Maastricht Treaty (1992). Due to new data resulting from the inclusion of three new countries, but also because of the need that existed on the part of the member states to meet the challenges of the SEA and the EMU at the same time, an additional help was needed.

For this second period, minor changes to the identification of priority goals were made. Goals 1, 2 and 5a remained. Goals 3 and 4 were merged into a new goal 3, while a new goal 4 was created to facilitate the readjustment of the workforce in the upcoming industrial changes, and goal 6 on enhancing growth and structural changes in remote areas of Sweden and Finland.

As Petrakos and Psycharis (2004) mention, the main pillars of structural policy of the Community remain, and principles of action of the structural funds deepen. Very important is the setting up of the Cohesion Fund during this period. The Cohesion Fund provides assistance to member states whose per capita gross national income is below 90% of the EU average. Its aim is to reduce the economic and social gap, and to stabilize their economies (in order to meet EMU criteria), while it funds projects in the sectors of transport and environment (Kamchis, 2007).

Finally, in terms of resources allocated to structural policies that period, the figure amounted to 177 billion Ecus, which accounted for 1/3 of the EU budget (Kamchis, 2007). 9% of the structural funds concerned the community initiatives, some of which were removed and others added, in relation to the previous programming period (Petrakos and Psycharis, 2004).

Table 3: Priority goals for EU s' regional policy: 1994-1999

Priority goals of the period 1994-1999	**Geographic/Thematic**
Goal 1: Encourage the development and the structural adjustment of regions whose development is delayed	ERDF, ESF, EAGGF-O/FEOGA
Goal 2: Converting the regions affected by industrial decline	ERDF, ESF
Goal 3: Fighting long-term unemployment, employability of young people, promoting equal opportunities for both men and women	ESF
Goal 4: Adaptation of workforce to industrial changes	ESF
Goal 5a: Adjustment of agricultural structures, modernisation and restructuring of fishery	ERDF, EAGGF-O/FEOGA, FIFG
Goal 5b: Development of vulnerable rural areas	ERDF, ESF, EAGGF-O/FEOGA
Goal 6: Development of the especially densely populated regions	ERDF, ESF, EAGGF-O/FEOGA

Source: Petrakos and Psycharis, (2004)

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For the period 2000-2006, the continuation and strengthening of the political cohesion had as a basis the forthcoming enlargement towards the countries of Eastern Europe, as well as the need to continue efforts to achieve converge. The politicy framework was set by the document known as Agenda 2000 (Kamchis, 2007).The experience of the first and second period has led to a reduction of both target and Community Initiatives. More specifically, the goals were reduced to three and the Community Initiatives to four (Interreg, Leader, Equal, Urban). However, apart from redefining the goals of the European Regional Development Policy, during that period, the joint responsibility of the regions was reinforced and the co-funding of the European Union and the member states was better clarified (Argiris, 2006). Finally, the new reform provided approximately 30 billion Euros annually for the structural funds and the Cohesion Fund for the period 2000-2006, ie 213 billion Euros total for all seven years (Kamchis, 2007).

Table 4: Priority goals for EU s' regional policy: 2000-2006

Priority goals for the period 2000-2006	**Geographic/Thematic**
Goal 1: Development and structural adjustment of underdeveloped regions	ERDF, ESF,EAGGF-O/FEOGA, FIFG
Goal 2: Economic and social conversion of regions facing structural difficulties	ERDF, ESF, FIFG
Goal 3: Adaptation and modernisation of policies and systems of education, training and employment	ESF

Source: Petrakos and Psycharis, (2004)

The last years have seen significant changes in the global arena with the result that the European Union cannot be left behind. The need to reform the framework which emerges is immediate, as there are challenges such as social and economic disparities, technological advances, knowledge society, rising immigration, the continually increasing competition generated by globalization etc. For these reasons, therefore, the community guidelines for the programming period 2007-2013 are directly related to the Lisbon Strategy for growth and employment (Kamchis, 2007).

In the last programming period (2007-2013), therefore, the EU's goal is to become the most dynamic and competitive knowledge society in a world capable of sustainable growth

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with more employment opportunities, social cohesion and environmental protection (Commission, 2005).More specifically, the accomplishment of the following priorities is sought for:

- Improvement of attractiveness of the regions, as locations for investment and employment
- Encouragement of innovation, entrepreneurship and development of the knowledge economy by research and innovation, including new information and communication technologies
- Creation of more and better working positions by attracting more people into the labour market or the entrepreneurial activity, the improvement of adaptability of workforce and enterprises and the increasing investments in human capital (European council, 2006; Kamchis, 2007).

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4.2. THE LISBON STRATEGY

As mentioned above, in recent years, significant changes have been observed in the global arena, both in terms of economic and social conditions and areas such as technological advances, education, immigration, competition etc., so that the European Union cannot be left behind. Those changes, therefore, led in March 2000 to the Lisbon Strategy, which was designed to give the European Union a new strategic goal, in order for employment, economic reform and economic cohesion to be strengthened, but also to be based on knowledge and innovation (Commission, 2005).

The Lisbon Strategy emphasizes on companies, the information society, human capital, employment, research and development, as well as on the environment and sustainable development.

More specifically, regarding the sector of employment and human resources, flexibility and responsiveness of young people, the unemployed as well as of the workforce is aimed at, in new circumstances and new data generated by the knowledge society. Another goal is to create more and better working positions, which can lead to increased employment. Finally, the modernization of social policy systems is sought, systems which should ensure adequate remuneration for work, the viability of their aging population, gender equality, as well as the elimination of social exclusion. The strengthening of social cohesion and elimination of social exclusion may be achieved through continual investment in human capital and education (Commission, 2005; Ministry of Development, 2005).

The aim for the sector of research and development is the existence of a single European area of research and innovation, attractive to the researchers. The increased investment from both private and public sector in research and development of new technologies, as well as the support of the education sector, are factors leading to the knowledge society.

