Innovation and Productivity

A story of convergence and divergence process in EU countries

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Abstract:

Technology is apparently one of the main determining sources of productivity and economic growth and there is a huge literature on productivity, growth and innovation.

This paper is aiming to review the main topics related to productivity, growth and innovation activities.

In particular, this paper reviews developments in economic growth and productivity at the aggregate country level and it focuses on the different growth pace of the European Union countries, examining the main factors affecting growth, in order to estimate the effects of innovation activities to productivity growth in EU member states and to conclude to some safe results and policy implications.

Key Words: Growth, Innovation Activities, Productivity

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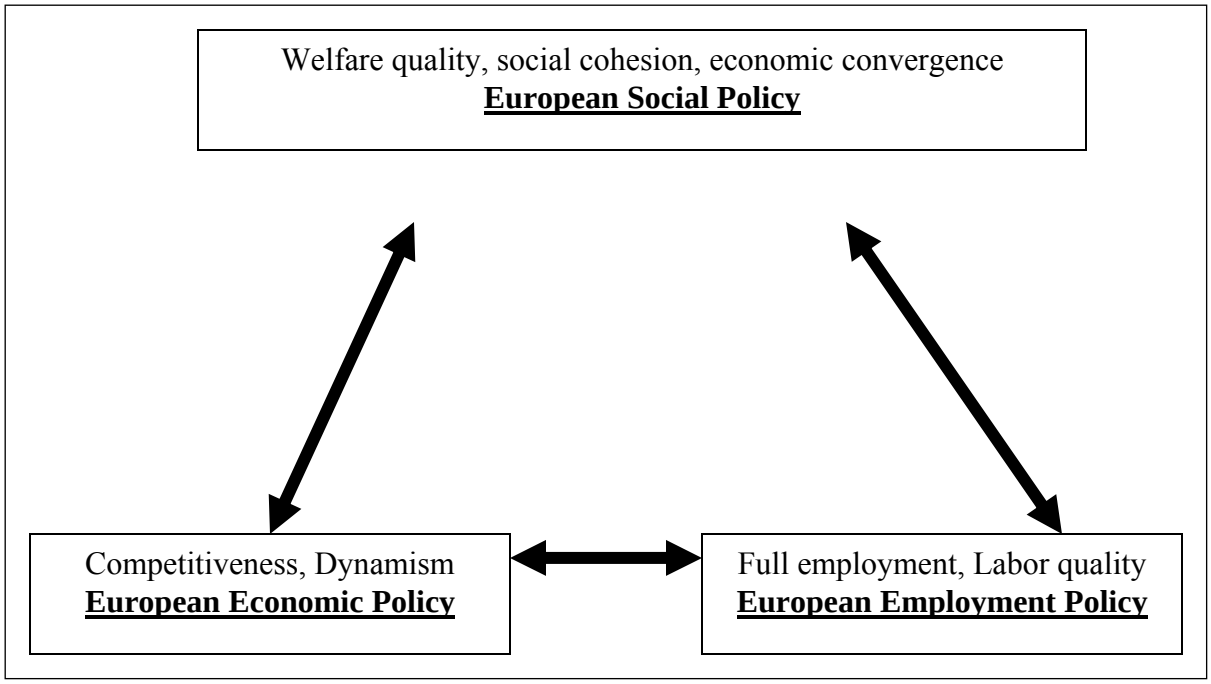
1. Growth Rates Development

One of the focal points of the Treaty of the European Union (E.U., 1992) is 'to promote economic and social progress along with a high level of employment, as well as to achieve balanced and sustainable development ….. through the strengthening of economic and social cohesion....'. The framework of these policy objectives could be illustrated in the following diagram:

Figure 1: Strategic policies, flows and socio – economic development



Source: G. M. Korres

The chart presents development as described by the inter-linkages among the economic and social policies aiming to achieve and sustain positive results towards development and growth. The combination of the three policies target to the enhancement and convergence as far as productivity, competitiveness and development process are concerned.

As it is also declared in the Third Report on Economic and Social Cohesion (2004), strengthening regional competitiveness throughout the Union will boost the growth potential of the EU economy as a whole. And, by securing a more balanced spread of economic activity across the Union, it will reduce the risk of imbalances and divergence, making it easier to sustain the European model of economy and society.

In policy terms, the objective is to help achieve a more balanced development by reducing existing disparities, avoiding regional imbalances, by making policies more

coherent, improving integration and encouraging cooperation between states and regions. On the other hand, there are imbalances in the EU, which threaten the convergence path:

Table 1: Threatens to E.U. regional convergence

Regional level	Threatens
• at EU level	• high concentration of economic activity and population in the central metropolitan areas, which account for the major percentage of population, GDP and R&D expenditure.
• at national level	• persistence of pronounced imbalances between the main metropolitan areas and the rest of the country in terms of economic development.
• at regional level	• persistence of territorial disparities beyond those measured by GDP or unemployment, such as, social exclusion, inadequate economic links and falling population.
• within regions and cities	• development of poverty and social exclusion in areas with often only limited availability of essential services.
• in specific areas constrained by geographical features (islands, sparsely populated areas and certain mountain areas)	• declining population and ageing, while accessibility continues to be a problem and the environment remains fragile and threatened.
• in outermost areas, with a cumulation of natural and geographical handicaps	• continuation of severe social and economic problems which are difficult to tackle because of their remoteness, isolation, topological features, climate, small size of market and dependence on a small number of products.

Source: Adaptation from the Third Report on Economic and Social Cohesion, 2004

Within this framework, the enhancement and convergence of growth and productivity are a major topic in the economic and social policy agenda of E.U. members, since governments seek to concentrate on problems not only related to growth, such as low employment growth, high unemployment, fiscal deficits and public debt, but also to regional disparities and convergence attainment.

In today's globalized markets, economies all over the world are described taking part in a race seeking the most appropriate and effective ways that could provide them with the strengths and opportunities necessary to obtain and sustain a competitive advantage over their rivals, trying intensively to find new investment opportunities and new channels for their products. Due to this competitiveness race, productivity enhancement is of great importance for the economic development in the face of uncertainties generated by

international competition. That is the reason why countries are struggling to maintain and also accelerate their growth rates.

Within this framework, in March 2000, at the Lisbon Summit, the European Union set itself the goal of becoming the most competitive and dynamic knowledge-based economy in the world, capable of sustained and sustainable economic growth and closer regional as well as social cohesion. At the Lisbon European Council, the EU defined a comprehensive strategy aimed at long term economic growth, full employment, social cohesion and sustainable development in a knowledge based society. Into doing, it has identified a number of priorities:

Table 2: Economic development priorities

Priority	Means and actions
• give priority to innovation and enterprise	• creating closer links between research institutes and industry, developing conditions favorable to R&D, improving access to finance and know-how and encouraging new business ventures;
• ensure full employment	• by emphasizing the need to open up employment opportunities, to increase productivity and quality at work and to promote lifelong learning;
• ensure an inclusive labor market	• unemployment is reduced and social and regional disparities in access to employment are narrowed;
• 'connect' Europe	• closer integration and by improving transport, telecommunications and energy networks;
• protect the environment	• stimulates innovation, and to introduce new technologies, for example, in energy and transport.

Source: Adaptation from the Third Report on Economic and Social Cohesion, 2004

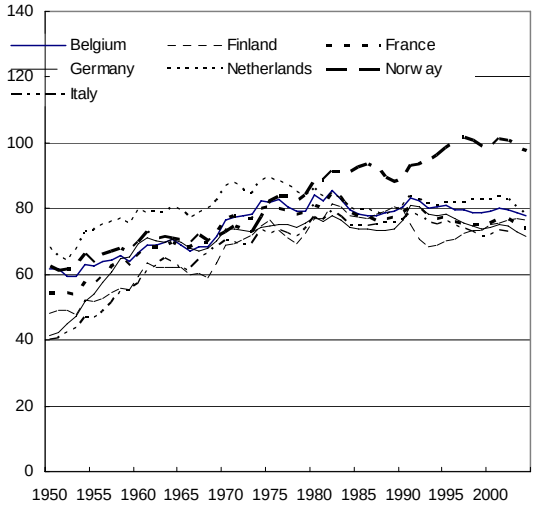
Regarding the so-called development race, productivity enhancement is a major element towards economic growth and development. Economies increase their productivity in two ways—micro and macro[2]. Microeconomic gains take place within an enterprise as it invests, trains workers, innovate and competes. Macroeconomic gains occur when the overall economy reorganizes and shifts resources so they produce more than before. Within this micro and macro framework, productivity has always played a leading role in raising economic growth and development, by boosting output, improving quality, and saving time and other resources. As companies and workers become more efficient, the economy reallocates resources to more productive uses, either in existing companies or new ones. As the market recycles workers and other resources, the economy grows. The payoff from productivity growth could be summarised in higher GDP, more leisure time,

[2] 2003 annual report – federal reserve bank of dallas, a better way productivity and reorganization in the American economy

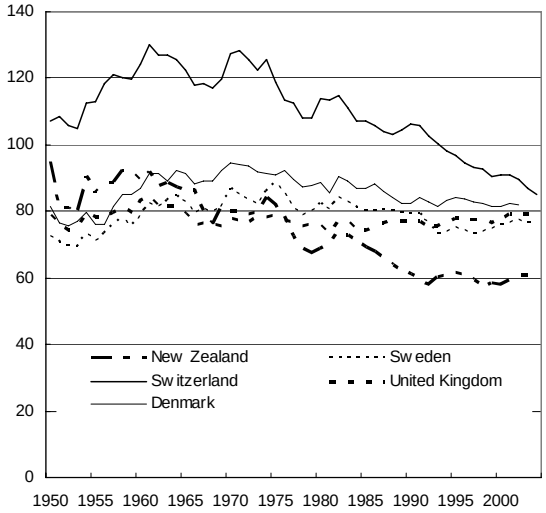
better working conditions, new and improved products, more variety, greater safety and security, as well as cleaner environment[3].