Regarding business, the Lisbon Strategy aims at ensuring the competitiveness of markets, at improving infrastructures, as well as at the removal of any obstacles, either of the internal or the external market. That way, the creation of an environment attractive to the new and innovative businesses can be achieved, as well as a greater capital mobility of capital internationally, a better risk management and the use of new financial holdings (venture capital) (Commission, 2005; Ministry of Development, 2005).

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Finally, the Strategy emphasizes on the information society. The goals are the reduction of the digital divide between the European regions, the ability for everyone to access the broadband networks and services offered via the internet. It is thus understandable that it is not enough just to have a European area of knowledge, but, for the benefit of all the citizens (workforce, businesses, researchers etc), their immediate and inexpensive access to a global information network and services is required (Commission, 2005; Ministry of Development, 2005).

The priorities set by the Lisbon Strategy presented above concisely, are not individual areas of intervention, but together they a comprehensive and integrated strategy which is able to achieve its vision only if each area separately and on the whole are crowned with success, as their connection and interrelationships are immediate. For the completion and the achievement of the above proposals, the council proceeded to adopt certain measures, which aimed at the smooth transition of the member states to the proposed form of the Lisbon Strategy (European Council, 2000). However, it is not deemed appropriate that a further analysis and presentation of the individual targets be made, as it is believed that it is something that would exceed the limits and the goal of this work.

The three new regional development policy objectives are the Convergence, the Regional Competitiveness & Employment, and finally, the Territorial Cooperation. The funds which will fund the operations of the targets are two structural ones, the ERDF and the ESF, and the Cohesion Fund.

The goal for Convergence refers to the acceleration of the convergence of the least developed member states and regions by improving conditions for the economic growth (Kamchis, 2007). The goal for the Regional Competitiveness & Employment aims at strengthening the competitiveness and the attractiveness of the regions, as well as at employment, providing the necessary economic and social changes (Kamchis, 2007). Finally, the goal for the Territorial Cooperation refers to the strengthening of border cooperation through joint local and regional initiatives, as well as to the strengthening of transnational cooperation, by means of actions conducive to integrated territorial development (Kamchis, 2007).

Regarding the first goal (Convergence), the ERDF funds activities listed in the following areas: research and technological advances, innovation and entrepreneurship, information society, environment, risk prevention, tourism, investment in transport, energy, investment in education, investment in health, and direct aid to investment in small and

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medium enterprises. For the second goal (Regional Competitiveness & Employment) the areas funded are: research and technological advances, technology transfer, innovation in the small and medium enterprises, environment and risk prevention, rehabilitation of polluted areas, renewable energy, access to transport and communication services. Finally, for the third goal (Territorial Cooperation), in regard to the border cooperation, it funds activities related to entrepreneurship, small and medium enterprises, tourism, protection of the environment, access to transport, telecommunications, water supply and energy distribution systems, as well as to the health, education and culture infrastructures (Kamchis, 2007).

The European Social Fund also contributes to the achievement of the first and second goal. More specifically, as for both the first (Convergence), and the second goal (Regional Competitiveness & Employment), it funds operations which have to do with the improvement of the access to employment and labour market participation, the strengthening of social inclusion and the fighting of discrimination. However, it also funds operations related only to the second goal and they have to do with expanding and improving investments in human capital (education, training, postgraduate studies), and increasing the efficiency of public administration and other organizations (studies, training of structural funds executives) (Kamchis, 2007).

Finally, the Cohesion Fund focuses on the intereuropean transport networks and on priority projects for the environment and sustainable development, by financing activities related to the connections of rail and maritime transport, sustainable urban transport, energy efficiency, and renewable energy sources (Kamchis, 2007).

Table 5: Priority goals for EU s' regional policy: 2007 - 2013

Goal 1: Convergence	ERDF, ESF, Cohesion Fund
Goal 2: Regional Competitiveness & Employment	ERDF, ESF
Goal 3: Territorial Cooperation	ERDF

Source: Kamchis, (2007)

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4.2.1. THE GOAL OF LISBON STRATEGY FOR EDUCATION

The European Council meeting in Lisbon in 2000 decided the differentiation of the European Union's policy, as well as its turn toward the area of education and training. After the needs and problems which exist in the field of the education and training of all the European Union citizens have been studied, the Lisbon objective was formed, according to which Europe has to become the most competitive and dynamic knowledge economy in the world, capable of sustainable economic growth with more and better working positions and with greater social cohesion. At this meeting, there were some key points on which specific emphasis was placed.

The increase of the quality of the education systems as well as the improvement of the training of the human resources was one of those factors. The upgrade of both the initial and the continuous training of educators in order for them to be able to cope with changes in society and the always increasing demands of students is an essential prerequisite. Moreover, the elimination of illiteracy is considered critical, as to ensure quality learning basic knowledge of reading, writing and mathematics is essential (European Parliament and Council, 2006; European Council, 2009).

Another key factor was the issue of access to learning, rendering therefore essential, not only the development of a system of lifelong learning but also the free movement of human capital. They decided, therefore, that easy access to lifelong learning was an area which called for changes in order to make possible the adjustment of the educational systems to the needs of people of all ages and, at the same time, at all stages of their lives (European Parliament and Council, 2006; European Council, 2009).

Furthermore, a significant issue was the content of the studies and the skills of young people, finishing the initial training, while the introduction of new technologies would have now to be taken for granted. In order for that to be feasible, universities and training centers will have to become more attractive and to consolidate their ties with local communities, ensuring a link between curricula and their teaching material, with the professional skills which people are required to have (Commission, 2008; European Council, 2008). Finally, a special emphasis was laid also on the issue of effectiveness. That is, quality assurance through assessment was deemed necessary, to provide a better price-quality relation (European Council, 2009).

All the above reflections and the directions which the Lisbon Strategy includes emerged because of the existing needs. The external as well as the internal environment of the

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European Union faces rapid changes. The labour market requires more and more professional skills, which did not happen in the past. The specialized skills which someone may have play an important role, providing them with a comparative advantage in the European Union society, where deficits in some areas exist (Commission, 2008; European Council, 2008).

There is also a problem in the level of universities. Young people and students are, as an age group, a top priority generally in the policies of the European Union but the same applies to the Lisbon Strategy. The increase of their mobility and the adjustment of potential manpower of the European Union to the new data is an essential factor. The increase of mobility can be achieved through exchanges of European programs for students (eg Erasmus), while strengthening links with business will help them gain a more comprehensive view on the mode of function, developing, at the same time, their entrepreneurial spirit (Commission, 2009; European Council, 2009).

Finally, the field of information and communication technologies is rapidly growing and has been incorporated in the everyday life of many people and, partly, of schools. The upgrade of school equipment is, therefore, essential, as well as the educators' training especially in the correct usage of the internet.

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4.2.2. THE SIGNIFICANCE OF RESEARCH AND DEVELOPMENT IN THE LISBON STRATEGY – THE CASE OF FRAMEWORK PROGRAMME 7 (FP7)

Scientific research and technological advances are essential to the economic and social development, as well as to the competitiveness of the European Union countries on an international level. For that reason, the common policy of research and development is vital to the European completion. This policy aims at coordinating the national research policies of European interest, in order to respond to the international market, to the interests of all member states, as well as to the essential financial and human resources, factors which a state cannot ensure by itself (Mousis, 2005).

While the challenges which the European Union faces are changing and, at the same time, the priorities of scientific and technological research are changing, the common policy of the community in this area is able to provide the necessary human, material and financial resources, as well as participation in research and development of small countries in Europe, which, otherwise, would have no possibility (Mousis, 2005).

A fact for the European Union is that radical changes take place, not only on an economical level but also on a social one. Traditional sectors of the economy such as the textile industry move towards the eastern European countries because of cheaper workforce, resulting to many countries of the European Union facing the phenomenon of deindustrialization. It is, therefore, an opportunity for Europe to fill the gap created, with the development of industries and generally by offering products and services of high technology. The research and the technological advances are capable of strengthening the competitiveness and the sustainability, but also to achieve their social goals.

The competitiveness and sustainability are defining factors for the future of the European Union. They depend on the ability of citizens, enterprises and regions to create and use knowledge and technology in order to be able to produce new goods and high quality services, to adopt new production processes etc. Strengthening the capability of innovation production and fostering the creation of businesses and services based on new technologies and new markets, the community research helps the European Union countries to solve major problems such as unemployment (Mousis, 2005).

The continuing growth means balancing the economic goals for technological and economic growth and the social goals for improvement of the quality of life, employment, security and environmental quality. If there is economic growth which does not lead to environmental degradation, the research may contribute both to enhancing competitiveness

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and increasing employment, and to improving the lives of the European Union citizens. Such an example is the research on new forms of mobility and methods of production friendly to the environment (Mousis, 2005).

The FP7 FAQs have been designed and conducted in the context of the preparation of the Seventh Framework Programme (FP7). The answers rely on the amended proposal of the Commission to the Council and Parliament in June 2006 and other official documents published since then. 'Framework programmes' (FPs) have been the main financial tools through which the European Union supports research and development activities covering almost all scientific disciplines. FPs have been implemented since 1984 and cover a period of five years with the last year of one FP and the first year of the following FP overlapping. The current FP is FP6, which runs up to the end of 2006. It has been proposed for FP7, however, to run for seven years. It will be fully operational as of 1 January 2007 and will expire in 2013. It is designed to build on the achievements of its predecessor towards the creation of the European Research Area, and carry it further towards the development of the knowledge economy and society in Europe (http://cordis.europa.eu/fp7/faq_en.html).

While building on the achievements of its predecessor, the Seventh Framework Programme will not be "just another Framework Programme". In its content, organization, implementation modes and management tools, it is designed as a key contribution to the re-launched Lisbon strategy. The new elements in FP7 include the following (http://cordis.europa.eu/fp7/faq_en.html):

- Emphasis on research themes rather than on "instruments"
- Significant simplification of its operation
- Focus on developing research that meets the needs of European industry, through the work of Technology Platforms and the new Joint Technology Initiatives
- Establishment of a European Research Council, funding the best of European science
- Integration of International cooperation in all four programmes
- Development of Regions of Knowledge
- A Risk-Sharing Finance Facility aimed at fostering private investment in research

The European Community part of FP7 is organized in four programmes corresponding to four basic components of European research:

Cooperation

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Support will be given to the whole range of research activities carried out in trans-national cooperation, from collaborative projects and networks to the coordination of national research programmes. International cooperation between the EU and third countries is an integral part of this action. This action is industry-driven and organized in four sub-programmes (http://cordis.europa.eu/fp7/faq_en.html):

- Collaborative research will constitute the bulk and the core of EU research funding
- Joint Technology Initiatives will mainly be created on the basis of the work undertaken by the European Technology Platforms
- Coordination of non-Community research programmes
- International Cooperation

Ideas

This programme will enhance the dynamism, creativity and excellence of European research at the frontier of knowledge in all scientific and technological fields, including engineering, socio-economic sciences and the humanities. This action will be overseen by a European Research Council.

People

Quantitative and qualitative strengthening of human resources in research and technology in Europe by putting into place a coherent set of Marie Curie actions.

Capacities

The objective of this action is to support research infrastructures, research for the benefit of SMEs and the research potential of European regions (Regions of Knowledge) as well as to stimulate the realization of the full research potential (Convergence Regions) of the enlarged Union and build an effective and democratic European Knowledge society.