Figure 2: Levels of GDP per capita and GDP per hour worked, 1950-2004 | Catch-up and convergence in OECD income levels, 1950-2004, United States = 100.

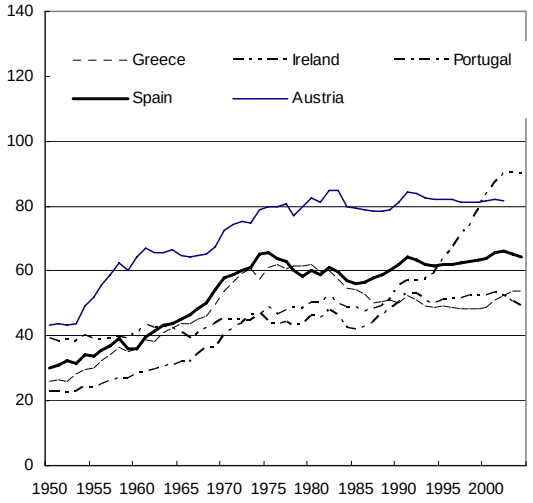
Medium rates of catch-up (< = 1.1% annually)



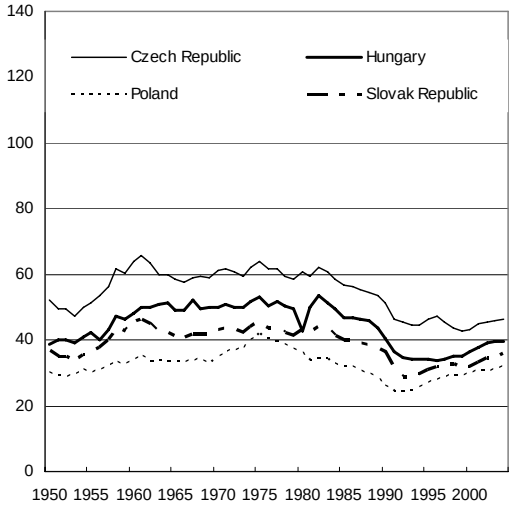
High-income, no catch-up (< 0.1% annually)



Rapid catch-up (> 1.1% annually)



Low starting point, low rates of catch-up (< 0.4% annually)



Source: 2004 productivity levels from previous years based on OECD productivity database and Angus Maddison (2001), The World Economy: A Millennial Perspective, Development Centre Studies, OECD, Paris.

[3] A better way, productivity and reorganization in the American Economy, 2003 annual report, Federal Reserve Bank of Dallas

Within this framework, development and innovation consist two of the core subjects both in economic and political debates and analyses. In the modern economy era, there is an increasing interest in the contribution of knowledge in the sustainable long-term economic growth, taking into consideration the need that the modern capitalistic competition forces the enterprises to import technological innovations, that increase the productivity, or to adopt other strategies of organization for the growth of their activities and their purchases (Kourliouros, p. 156).

The developments in the theory of economic growth have renewed the interest for the role that the innovation plays in the development process, underlining the interaction between the investment in innovative activities, the technological change and the economic growth. Technological change and the effects on productivity level have been analysed, among others, by Mansfield (1968). The base for this analysis was provided by the main sources of economic growth:

- Increase in the productive base in order to increases the productive possibilities of the economy within a time period (as, for example though increases in total work force or Gross Fixed Capital formation)
- economies of scale that are related with increase in the factors of production
- technological progress

Technology and innovation play an important role in the creation of wealth and economic growth and technology has become one of the most important factors in the models of growth (Geroski and Machin, 1993, Barro and Sala-i-Martin, 1995, 1997, Freeman and Soete, 1997, and Sternberg, 2000)[4]. The role of innovation is multiple: as motive force it directs the enterprises to ambitious and long-term objectives, it leads to the renewal of methods of production, supply and distribution, and management and marketing, as well as industrial structures and the appearance of new sectors of economic activity, achieving a wider spectrum of products and services, as well as relative markets. Inputs affect the intermediate inputs, which consequently affect and define the productivity and competitiveness level. Technological change, innovation and technology creation and diffusion are an important factor to economic progress. While innovation may lead to divergence between firms or nations, imitation through diffusion and dissemination tends to erode differences in technological competencies, and hence lead to convergence (Fagerberg and Verspagen, 2002). On the other hand, combining the production functions in order to create and disseminate innovations leads to improvements in productivity and economic development (Malecki and Varaia 1986; Malecki 1991, Fagerberg and Verspagen, 2002).

[4] Arrow (1962) was the first to systematically appreciate the importance of innovation and technological change in the capital formation and economic growth. He observed that increases in income per capita couldn't be explained by increases in capital to labour ratio, and concluded that the power behind the increase in productivity is the acquisition of knowledge and learning experience created and acquired during the production procedure.

The economic processes that create and diffuse the new knowledge are critical in the development process and there are powerful contacts between the investment in the human capital, the technological change and finally the economic growth (Acs, Anselin and Varga, 2002). As a motive force, it prompts the enterprises to long-term development objectives and the advancement of productive structures, so that they maintain the elements of growth, competitiveness and employment. Investments in new technologies aim to the modernisation of productive process and the qualitative upgrade of products, which is one from the basic factors of increase of enterprises. The reason is that the new technologies lead to increase of productivity of factors of production, contributing in the long-term improvement of competitiveness (Griliches, 1980). The technology, also, contributes in the growth of economy, on the one hand because the new or improved products that result from innovations improve the level of existence, and on the other hand, because, with regard to the international trade, the record of open economy depends also from the propensity to innovativeness (Fagerberg, 1988). One additional reason is that via innovation the individual and collective needs are satisfied better which constitutes fundamental element of entrepreneurial spirit. The same holds also for countries and economies, which in order to maintain the elements of growth, competitiveness and employment, owe to change fast the new ideas in technical and commercial successes (Korres and Tsompanoglou, 2004).

Innovative actions are considered to be rather important to economic growth, development and welfare. Firstly, they stimulate investments which introduce new commodities and processes, which improve the living standards of the society. Moreover, they lead to new developments, which increase the comparative advantage of an economy and affect positively the trade performance and competitiveness of a country worldwide. These effects result in a greater level of economic growth. On the other hand, innovation is rather important to an individual firm for two main elements, namely a double role in the incentives of the companies to pursuit and invest on it.[5] Firstly, a corporation, which undertakes R&D programmes, acquires new information and knowledge to embody in the new commodities, as well as new production and marketing processes, ready to be employed in product and process innovation. As a result, through innovation, a company is able to develop directly new products and processes and bring them to the market acquiring an advantage over its competitors. Furthermore, it can enhance the ability of the firm to develop and maintain capabilities to absorb and expand technology information available by external sources, and identify, assimilate and exploit new knowledge and technology produced elsewhere (Cohen and Levinthal, 1989).

From an economic analysis point of view, the theoretical framework of the effects of innovation on the economic efficiency, productivity and growth is based on endogenous growth theory developed by Solow, 1957, Arrow, 1962, Romer 1986 and 1990, Lucas, 1990 and 1993. Endogenous growth theory claimed that not only the accumulation of capital, but mainly the development and accumulation of knowledge and technological change leads to increased and sustainable growth.

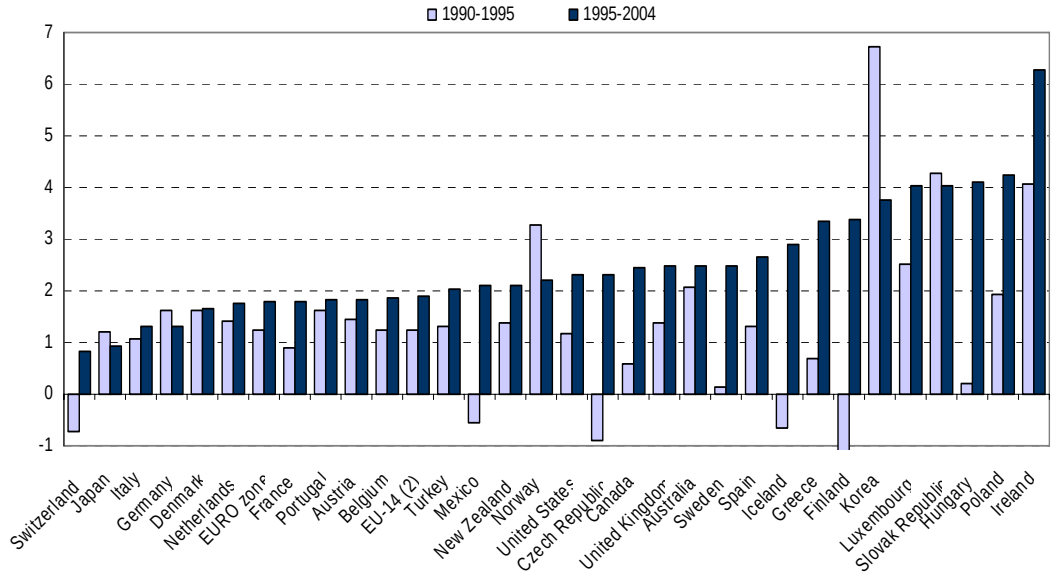
[5] Cohen and Levinthal (1989) called this double role of innovation ‘dual role’.