Each of these programmes will be the subject of a 'Specific programme'. In addition, there will be a 'Specific programme' for the Joint Research Centre (non-nuclear activities) and one for Euratom nuclear research and training activities (http://cordis.europa.eu/fp7/faq_en.html).

FP7 presents strong elements of continuity with its predecessor, mainly as regards the themes which are covered in the Cooperation programme. The themes identified for this programme correspond to major fields in the progress of knowledge and technology, where research must be supported and strengthened to address European social, economic,

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environmental and industrial challenges. The overarching aim is to contribute to sustainable development (http://cordis.europa.eu/fp7/faq_en.html).

The ten high level themes proposed for EU action are the following (http://cordis.europa.eu/fp7/faq_en.html):

- Health
- Food, Agriculture and Fisheries, Biotechnology
- Information & Communication Technologies (ICT)
- Nanosciences, Nanotechnologies, Materials & New Production Technologies
- Energy
- Environment (including climate change)
- Transport (including aeronautics)
- Socio – economic Sciences and the Humanities
- Space
- Security

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4.3. CONCLUDING REMARKS

As it follows, therefore, from the above analysis, the main goal of the regional development policy is to reduce the existing regional disparities, as well as to prevent the creation of new, through the transfer of resources from richer to poorer regions. The development of the Regional Development Policy since 1960 until today has been spectacular. Essentially, until 1960 there has not been a Regional Development Policy on the part of the community, while some steps towards that direction have been made since the 1970s. However, up until 1987, the Regional Development Policy of the community has been an exogenous and additional involvement in the regional policy which every state separately shaped.

Later, three programming periods followed (1989-2006). Especially in the first two periods, the priorities of the regional development policy geared mainly to the transfer of financial aid to regions whose development was lagging, to the funding of the construction of infrastructures, as well as to the strengthening of investments which would create employment (given the problems of deindustrialization and agricultural structures which hit many regions of the community).

However, the landscape in the European Union and globally would constantly change. At the same time, the European Policy of the community would change. Therefore, in 2000 a new direction was given through the Lisbon Strategy, which created new perspectives. The European committee realized that the creation of infrastructures is, on the one hand, essential, but not a sufficient condition for the development of the underdeveloped countries. Interventions were required on other levels too, such as the institutional or the level of growth of the manpower skills (Petrakos and Psycharis, 2004). Realizing the scale of events, it shifted the burden of priorities from the infrastructures and the transfer of financial resources to the regions facing structural problems, such as deindustrialization, to human capital and technological advances, considering that from then on they would be the main factors which would ensure the competitiveness of the European Union as well, in order for it to retain its position in the global scene.

The data which the Lisbon Strategy suggested concerned mainly employment, the economical reform and the social cohesion, and they formed the strategic goal for the next decade. That goal was a new challenge which, through the strengths and weaknesses of the Union, would try to be avoided and be given a new direction which was no other than to make Europe the most competitive and most powerful economy of knowledge, capable of a

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sustainable economic development, with more and better working positions and greater social cohesion (European Council, 2000).

The areas, therefore, of human capital and of research and technological advances come strongly to the fore, being inextricably linked to the growth and the convergence. It was supported that the economic success of a region depends largely on the chances of securing stable access to research and the technological advances. Innovation has been an ongoing process, which requires the use of every new technological advance and, thus, a constant interaction between the research laboratories and the companies developing new technologies.

In terms of human capital, it is believed that the prospects of growth of a region are directly linked to the quality rather than the quantity of work. In a time when knowledge is emerging as the most important factor of progress and development, the regions which will dispose of qualified manpower, will have much more chances to attract investment capital and to enhance intrinsic business activities from the regions where the unqualified workforce dominates. The policies, therefore, shifted towards the training of the newcomers in the labour market, towards the retraining of unemployed whose specialization no longer ensure employment prospects and towards policies of lifelong learning (Petrakos and Psycharis, 2004).

A very important observation is that these two factors, human capital and technological advances are interdependent, while, at the same time, they are directly linked to the regional development. A skilled, adaptable and flexible workforce is an essential factor of competitiveness, productivity and quality of business. It allows industries and regions to adapt to the needs of technology and the developments of the market and become or remain competitive. The achievement of the increase of investments in research and technological advances requires, amongst other things, the existence of workforce with excellent professional qualifications and a strong research base (Mousis, 2005).

Regarding the Lisbon objectives, since 2000, some reforms have been completed and some objectives have been achieved. Nevertheless, some states continue to fail in achieving the goals and as a result the road towards full success is especially long. There are many reasons which this failure may be due to.

Initially, the introduction of the member states in the last two enlargements completely changed the data in the European area. All those states are poorer than the average of the fifteen countries of the European Union. They have limited resources but also great needs in infrastructure works and social programs. Furthermore, they have a reduced absorption

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capacity as well as an inability to promote the necessary reforms on a national level. Therefore, their economical priorities differ from those of the European Union of the fifteen (Collignon et al, 2005).

Another reason is that progress seems to be faster in areas where the member states have similar beliefs but slower in areas where national preferences differ (Collignon et al, 2005). There is not, that is, from all the member states the same feeling as regards the position they have within the European Union membership, while they continue to place a priority on their national interests in relation to the goals which the European Union sets.

On the part of the Union now, the problem which could be created is that, while the differences between the member states are known, perhaps finally a more uniform than it should resolution of problems is sought for. Problems, which by nature, differ from region to region (Argiris, 2006).

The human capital and the technological advances are factors which create external economies. That has led to great disparities in both infrastructure and the quality of human resources in terms of skills and knowledge. So, usually, the favorable factors for research and technological advances are concentrated on the developed regions. The same is done by businessmen when they are asked to chose where they are going to settle. Maybe this is a good explanation of the phenomenon of increasing inequality within the member states and their reduction within countries. The convergence of the countries, in a nutshell, was achieved by further strengthening the metropolitan centers and other areas which already had a dynamic.