Endogenous growth theory, as represented by Romer (1986), takes innovation as an endogenous variable which can explain the different national growth rates and why economies, even with different rates, do not converge to long-run steady state equilibrium. The reason is that the long-run productivity decrease is avoided, due to capital accumulation through the qualitative-technological improvements of natural and human capital. According to Romer (1986, 1990), knowledge and technological progress are the main engines of economic dynamism and the economy grows endogenously through the accumulation and spillover of knowledge. Growth rate depends on the amount of technological activity within the economy and on the ability of the economy to exploit external technological achievements (Martin and Ottaviano, 1999, Grossman and Helpman, 1994, Coe and Helpman, 1995). Increasing returns and technical change are incorporated within the production function as determinants of the endogenous growth rate (Romer 1986, Lucas 1988, Grossman and Helpman 1994, Barro and Sala-i-Martin, 1997) and economic growth is sustained because of the continuous creation and diffusion of knowledge.

An important contribution of the endogenous growth theory (Romer, 1987 and 1990) has been to identify the central role that knowledge and knowledge spillovers play in creating and sustaining growth. Pavitt and Soete (1982) examined growth as a result of the development of new knowledge in a country and the diffusion of knowledge between countries. According to Fagerberg (1987) there is a close relation between a country's economic and technological level of development. The rate of economic growth of a country is positively influenced by technological level of the country and its ability to increase it through imitation and exploitation of the possibilities offered by technological achievements elsewhere. Krugman (1991) identified the major role that knowledge spillovers play in generating increasing returns and higher growth. Geroski and Machin (1993) asserted that innovations positively affect the development of enterprises and economies. Moreover, according to Silverberg and Verspagen (1995), technological change and diffusion constitute important factors in long-run macroeconomic growth and development. Moreover, Barro and Sala-i-Martin (1995 and 1997) asserted that growth rate may increase in correlation with technological growth. Furthermore, Freeman and Soete (1997) focused on the importance of technology and innovation claiming that lack of innovation leads to economic death. At the same point of view, Sternberg (2000) said that in industrialized economies the rate of long-term macroeconomic growth depends on the ability of constant development of innovative products and processes.

2. Growth Rates and the relation with Productivity and Innovation

Figure 3: Growth in GDP per capita, 1990-1995 and 1995-2004
(Total economy, percentage change at annual rate)

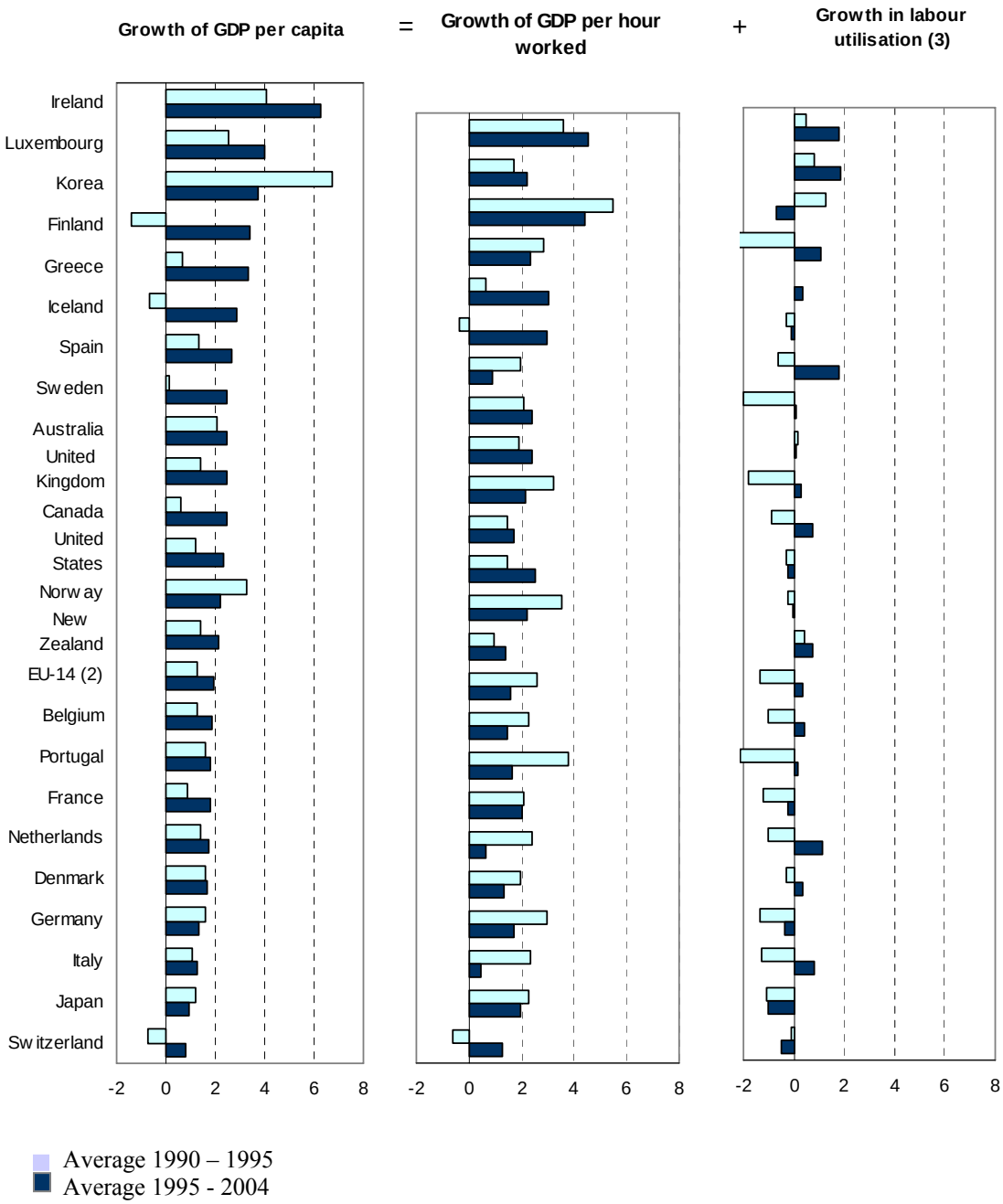


Source: OECD, Productivity Database, July 2005

Estimates of the increase in GDP per capita for EU countries for 1990-1995 and 1995-2004 show that rates of growth in GDP per capita were high for both periods in Ireland, Luxembourg and the Slovak Republic. In most EU countries, growth of GDP per capita was higher from 1995-2004 than from 1990-95. The Czech Republic, Finland and Hungary were the countries with the largest improvement over the period. In a few countries, such as Germany and Norway, growth of GDP per capita was lower over 1995-2004 than from 1990-95 (OECD 2005, Economy-Wide Indicators Of Productivity).

The long-term economic objective is to achieve high and stable rates of economic growth and employment. Increasing productivity is the driving force behind this, and the route to higher prosperity. Economic growth is driven by a combination of employment growth and productivity growth. The growth in GDP per capita can be broken down in a part which is due to labour productivity growth and a part that is due to increased labour utilisation, measured as hours worked per capita:

Figure 4: Growth in GDP per capita, the contribution of productivity and labour utilisation (Total economy, percentage change at annual rate)



Source: OECD, Productivity Database, July 2005

Estimates of the increase in GDP for OECD countries for 1990-1995 and 1995-2004 show that rates of labour productivity growth were higher in Korea and Ireland. For 1995-2004, the Slovak Republic also had very high productivity growth. Labour productivity growth has varied considerably over the past 15 years. In Greece, Iceland,

Ireland and the United States, it grew much faster from 1995-2004 than from 1990-1995. In other OECD countries, notably Belgium, Germany, Italy, the Netherlands, Norway, Portugal and Spain, it slowed down over the period. With the slowdown of the world economy since 2000, most OECD countries have experienced a marked slowdown in labour productivity growth, some European countries, notably the Czech Republic, Iceland and Spain being the main exceptions.

Growing labour utilisation has had considerable impacts on the growth of GDP per capita. In the first half of the 1990s, most OECD countries, in particular many European countries were characterised by a combination of high labour productivity growth and declining labour utilisation. The high productivity growth of these EU countries may thus have been achieved by a greater use of capital or by dismissing (or not employing) low-productivity workers. In the second half of the 1990s, many European countries, improved their performance in terms of labour utilisation, as unemployment fell and labour force participation increased. However, the growth in labour utilisation was accompanied by a sharp decline in labour productivity growth in many European countries. In contrast, some other OECD countries, such as Canada and Ireland experienced a pick-up in both labour utilisation and labour productivity growth from 1990-95 to 1995-2004, showing that there need not be a trade-off between labour productivity growth and increased labour use[6].

There are many different measures of productivity growth[7]. Broadly, productivity measures can be classified as single-factor productivity measures (relating a measure of output to a single measure of input) or multi-factor productivity measures (relating a measure of output to a bundle of inputs). Adopting such a set of indicators relating to the areas that are most important for productivity may make it easier to present a clear picture of the member states performance relative to their major competitors[8].

MFP is commonly defined as the portion of output growth left after accounting for growth in capital and labour, where both capital and labour are expressed in quality-

[6] Source: OECD 2005, Economy-Wide Indicators Of Productivity

[7] An examination of income and productivity levels may give insights into the possible scope for further gains, and also places a country's growth experience in the perspective of its current level of income and productivity (OECD, Internet site, at: www.oecd.org/statistics/productivity). Productivity growth is the basis for improvements in real incomes and welfare. Slow productivity growth limits the rate at which real incomes can improve, and also increases the likelihood of conflicting demands concerning the distribution of income (Englander and Gurney, 1994). Measures of productivity growth and of productivity levels therefore constitute important economic indicators, describing the relationship between output and the inputs that are required to generate that output. International comparisons of productivity growth can give useful insights in growth processes, but should ideally be complemented with international comparisons of income and productivity levels. An examination of levels gives insights into the possible scope for further gains, and also places a country's growth experience in the perspective of its current level of income and productivity.

[8] Productivity in the UK 5: Benchmarking UK productivity performance A consultation on productivity indicators Department of Trade and Industry contacts This document can accessed from the DTI Internet site at: www.dti.gov.uk

adjusted terms[9]. This measure captures disembodied technological and organisational improvements that increase output for given amount of inputs. Multifactor productivity is designed to measure the joint influences of economic growth on technological change, efficiency improvements, returns to scale, reallocation of resources, and other factors, allowing for the effects of capital and labor[10]. Firms compete and increase productivity by improving business processes, creating technological innovations, investing in useful business assets, educating employees, and trading for goods and services. Our economy becomes more productive through reorganizing capital goods, labor skills and new technology and trading with other countries[11]. A change in multifactor productivity reflects the change in output that cannot be accounted for by the change in combined inputs. As a result, multifactor productivity measures reflect the joint effects of many factors including new technologies, economies of scale, managerial skill, and changes in the organization of production. Inputs are weighted together using cost weights representing each input's share of total output to develop the combined inputs index. Although the industry multifactor productivity measures relate output to a combination of several categories of inputs, they still reflect the impact of many other influences such as economies of scale, capacity utilization, and skill and effort of the work force as well as technological change. Multifactor productivity measures can be thought of as labor productivity measures adjusted to remove the effects of changes in capital per hour and intermediate purchases per hour[12].

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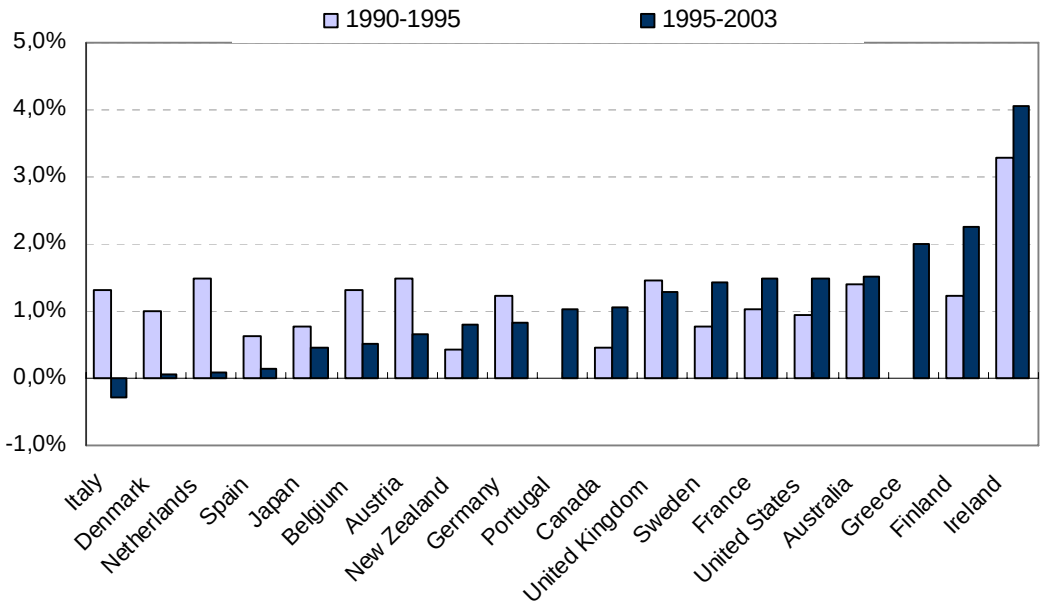
[9] Solow focused on growth measurement combining economic growth and technological development in the U.S. economy. He used the technique of Growth Accounting to break down growth in U.S, labour productivity into components. According to Barro and Sala - i – Martin (1995), Growth Accounting is the section of bibliography used in order to explain economic growth by examining the empiric force of neo – classical Solow model, defining how much from the growth is owed in the increase of surge of capital (gK), surge of work (gL) and technological progress (gA). According to the theory of "Growth Accounting", GDP in a economy can be explained mainly from factors, as the total formation of capital, the size and quality of workforce and the available technology. This method allows the growth in production and labour productivity to be decomposed into growth of the factor inputs and growth in total factor productivity, TFP. Total factor productivity, represents the change in the product that is not explained by the level of surges (capital and work). This size measures the technology used, that is to say "Solow residual". Growth accounting provides an additional tool to assess changes in economic growth, productivity and competitiveness. Economic growth can be increased in several ways; by increasing the amount and types of labour and capital used in production, and by attaining greater overall efficiency in how these factors of production are used together, *i.e.* higher multi-factor productivity.

[10] Internet address: http://www.bls.gov/mfp, The Bureau of Labor Statistics of the U.S. Department of Labor

[11] Kedrova, Julia (2004), "Measuring Productivity," Federal Reserve Bank of Dallas *Expand Your Insight*, June 2004, http://www.dallasfed.org/eyi/free/0406product.html , Free Enterprise, Measures of Productivity, Julia Kedrova looks at measures and limitations of overall business sector and industry productivity.

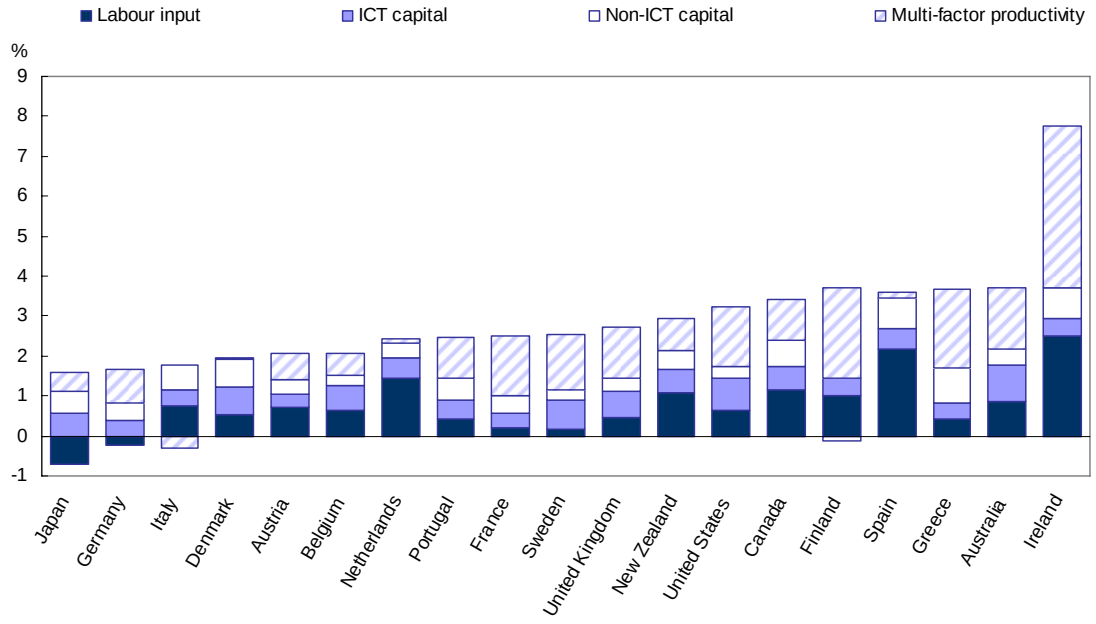
[12] www.bls.gov

Figure 5: Multi-factor productivity growth, 1990-1995 and 1995-2003 (In percentage points)



Source: OECD, Productivity Database, September 2005

Figure 6: Contributions to GDP growth, all OECD countries (Annual average growth in percentage points, based on cost shares and hedonics, 1995-2003)



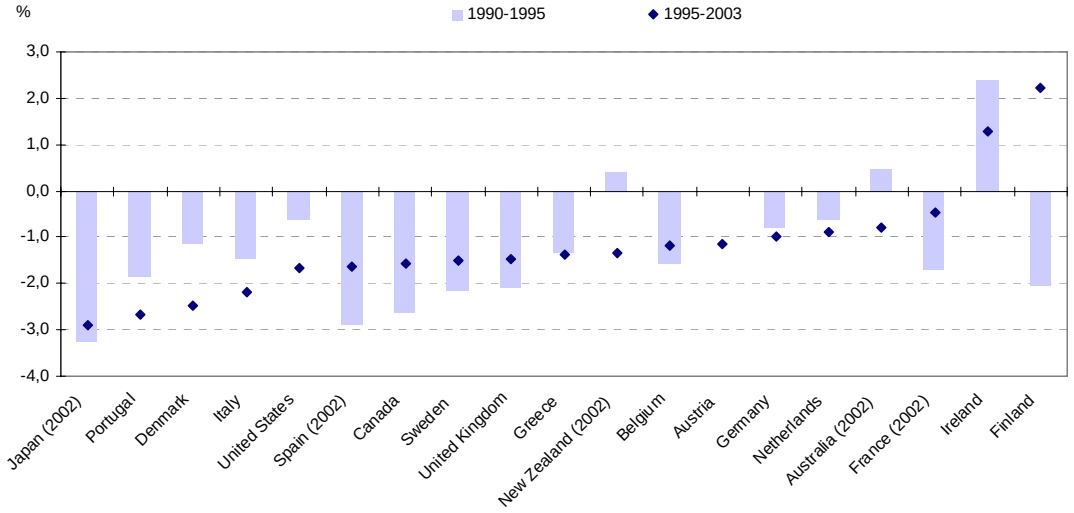
Source: OECD, Productivity Database, September 2005.