The pursuit, therefore, of regional policy, in spite of the weaknesses reported above, is essential as it can operate in a countervailing way as far as the pursuit of other horizontal policies are concerned (like for example policies for human resources, policy research and development), which are on the one hand indispensable for the improvement of the efficiency and development of the economy as a whole, but it is known that they are in fact contributing to the intensification of regional disparities (Petrakos and Psycharis, 2004).

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5. THE CONTRIBUTION OF INFORMATION AND COMMUNICATION TECHNOLOGIES AND OPEN SOURCE MOVEMENT TO REGIONAL DEVELOPMENT

5.1. INTRODUCTORY COMMENTS

According to Arvanitidis and Petrakos (2007), knowledge – driven economic dynamism embodies four building elements. One of them is the information access. Even if a country has achieved the desired or necessary levels of human capital and technological advances, in order to maintain and increase its competitiveness, the information access is regarded a crucial factor on modern globalised environment.

The contribution of this specific factor has benefits, both directly to the economic growth (as it is a notion directly linked to the open economy, but it is, at the same time, necessary condition for its existence), and to human capital and technological advances separately. The relationship, therefore, between information, knowledge and information and communication technology is interactive.

Nowadays, according to Arvanitidis and Petrakos (2007), knowledge differs from traditional commodities on a number of points. Firstly, it does not have a physical appearance, though it is embedded in some specific blueprint form (such as a patent, an artifact, a composition, a manuscript or a computer programme), in human beings and in organizations. Secondly, knowledge is non – rival and also non – excludable, and finally knowledge is not depleted by use. In fact the more people that use it, the greater the social return and its value become. As a result positive externalities arise (Arvanitidis and Petrakos, 2007).

Moreover, information access has to do with the usage of information and communication technologies (ICTs). ICTs have revolutionized the transmission of information around the globe. ICTs are an essential ingredient of knowledge-based dynamism. Over the last years, there have been a few studies exploring the links between ICT and economic growth (Arvanitidis and Petrakos, 2007).

Nevertheless, in the past, knowledge and information were spatially localized mainly in large cities where there were universities, and it was furthermore difficult to access them, as there were significant limitations in their distribution both financially and in terms of availability because of their physical status (written form). The role of information and

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communication technology in transferability and creation of knowledge is significant (Arvanitidis and Petrakos, 2007). The information and communication technology have broken not only the barriers of distance but also the obstacles of their limited distribution because of the present electronic form of information. However, an important barrier in the distribution/share of information remains to some extend and it concerns the cost of information, resulting in blocking access of the economically feeble population groups to it.

However, several attempts have been made to render a substantial part of the information freely available to everybody. One of the goals of the European Commission within the Lisbon Strategy is to provide low-cost internet access. Moreover, examples of ventures moving to that direction are the program Open Course Ware of the MIT University and Wikipedia, which will be analyzed below. Therefore, an enormous amount of information of high reliability and quality are freely available to every citizen of the world, as long as they have the means (PC) and internet access.

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5.2. THE CONTRIBUTION OF OPEN SOURCE MOVEMENT

Open source describes practices in production and development that promote access to the end product's source materials. A main principle and practice of open source software development is peer production by bartering and collaboration, with the end-product, source-material, "blueprints" and documentation available at no cost to the public. Some consider open source a philosophy, others consider it a pragmatic methodology. Opening the source code enabled a self-enhancing diversity of production models, communication paths, and interactive communities. Subsequently, a new, three-word phrase "open source software" was born to describe the environment that the new copyright, licensing, domain, and consumer issues created (http://en.wikipedia.org/wiki/Open_source).

However, software is not the only field affected by open source; many fields of study and social and political views have been affected by the growth of the concept of open source. Advocates in one field will often support the expansion of open source in other fields, including Linus Torvalds who is quoted as saying, "the future is open source everything" (http://en.wikipedia.org/wiki/Open_source).

One of the areas, thus, directly affected by the open-source is that of technology. Results of this influence are the Open Source Software, as well as the Open Design. A very important venture is also the Open Source Appropriate Technology (OSAT) which refers to technologies that are designed in the same fashion as free and open-source software. These technologies must be “appropriate technology” (AT), meaning technology that is designed with special consideration to the environmental, ethical, cultural, social, political, and economical aspects of the community they are intended for. Finally, it is worth mentioning the “Teaching” which involves applying the concepts of open source to instruction using a shared web space as a platform to improve upon learning, organizational, and management challenges. An example of an Open Source Courseware is the Java Education & Development Initiative (http://en.wikipedia.org/wiki/Open_source).

Regarding the area of education, within the academic community, there is discussion about expanding what could be called the "intellectual commons" (analogous to the Creative Commons). Proponents of this view have hailed the Connexions Project at Rice University, Open Course Ware project at MIT, Eugene Thacker's article on "Open Source DNA", the "Open Source Cultural Database" and Wikipedia as examples of applying open source outside the realm of computer software (http://en.wikipedia.org/wiki/Open_source).

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Another strand to the academic community is in the area of research. Many funded research projects produce software as part of their work. There is an increasing interest in making the outputs of such projects available under an open source license. In the UK the Joint Information Systems Committee (JISC) has developed a policy on open source software. Furthermore, the Science Commons was created as an alternative to the expensive legal costs of sharing and reusing scientific works in journals etc., while the Open Source Science Project was created to increase the ability of students to participate in the research process by providing them access to microfunding, which, in turn, offers non-researchers the opportunity to directly invest, and follow, cutting-edge scientific research. All data and methodology is subsequently published in an openly accessible manner under a Creative Commons fair use license (http://en.wikipedia.org/wiki/Open_source).

In addition, it is worth referring to the influence of the open-source in the Innovation Communities. One of the recent initiatives in scientific publishing has been open access. The idea is that research should be published in such a way that it is free and available to the public. There are currently many open access journals where the information is available free online; however most journals do charge a fee (either to users or libraries for access). The Budapest Open Access Initiative is an international effort with the goal of making all research articles available free on the Internet (http://en.wikipedia.org/wiki/Open_source).