In terms of economic theory, growth rate is considered to be the result of a wide range of economic, social and political factors. Firstly, economic growth may be the result of physical, as well as human capital accumulation (Jones and Manuelli, 1990; Rebelo, 1991). Secondly, economic growth may be attributed to the existence of external economies and the interactions among the investments of different private or public enterprises and business entities (Arrow, 1962, Lucas, 1988). Thirdly, growth may result from the creation and adoption of new ideas and the accumulation of technological knowledge (Romer 1990, Grossman and Helpman 1991, and Aghion and Howitt 1992).

Growth rate may be the result of physical capital accumulation

Investment in physical capital plays an important role in labour productivity growth. Capital deepening expands and renews the existing capital stock and enables new technologies to enter the production process.

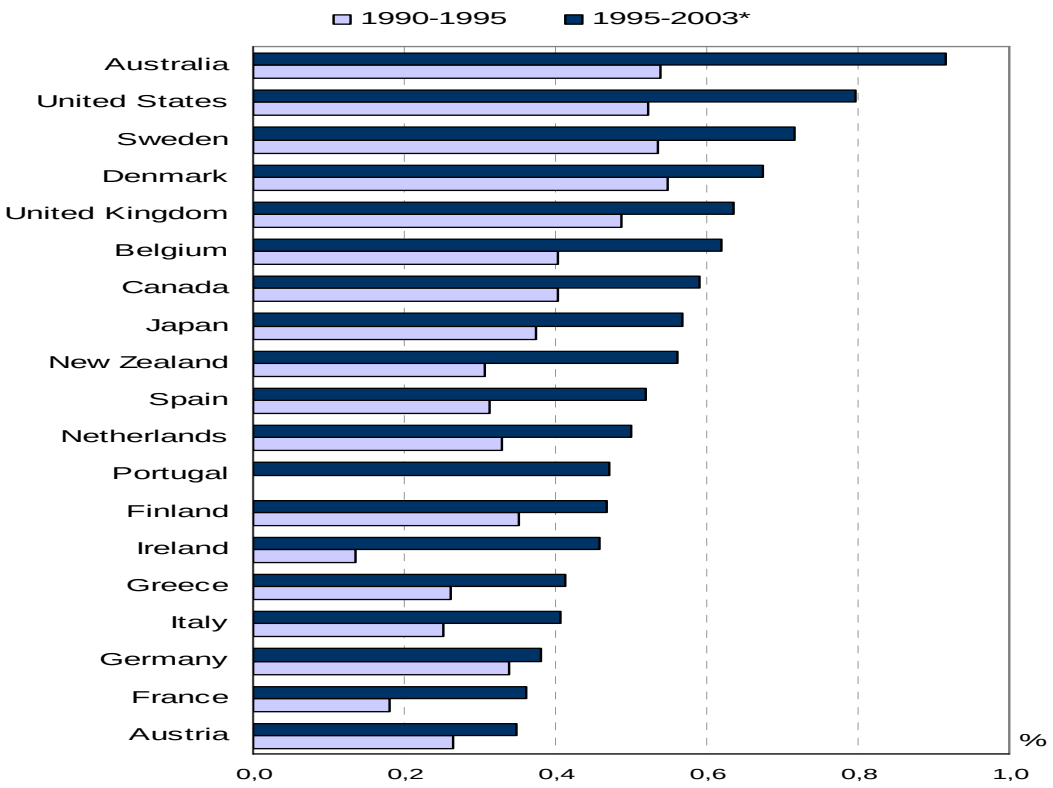
Figure 7: Growth in capital productivity, 1990-1995 compared with 1995-2003, capital per hour worked, average annual growth rates



Source: OECD Productivity database: Sep. 2005

While some countries have experienced an overall increase in the contribution of capital to growth over the past decade, ICT has typically been the most dynamic area of investment. This reflects rapid technological progress and strong competitive pressure in the production of ICT goods and services and a consequent steep decline in prices. This fall, together with the growing scope for application of ICT, has encouraged investment in ICT, at times shifting investment away from other assets.

Figure 8: Growth accounts, the contribution of ICT capital, 1990-1995 and 1995-2003
(In percentage points)



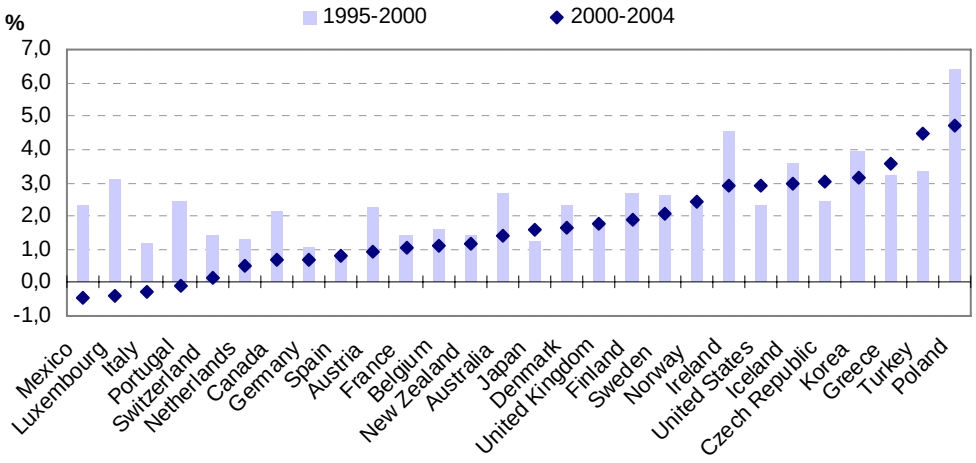
Source: OECD, Productivity Database, September 2005

Information and communications technology (ICT) has brought both new opportunities and challenges for businesses and represents a new factor of regional competitiveness. For regions, ICT has increased the pace of change with potentially profound effects on living and working conditions and on the territorial distribution of economic activity. From a cohesion perspective, ICT seems to offer a major opportunity for reducing the 'friction of distance and the problems of remoteness which many peripheral regions — and even more, outermost areas —suffer from. At the same time, however, there is growing concern over the territorial dimension of the so called 'digital divide' and a fear that restrictions on access to ICT networks or limitations in the ability of enterprises and households to use the new technology could serve to widen rather then narrow disparities in regional performance. Although the pattern of development of different aspects of ICT varies, a number of regional disparities are already evident, taking into account that there is a north-south divide in the present EU in the development of most of the new technologies, which is broadly to a divide between cohesion and non-Cohesion countries;

Growth rate may be the result of human physical capital accumulation

Disparities in income and employment across the European Union have narrowed over the past decade, especially since the mid-1990s. Between 1994 and 2001, growth of GDP per head in the Cohesion countries, even excluding Ireland, was 1% a year above the EU average, and the proportion of working-age population in employment in all apart from Greece increased by much more than the average[13]. In Greece, on the other hand, as in Ireland, growth of labour productivity was over twice the EU average over this period and it was also well above average in Portugal. In these two countries, therefore, the productive base seems to have been strengthened, increasing the potential for continued convergence in income in future years[14].

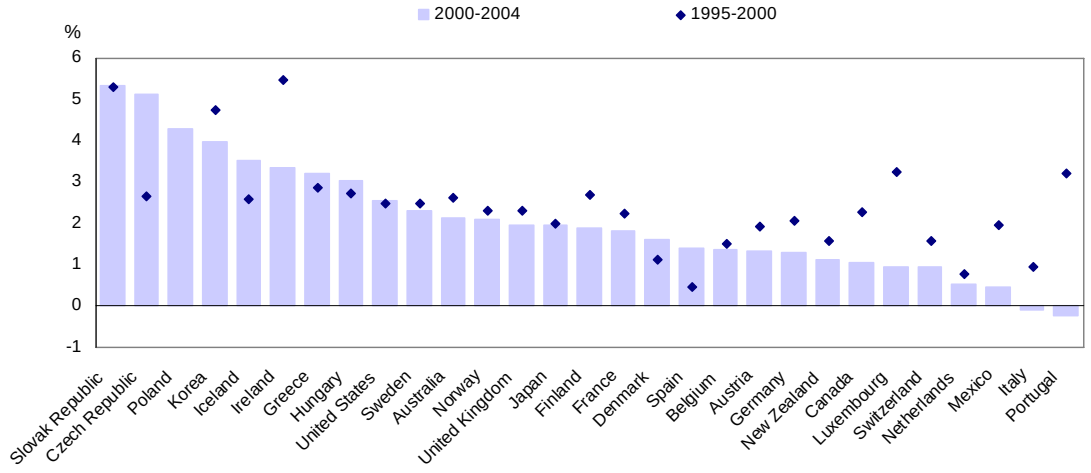
Figure 9: Growth in GDP per employee, 1995-2000 compared with 2000-2004
Percentage change at annual rate



Source: OECD, Economic Outlook 76, 2005

[13] Third Cohesion Report, 2004
[14] Third Cohesion Report, 2004

Figure 10: Growth in GDP per hour worked, 1995-2000 compared with 2000-2004 Percentage change at annual rate



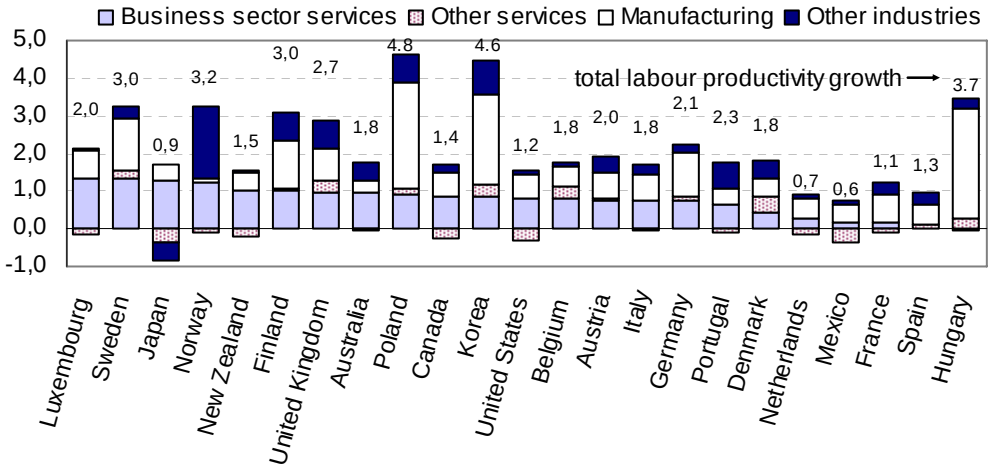
Source: OECD, Productivity Database, July 2005; Annual National Accounts Database, May 2005.

Growth rate may be the result of the existence of external economies and the interactions among the investments of different private or public enterprises and business entities

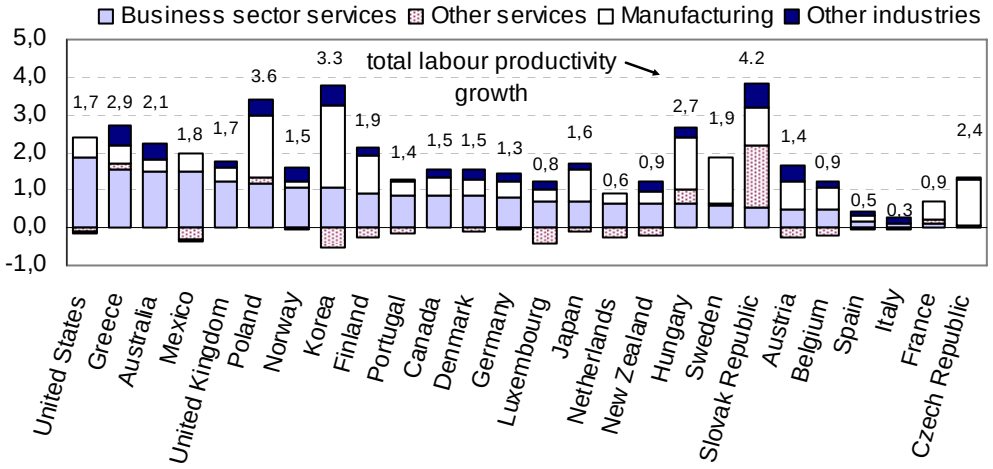
As far as the sectoral contribution to growth is concerned, the role of each kind of production sectors is demonstrated in the following figures, giving the contribution o0f each sector to the total labour productivity growth:

Figure 11: Contribution of key activities to aggregate productivity (value added per person employed) growth (Annual average growth and contributions in percentage points, 1990-1995 and 1995-2003)

1990-1995



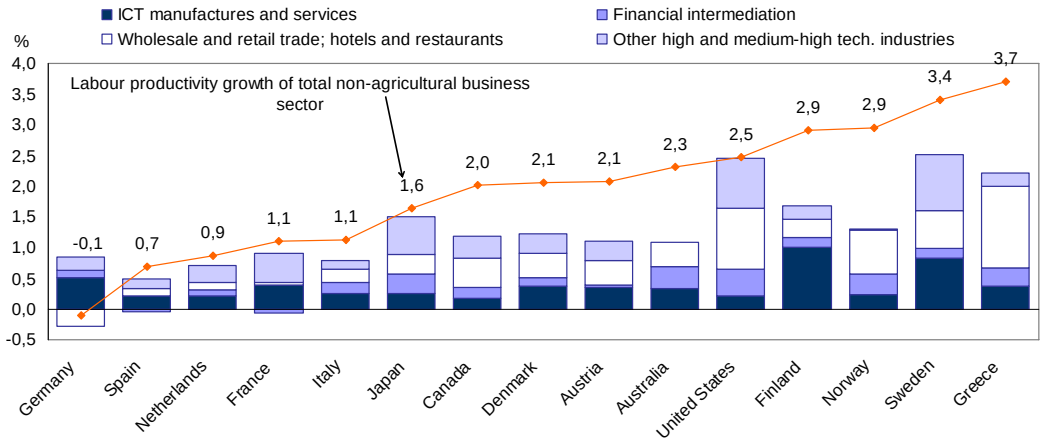
1995-2003



Source: OECD, STAN, STAN Indicators Databases, August 2005

The same picture holds in examining the contribution of the main business sectors to the productivity growth within an economy. As indicated by the following figure, ICT manufactures and services, as well as high and medium – high technology industries are the sectors which are mostly responsible for the labour productivity enhancement. R&D activity tends to vary with firm size, particularly in manufacturing. Regions with a high concentration of manufacturing employment in small firms, which are predominantly in the south of the EU, tend to have low rates of expenditure on R&D. In 2000, the share of employment in manufacturing in firms with fewer than 50 people employed amounted to 47% in Portugal, 53% in Spain and 56% in Italy (no data available for Greece) as compared with only 27% in the rest of the EU. Moreover, within these countries, the share of employment in small firms are even larger in the weaker regions—over 60% in Objective 1 regions in southern Italy and 65% in those in Spain, according to estimates. This disparity in firm size between regions is equally evident in the rest of the EU. In Germany, for example, small firms account for a third of employment in manufacturing in the new Lander as against around 20% in the rest of the country.

Figure 12: Contributions of key sectors to labour productivity growth in the non-agricultural business sector (Contributions to average annual growth rates), 1990-2003



Source: OECD, STAN, STAN Indicators Databases, May 2005.

Growth rate may be the result of the creation and adoption of new ideas and the accumulation of technological knowledge

There seems now to be a broad consensus that the productivity growth of the modern economies accelerated in the second half of the 90s, perhaps due to the industrial revolution based on innovation. Within this framework, development and innovation consist two of the core subjects of economic theory[15]. Indeed, there is a substantial body of empirical studies supporting what is called the New Economy view[16]. Among them, Oliner and Sichel (2001), Jorgenson and Stiroh (2000) are frequently cited empirical studies reporting the positive effects of innovation on productivity growth in the late 90s[17].

[15] Adam Smith (1895, edited in 1937) was the first to form a theory of technological change and economic development and growth and recognized the significance of technological progress in relation to wealth increase. However, the first approach towards the definition of innovation is given by Schumpeter (1934), who emphasized on innovation as basic source of economic dynamism in capitalistic social and economic development.

[16] In addition to these aggregate level empirical studies, Stiroh (2001) examines the role of IT capital and labor productivity based on industry level data to conclude that IT use is closely related to (labor) productivity gain and such IT oriented productivity growth is widespread throughout the economy. As Stiroh (2001) states, however, not everyone is convinced. From this standpoint, Gordon (2000, 2003), for example, argues that the majority of the higher growth of U.S. productivity in the late 90s is due to cyclical utilization and, therefore, adopts a sceptical view of the New Economy arguments.

[17] Solow (1956, 1957), Abramovitz (1986), Jorgenson in Jorgenson, Gollop & Fraumeni (1987) defined as the main productive inputs in the economic system the capital, the labour and technology or technological change, responsible for the ¾ of development[17], indicating that almost all growth in the U.S. economy was due to technological developments and very little to capital deepening[17]. Solow (1956) formatted the neoclassical model of economic growth in which technological progress is regarded as a source of

In their drive to boost innovation, several OECD countries, including the European Union, have introduced formal R&D targets over the past decade (Sheehan and Wyckoff, 2003). While some doubts can be raised about the usefulness of such targets for economic growth, achieving R&D targets typically primarily involves increases in business R&D (Figure 9). Indeed, in most of the countries with high R&D intensity, the business sector is the main source of R&D, with much of this concentrated in a number of high-technology sectors and in a number of large, often multinational, firms. Increasing business R&D thus has close links with broader structural changes in economies, and is thus not an objective that can be achieved in isolation, for convergence to be achieved.

Several indicators are presented below.