Moreover, the National Institute of Health has recently proposed a policy on "Enhanced Public Access to NIH Research Information." This policy would provide a free, searchable resource of NIH-funded results to the public and with other international repositories six months after its initial publication. The NIH's move is an important one because there is a significant amount of public funding in scientific research. Many of the questions have yet to be answered — the balancing of profit vs. public access, and ensuring that desirable standards and incentives do not diminish with a shift to open access (http://en.wikipedia.org/wiki/Open_source).

Finally, another example is Farmavita.Net. It is about a Community of Pharmaceutical Executives that have recently proposed new business models of Open Source Pharmaceuticals. The project is targeted to development and sharing of know-how for manufacturing essential and life saving medicines. It is mainly dedicated to the countries with less developed economies where local pharmaceutical research and development resources are insufficient for national needs. It will be limited to generic (off-patent) medicines with established use. By definition, medicinal products have a “well-established use” if used for at

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least 15 years, with recognized efficacy and an acceptable level of safety. In that case, the expensive clinical tests and trial results could be replaced by appropriate scientific literature (http://en.wikipedia.org/wiki/Open_source).

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5.3. THE CASE OF THE MIT – OPEN COURSE WARE

By choosing to share their course materials freely and openly on the Web, the MIT faculty has created a unique global educational resource that has touched the lives of millions. OpenCourseWare (OCW) is a revolutionary approach to sharing educational resources. The site presents the core academic content–including lecture notes, syllabi, assignments and exams–from substantially all of MIT's undergraduate and graduate curriculum freely and openly to support formal and informal learning around the world. Many of the site's more than 1,900 courses also include rich media resources such as video lectures, simulations, and animations. OCW has inspired a worldwide movement that now includes hundreds of universities sharing materials from more than ten thousand courses (http://ocw.mit.edu).

The concept for MIT OpenCourseWare grew out of the MIT Council on Education Technology, which was charged by MIT provost Robert Brown in 1999 with determining how MIT should position itself in the distance learning/e-learning environment. The MIT OpenCourseWare was then initiated to provide a new model for the dissemination of knowledge and collaboration among scholars around the world, and contributes to the "shared intellectual commons" in academia, which fosters collaboration across MIT and among other scholars. The project was spearheaded by Hal Abelson and other MIT Faculty (http://en.wikipedia.org/wiki/MITOpenCourseWare).

In September 2002, the MIT OpenCourseWare proof-of-concept pilot site opened to the public, offering 32 courses. In September 2003, MIT OpenCourseWare published its 500th course, including some courses with complete streaming video lectures. By September 2004, 900 MIT courses were available online. The response from MIT faculty and students has been very positive and MIT OpenCourseWare is seen as being consistent with MIT's mission (to advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century) and is true to MIT's values of excellence, innovation, and leadership (http://en.wikipedia.org/wiki/MIT OpenCourseWare).

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5.4. THE CASE OF WIKIPEDIA

Wikipedia is a free, web-based, collaborative, multilingual encyclopedia project supported by the non-profit Wikimedia Foundation. Its 16 million articles (over 3.3 million in English) have been written collaboratively by volunteers around the world, and almost all of its articles can be edited by anyone with access to the site. There are currently 262 language editions of Wikipedia; of these, 24 have over 100,000 articles and 81 have over 1,000 articles (http://en.wikipedia.org/wiki/Wikipedia).

Jimmy Wales has described Wikipedia as "an effort to create and distribute a free encyclopedia of the highest possible quality to every single person on the planet in their own language." Though each language edition functions more or less independently, some efforts are made to supervise them all. They are coordinated in part by Meta-Wiki, the Wikimedia Foundation's wiki devoted to maintaining all of its projects (Wikipedia and others). For instance, Meta-Wiki provides important statistics on all language editions of Wikipedia, and it maintains a list of articles every Wikipedia should have. The list concerns basic content by subject: biography, history, geography, society, culture, science, technology, foodstuffs, and mathematics. As for the rest, it is not rare for articles strongly related to a particular language not to have counterparts in another edition. For example, articles about small towns in the United States might only be available in English (http://en.wikipedia.org/wiki/Wikipedia).

Translated articles represent only a small portion of articles in most editions, in part because automated translation of articles is disallowed. Articles available in more than one language may offer "InterWiki" links, which link to the counterpart articles in other editions (http://en.wikipedia.org/wiki/Wikipedia).

Finally, Wikipedia has also spawned several sister projects, which are also run by the Wikimedia_Foundation. Wiktionary, a dictionary project, was launched in December 2002; Wikiquote, a collection of quotations, a week after Wikimedia launched, and Wikibooks, a collection of collaboratively written free textbooks and annotated texts. Wikimedia has since started a number of other projects, including Wikiversity, a project for the creation of free learning materials and the provision of online learning activities. None of these sister projects, however, has come to meet the success of Wikipedia (http://en.wikipedia.org/ wiki/Wikipedia).

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5.5. THE CASE OF "ONE LAPTOP PER CHILD" PROJECT

Finally, another example will be presented, which is a comprehensive approach in order to offer a solution to the problem of access to knowledge. It concerns both the equipment required to have access to knowledge (PC) and free access to information/knowledge itself. More specifically they aimed at One Laptop Per Child delivering technology and resources to targeted schools in the least developed countries, breaking down, in this way, world barriers of race, age, gender, language, class, economics and geography.

5.5.1. ONE LAPTOP PER CHILD

The vision of this specific program is to create educational opportunities for the world's poorest children by providing each child with a rugged, low-cost, low-power, connected laptop with content and software designed for collaborative, joyful, self-empowered learning. When children have access to this type of tool they get engaged in their own education. They learn, share, create, and collaborate. They become connected to each other, to the world and to a brighter future (http://laptop.org/en/vision/index.shtml).