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development which increases the productive capability. Solow (1956, 1957) incorporated the Cobb – Douglas production function within the economic development theory. According to Solow (1957), the production function is:

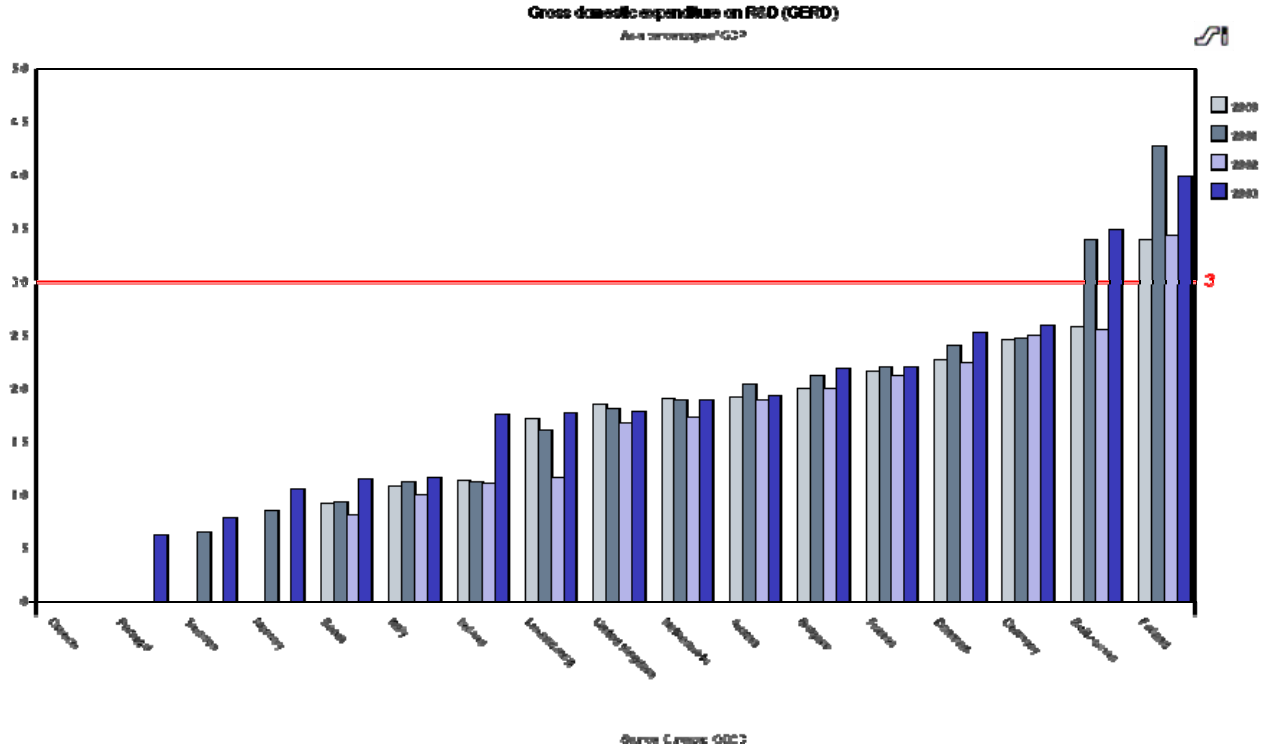
$Q(t) = A(t)\, F(K(t), L(t))$

Technological progress A(t) is outside the production function:

$Y = A(t) f(K, L)$

Where $A > 0$ and $dA/dt > 0$, and A is the parameter of technological progress

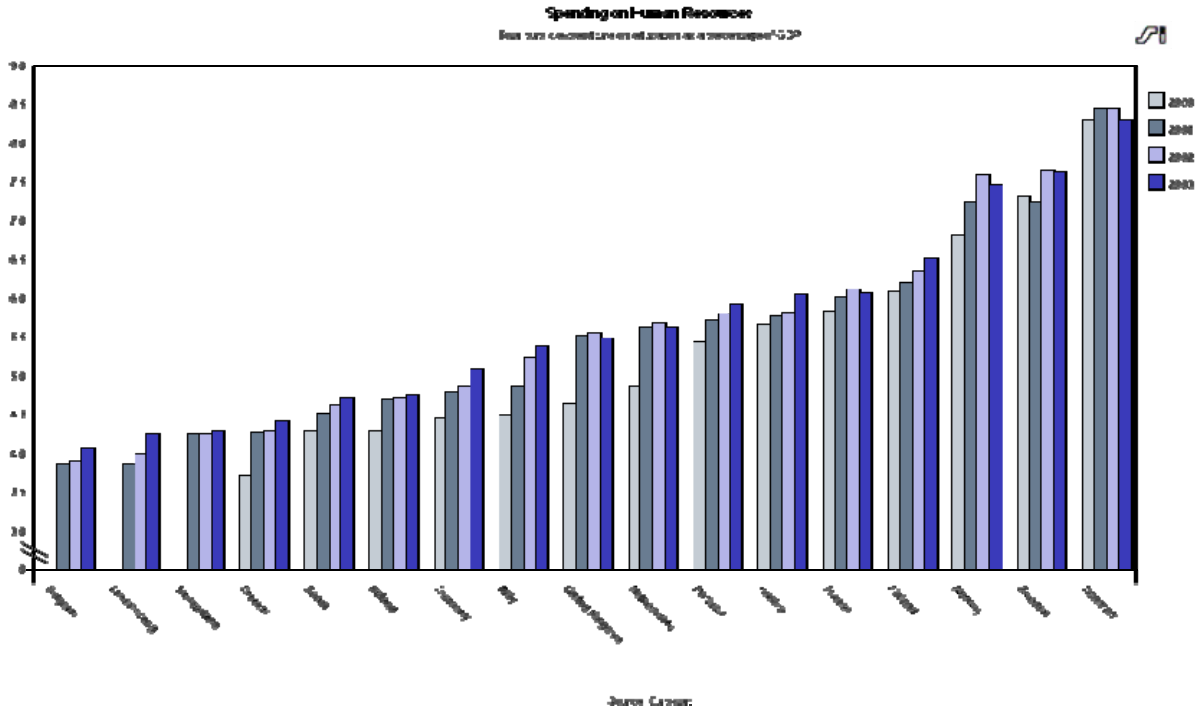
Figure 13: Gross domestic expenditure on R&D, total, 2000 - 2003



Source: Eurostat website, 2006

The picture they show is not new, but it confirms the extent of relative disadvantage of regions in the accession countries, as well as those currently designated as Objective 1. Various indicators, however — the relative scale of R&D expenditure, employment in research activities and the number of patent applications, in particular—suggest that there is a wide gap in innovative capacity between the stronger regions in central parts of the Union and others. There is also a similarly wide disparity both between the accession countries and the EU15 average. Both R&D and high-tech activities are highly concentrated in the core regions of the present EU. In 1999, just 8 regions in the present EU accounted for over a quarter of total R&D expenditure in the Union and 30 were responsible for approximately half. As might be expected, there is a similar concentration of patents—an indicator, if only a partial one, of the output of innovation— with half of all high-tech applications to the EU Patent Office being made in just 13 core regions(Map A1.9).

Figure 14: Spending on Human Resources, 2000 - 2003

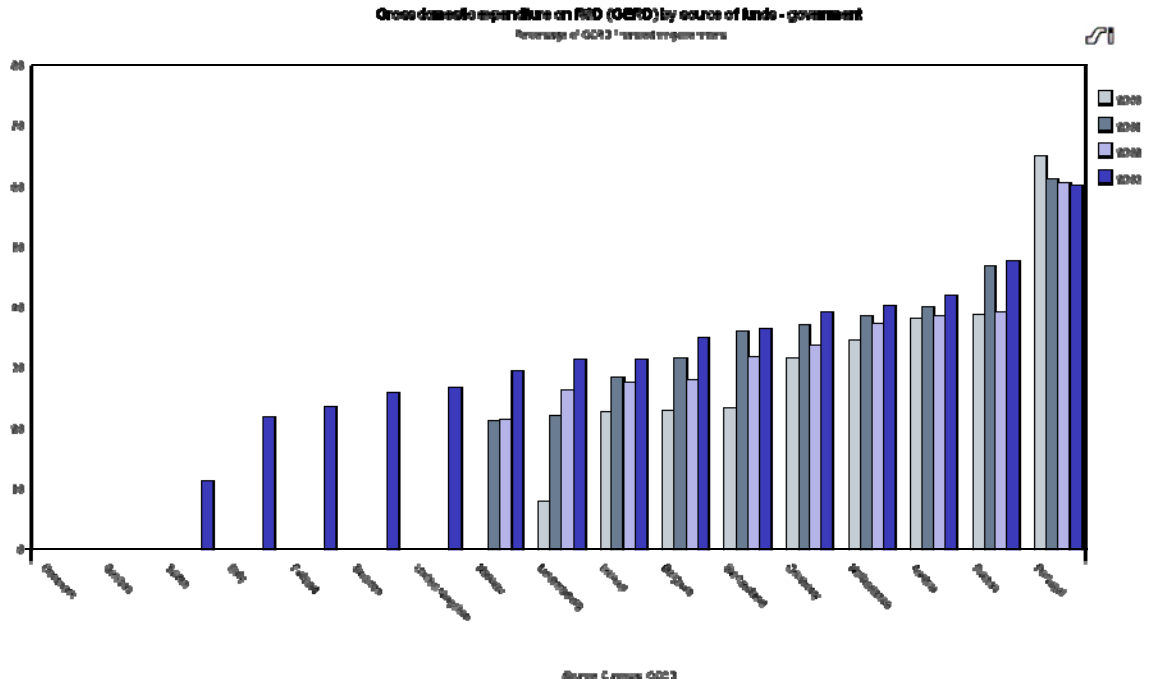


Source: Eurostat website, 2006

Moreover, employment growth in the EU tends to be concentrated in knowledge-intensive activities, which means that regions in which such activities are concentrated are not only likely to gain in competitiveness but they are better placed to generate new jobs. Overtime, this could lead to an increasing concentration of these activities in the stronger regions and widening disparities between these and other regions.

Government expenditure on R&D is much more similar between regions. Nevertheless, it was still slightly smaller in relation to GDP in Objective 1 regions in 1999 than in other areas (between 0.15% in Spain and Greece and 0.21% in Portugal as against an EU average of 0.27% in 1999 and, therefore, does not begin to compensate for the huge difference in the scale of business spending. This also applies, to a larger extent, to expenditure in higher education, which was much the same in Objective 1 regions as in others (around 0.4% of GDP).While there was some increase in business expenditure on R&D in Objective 1 regions between 1995 and 1999, this was slightly smaller in relation to GDP than the growth in non-Objective 1 regions (though spending increased by more in percentage terms in the former than the latter). At the same time, government expenditure rose relative to GDP in Objective 1 regions while in other areas, it fell.

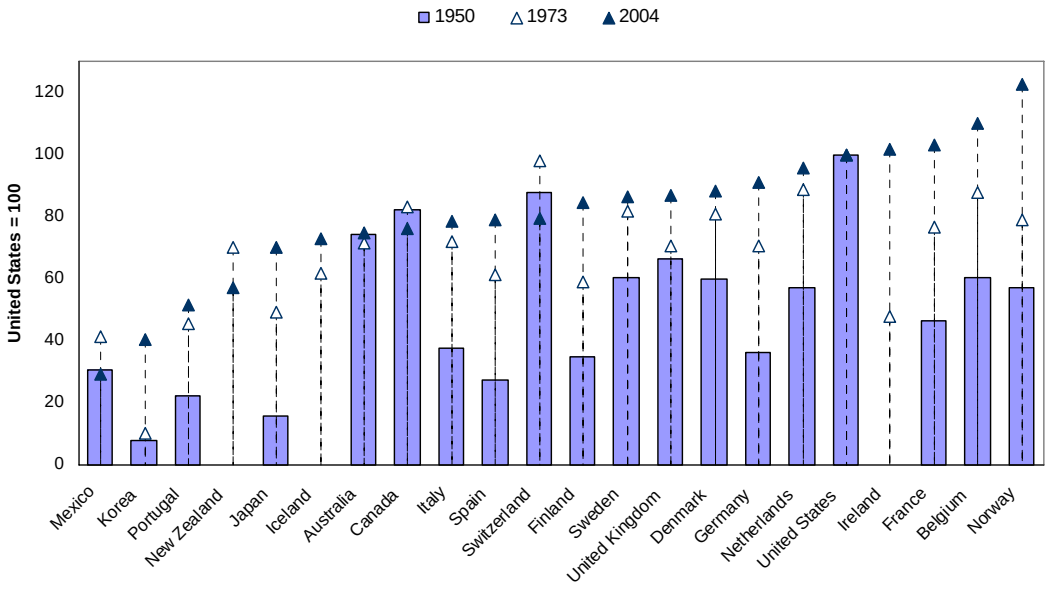
Figure 15: Gross domestic expenditure on R&D, by government, 2000 - 2003



Source: Eurostat website, 2006

It is also important to highlight the differing levels of support which Member States provide to businesses in the form of state aid for R&D 19. Governments in the more prosperous countries, with a few notable exceptions, give substantially more support for the expenditure which companies undertake than those in less prosperous ones. According to the latest data, the scale of support, varied from well over EURO 300 per person employed in manufacturing in Finland and Austria to only EURO 28 in Portugal and just EURO 12 in Greece. (Table A1.9). Firms in less favored regions suffer from being isolated from the best international R&D networks and research centers developing new technologies 20. Sees in these regions, in particular, have difficulty in finding out about the latest technological developments and how to use these and in making contact with suitable partners elsewhere.

Figure 16: GDP per hour worked in the OECD area, 1950, 1973 and 2004, U.S. = 100.



Source: OECD, Productivity Database, July 2005

These territorial disparities cannot be ignored, since they affect the overall competitiveness of the EU economy. Covering costs of congestion or treating the social consequences of disparities implies a sub-optimal allocation of resources, as well as a lower level of efficiency and economic competitiveness than could potentially be attained in the regions affected. To combat territorial disparities and achieve a more spatially balanced pattern of economic development requires some coordination of development policies if they are to be coherent and consistent with each other[18]. Under these circumstances, growth rate is one of the main points in the EU political and economic agenda.

European cohesion policy makes a major contribution to these objectives, especially in those regions where there is unused economic and employment potential which can be realized through targeted cohesion policy measures, so adding to the growth of the EU economy's a whole. From a policy perspective, for regional development to be sustained requires favorable conditions being established at the national level, in particular a macroeconomic environment conducive to growth, employment and stability and a tax and regulatory system which encourages business and job creation. At the regional level, two complimentary sets of conditions need to be satisfied[19]. The first is the existence of suitable endowment of both basic infrastructure (in the form of efficient transport, telecommunications and energy networks, good water supplies and environmental facilities and so on) and a labor force with appropriate levels of skills and training, strengthening of both physical and human capital, together with improvements in

[18] Third Cohesion Report, 2004
[19] Third Cohesion Report, 2004

institutional support facilities and the administrative framework in place. The second set of conditions, which directly relates to the factors of regional competitiveness which are important in the knowledge-based economy, is that innovation should be accorded high priority, that information and communication technologies (ICT) should be widely accessible and used effectively and that development should be sustainable in environmental terms.; a business culture which encourages entrepreneurship; and the existence of cooperation networks and clusters of particular activities[20].

Table 3: Framework of productivity and competitiveness

1st phase	**Inputs** (Productivity enhancement)	• Macroeconomic, entrepreneurial and work environment • Economic and technological infrastructure • Education and skills • Entrepreneurship and business development • Innovativeness and creativity
2nd phase	**Intermediate output** (Productivity enhancement)	• Productivity • Production factors cost • Prices and wages
3rd phase	**Final output** (Competitiveness enhancement)	• Development • Employment • Living standards • Quality of life • Competitiveness

Source: Adaptation from the Ministry of Development, Greece, Annual Competitiveness Report 2004, page 4

3. Prospects

In the past decades, important changes in the pattern of economic growth in countries worldwide have taken place. Recent improvements in productivity and employment have been interpreted as a movement towards a knowledge-based economy (OECD, 2003). Currently, output and employment are expanding fast in high-technology industries such as computers and electronics, as well as in knowledge-based services such as financial and other business services. More resources are spent on the production and development of new technologies, in particular on information and communication technology. Computers and related equipment are now the fastest growing component of tangible investments. At the same time, major shifts are taking place in the labour market in particular the increased demand for skilled labour whereas demand for low-skilled workers is falling across the OECD.

[20] Third Cohesion Report, 2004

As it has been asserted in this paper, globalization and worldwide competition has shifted the comparative advantage of economies towards the factor of knowledge and innovation, where productivity based on the endogenous development capabilities plays a rather important role, as far as growth and competitiveness enhancement are concerned. In order to promote innovation activities and technological opportunities, productivity enhancement seems to have a significant to the long run performance of the economy as a whole.

As indicated above, two complimentary sets of conditions need to be satisfied for regions in the Union to sustain economic development and employment in competitive environment. The first is that they must have suitable levels of both physical infrastructure and human capital. The second is that, in the new knowledge-based economy, regions must have the capacity to innovate and to use both existing and new technologies effectively. Community enterprise, industrial and innovation policy is aimed at strengthening the competitiveness of EU producers by promoting competition, ensuring access to markets and establishing an environment which is conducive to R&D across the Union. As is recognized, a lack of innovative capacity at regional level stems not only from deficiencies in the research base and low levels of R&D expenditure but also from weaknesses in the links between research centres and businesses, and slow take-up of information and communication technologies. Knowledge and access to it has become the driving force for growth in advanced economies like the EU known-how and intellectual capital, much more than natural resources or the ability to exploit abundant low-cost labor, have become the major determinants of economic competitiveness since it is through these that economies can not only increase their productive efficiency but also develop new products. Innovation, therefore, holds the key to maintaining and strengthening competitiveness which in turn inessential for achieving sustained economic development.
To achieve both sets of conditions requires an effective institutional and administrative framework to support development. The cost of not pursuing a vigorous cohesion policy to tackle disparities is, therefore, measured in economic terms, as a loss of the potential real income and higher living standards. Given the interdependencies inherent in an integrated economy, these losses are not confined to the less competitive states but affect every state in the Union (Third Report on Economic and Social Cohesion, 2004).

Under this perspective, growth policies should focus on creating favorable environment for the co-operation between firms and institutions that support the development and exploitation of knowledge and innovation. Furthermore, policies should promote the entrepreneurial relations between firms and institutions, fostering the development and dissemination of the expertise, the mobility of human and physical capital and the enhancement of the relationships between business and research entities. Specifically, they should encourage actions such as, promoting innovation, technology transfer and interactions between firms and higher education and research institutes, networking and industrial co-operation and support for research and technology supply infrastructure.

As it has already been mentioned, innovation and technology is an important source of regional competitiveness through facilitating cooperation between the various parties involved in both the public and private sectors. In particular, they can improve collective processes of learning and the creation, transfer and diffusion of knowledge and transfer, which are critical for innovation. Such cooperation and the networks that are formed help to translate knowledge into economic opportunity, while at the same time building the relationships between people and organizations which can act as a catalyst for innovation. Such actions should extend to all the policy areas relevant for economic, scientific and social development and should ideally establish a long-term policy horizon.

This, however, needs to happen not just in central parts where productivity and employment are highest and innovative capacity most developed but throughout the Union. Countries and regions need assistance in overcoming their structural deficiencies and in developing their comparative advantages. This means, among others, that encouraging the development of knowledge-based economic activities and innovation and that particular attention needs to be given to[21]:

- developing new innovation promotion policies which focus much more on the provision of collective business and technology services to groups of firms which can affect their innovative behaviour, rather than direct grants to individual firms which tend only to reduce costs temporarily.
- developing new policies to strengthen the capacity of SMEs to innovate through business networks and clusters and improving their links with the knowledge base, including with universities and research centres.
- encouraging the development of the indigenous R&D potential of weaker regions and their capacity to adapt technological advances made elsewhere to local circumstances and needs.
- facilitating access of researchers, businesses and others in less favoured regions to international networks of excellence, sources of new technology and potential R&D partners.

These conditions are largely related to economic competitiveness and include, among others, the capacity of a regional economy to generate, diffuse and utilize knowledge and so maintain an effective regional innovation system

[21] Third Cohesion Report, 2004

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