The mission of One Laptop per Child (OLPC) is to empower the children of developing countries to learn by providing one connected laptop to every school-age child. They argue that in order to accomplish their goal, they need people who believe in what they're doing and want to help make education for the world's children a priority, not a privilege (http://laptop.org/en/vision/mission/index.shtml).

In 2002, MIT Professor Nicholas Negroponte experienced first-hand how connected laptops transformed the lives of children and their families in a remote Cambodian village. A seed was planted: If every child in the world had access to a computer, what potential could be unlocked? What problems could be solved? These questions eventually led to the foundation of One Laptop per Child, and the creation of the XO laptop. According to Negroponte it's not a laptop project. It's an education project (http://laptop.org/en/vision/mission/index.shtml).

OLPC's mission is to provide a means for learning, self-expression, and exploration to the nearly two billion children of the developing world with little or no access to education. While children are by nature eager for knowledge, many countries have insufficient resources to devote to education, sometimes less than $20 per year per child (compared to an average of $7,500 in the United States). They support that by giving children their very own connected XO laptop, they are giving them a window to the outside world, access to vast amounts of

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information, a way to connect with each other, and a springboard into their future. And they're also helping these countries develop an essential resource educated, empowered children (http://laptop.org/en/vision/mission/index.shtml).

Most of the nearly two–billion children in the developing world are inadequately educated, or receive no education at all. One in three does not complete the fifth grade. They support that the individual and societal consequences of this chronic global crisis are profound. Children are consigned to poverty and isolation just like their parents never knowing what the light of learning could mean in their lives. At the same time, their governments struggle to compete in a rapidly evolving, global information economy, hobbled by a vast and increasingly urban underclass that cannot support itself, much less contribute to the commonwealth, because it lacks the tools to do so (http://laptop.org/en/vision/mission/index.shtml).

Any nation's most precious natural resource is its children. They believe the emerging world must leverage this resource by tapping into the children's innate capacities to learn, share, and create on their own. Their answer to that challenge is the XO laptop, a child's machine designed for "learning - learning". The laptops are given to students, similar to school uniforms and ultimately remain the property of the child. The operating system and software is localized to the languages of the participating countries (http://laptop.org/en/vision/mission/index.shtml).

Extensively field-tested and validated among some of the poorest and most remote populations on earth, constructionism emphasizes what Papert calls "learning - learning" as the fundamental educational experience. A computer uniquely fosters "learning - learning" by allowing children to "think about thinking", in ways that are otherwise impossible. Using the XO as both their window on the world, as well as a highly programmable tool for exploring it, children in emerging nations will be opened to both illimitable knowledge and to their own creative and problem-solving potential (http://laptop.org/en/vision/mission/index.shtml).

OLPC is not, at heart, a technology program, nor is the XO a product in any conventional sense of the word. OLPC is a non-profit organization providing a means to an end that sees children in even the most remote regions of the globe being given the opportunity to tap into their own potential, to be exposed to a whole world of ideas, and to contribute to a more productive and saner world community (http://laptop.org/en/vision/mission/index.shtml).

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5.5.2. GIVE 1 GET 1 PROGRAM

OLPC initially stated that no consumer version of the XO laptop was planned. The project, however, later established the laptopgiving.org website to accept direct donations and ran a "Give 1 Get 1" (G1G1) offer starting on November 12, 2007. The offer was initially scheduled to run for only two weeks, but was extended until December 31, 2007 to meet demand. With a donation of $399 (plus US$25 shipping cost) to the OLPC "Give 1 Get 1" program, donors received an XO-1 laptop of their own and OLPC sent another on their behalf to a child in a developing country. Some 83,500 donors participated in the program. (http://en.wikipedia.org/wiki/One_Laptop_per_Child).

Table 6: Summary of laptop orders

Year	**Confirmed number (approximate)**	**Date confirmed**	**Purchaser**
2007	100,000	October 2007	Uruguay
	15,000	November 14, 2007	Bairmingham, Alabama,United States
	260,000	December 1, 2007	Peru
	50,000	December 1, 2007	Mexico (Mexican businessman Carlos Slim)
	167,000	January 5, 2008	G1G1 2007 program
2008	65,000	May 29, 2008	Colombia (Caldas)
	+200,000	June 2008	Uruguay
	+30,000	October 2008	Peru
	10,000	November 10, 2008	Ghana
	12,500	January 9, 2009	G1G1 2008 program
2009	5,000	April 24, 2009	Sierra Leone
	100,000	May 14, 2009	Rwanda
	+160,000	October 13, 2009	Uruguay (total: 362,000 children, 18000 teachers)
2010	+260,000	March 17, 2010	Peru
	+60,000	April 13, 2010	Argentina
Total	1,494,500		

Source: Wikipedia, (2010)

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5.5.3. CRITICISM

As it always happens, this program did not lack of criticism and negative comments.

At the World Summit on the Information Society held by the United_Nations in Tunisia from November 16–18, 2005, several African officials, most notably Marthe Dansokho of Cameroon and Mohammed Diop of Mali, voiced suspicions towards the motives of the OLPC project and claimed that the project was using an overly U.S. mindset that presented solutions not applicable to specifically African problems. Dansokho said the project demonstrated misplaced priorities, stating that clean water and schools were more important for African women, who, he stated, would not have time to use the computers to research new crops to grow. Diop specifically attacked the project as an attempt to exploit the governments of poor nations by making them pay for hundreds of millions of machines (http://en.wikipedia.org/wiki/One_Laptop_per_Child).

John Wood, founder of Room to Read, emphasizes affordability and scalability over high-tech solutions. While in favor of the One Laptop per Child initiative for providing education to children in the developing world at a cheaper rate, he has pointed out that a $2,000 library can serve 400 children, costing just $5 a child to bring access to a wide range of books in the local languages (such as khmer or Nepali) and English; also, a $10,000 school can serve 400–500 children ($20–$25 a child). According to Wood, these are more appropriate solutions for education in the dense forests of Vietnam or rural Cambodia (http://en.wikipedia.org/wiki/One_Laptop_per_Child).

In 2007, XO laptops in Nigeria were reported to contain pornographic material belonging to children partaking in the OLPC Program. In response, OLPC made plans for adding content filters. The OLPC foundation maintained the position that such issues were societal, not laptop related. Similar responses have led some to suggest the OLPC takes an indifferent stance concerning this issue. According to Wayan Vota Senior Director at Inveneo and founder of the independent OLPC News, "The use of computers to look at porn is a social problem, not a hardware one. Children have to be taught what's good and what's bad, based on the cultural context" (http://en.wikipedia.org/wiki/One_Laptop_per_Child).

India's Ministry of Human Resource Development, in June 2006, rejected the initiative, saying “it would be impossible to justify an expenditure of this scale on a debatable scheme when public funds continue to be in inadequate supply for well-established needs listed in different policy documents”. Later they stated plans to make laptops at $10 each for schoolchildren. Two designs submitted to the Ministry from a final year engineering student

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of Vellore Institute of Technology and a researcher from the Indian Institute of Science, Bangalore in May 2007 reportedly describe a laptop that could be produced for "$47 per laptop" for even small volumes. The Ministry announced in July, 2008 that the cost of their proposed "$10 laptop" would in fact be $100 by the time the laptop became available. This project is called Sakshat. In 2009 a combination of states announced plans to order 250,000 OLPCs. In 2010, a $35 Sakshat Tablet was unveiled in India (http://en.wikipedia.org/wiki/One_Laptop_per_Child).

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5.6. CONCLUDING REMARKS

Human communities all over the world can improve their living standards by tapping the knowledge which is continually accumulating on the internet. Students, who are facing the problem of lack of resources (in universities and schools) in the Third World countries, can have access to the same information available to students of the best universities.

This change can contribute to reducing regional disparities, as space tends to play a less and less important role, because intangible services and products can be distributed with little cost to every part of the planet. While territorial barriers are breaking, economic barriers to the dissemination of knowledge continue to exist. The answer to this problem is attempted by the movement of Open-source, which is not just a tendency of free-inexpensive information and services, but it also reflects and expresses principles such as humanism and equality.

Undoubtedly, the societies of the Third World can benefit if they exploit ICT which will meet, however, their needs and potentials. Thereby increasing the access of people to information (information society) and provided that this information is properly exploited by them (knowledge society), the collective welfare of their communities can be improved (regional development).

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6. CONCLUSIONS

As it comes out from the overall previous analysis, both two factors examined in this study, human capital and technological progress, contribute to regional development in a positive way.

In the first chapter, where the theoretical background was analysed, the ways with which the two factors can affect either economic development in general or regional development in particular were reported. More specifically, human capital raises local productivity. Also, it can raise wages above the private returns to education even in the absence of any spillover or market-mediated concentration force. An educational background would be complementary with new technologies and the results also suggest an important role for the diffusion of technology. So, higher education is associated with both production of new knowledge and efficient adaptation and innovative use of established one.

Two very important conclusions that come out from the theoretical and empirical analysis are the following: economic growth depends on positive interaction between human capital and technological progress and the extent to which these two factors influence regional development varies significantly in the case of developed regions in relation to less developed one.

In more details, in 1961, Schultz felt that Solow's technical change should be replaced with a human capital variable given that technical change in large part resulted from an 'investment in man.' Later on, Nelson and Phelps in 1966 found that growth is positively affected by the rate of technological innovations and the rate of diffusion or adoption of existing innovation, and that the stock of human capital affects both of these rates. Also, Lin (2009) argues that a flexible process of industrial and technological upgrading requires simultaneous improvements in education, in infrastructures, etc.

Regarding the second important point that refers to the extent to which the two factors influence regional development varies significantly in the case of developed regions in relation to less developed ones; a recent analysis by Aghion and Cohen in 2004 put in evidence that high-level human capital has a positive effect on economic performance only if a country is close to the technological frontier: countries that are far from this frontier, specialized in traditional sectors, can grow, almost in the short run, even exploiting medium-level human capital (Baici and Casalone, 2005). However, especially for the less developed country, there is not only a need for education or accumulation of human capital, but also they

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should adopt technologies that are consistent with their comparative advantage and their level of economic development.

Towards the same direction, namely the recognition of positive contribution by human capital and technological progress to development, it appears that is moving towards the cultural context. The Lisbon's Treaty stressed those sectors which until then were of secondary importance in the union's choices. Lisbon's Treaty purpose is to enhance new sectors and to promote development by targeting in human capital, recognizing it as the main factor of the union. Consequently, the creation of the knowledge society along with investments in the sectors of research and development, education, lifelong learning, human capital mobility, as well as new technologies, creates prospects for development and finance of new targets.

Nevertheless, there are some reactions in respect to the change that the Union has done as regards its targets and priorities, as there are regions which cannot follow this new route and they are stuck in that particular stage where their main needs lie in the infrastructure sector. However, with the developments that currently are taking place in global level, the education sector and R&D sector are experiencing huge growth and are firmly linked with the development term. This change in the European Regional policy, was a necessity for the European Union in order to be prepared to support every change and innovation, to apply it in its interest, to retain its competitiveness and as a result to linger at the path of development.

Finally, Information and Communication Technologies could potentially contribute in decrease of the regional inequalities through a number of their applications. It is considered noteworthy, to mention some applications such as Wikipedia, MIT open course ware, Linux, etc. which are not impose economical or spatial barriers as regard to their utilization – use. So, increasing the access of people to information (information society) and provided that this information is properly exploited by them (knowledge society), the collective welfare of their communities can be improved.

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