The Knowledge Economy and Catching-up Member States of the European Union

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I. Introduction

Since the adoption of the Lisbon Strategy, transition towards a knowledge economy has become a pivotal policy area for the EU. The accession of generally less developed Member States, particularly during the last enlargement phases, has raised the challenge of reaching the Lisbon objectives of becoming the most competitive and dynamic knowledge based economy of the world. Persistent, large and even growing disparities among the EU-27 in terms of their overall development, and especially in terms of their knowledge creation, adoption and diffusion, do not bode well for the long-term growth potential of the EU, for its competitive position in the world and its resilience to shocks.

Since the early 1990's, catching-up member states of the EU have made significant progress in reducing their development gap vis-à-vis the EU average when measured by per capita GDP. But the catching-up process of these countries towards knowledge-based economies is a much slower and complex process. If not treated with sufficient policy attention, a continued lagging behind of catching-up countries with respect to their knowledge economy aspirations may lead to a Europe as a two- tier or multi-tier economy with potentially negative economic and political consequences for the EU as whole.

The overall objective of this Report is to assess the performance of the so-called catching-up Member States of the EU (in EU terminology also referred to as cohesion countries) with respect to their transformation towards the knowledge economy. In more operational terms, the Report has the following three objectives: (i) to provide empirical evidence on catching-up and convergence processes inside the EU-27 (ii) to analyse factors / sources

that are important in these processes, and (iii) to propose policies / measures that will support the catching-up process of less developed Member States towards the knowledge economy.

With the term "catching-up MS", the Report covers the 10 transition "new" Member States (NMS-10) as well as the four former cohesion countries (Greece, Portugal, Spain and Ireland). While the term "cohesion countries" is associated primarily with the Member States that are fully eligible for the use of EU budgetary funds for structural actions in the period 2007 – 2013, the term "catching-up" countries reflects a broader range of areas in which less developed Member States try to reach the benchmarks set by more developed Member States. The focus of the discussion will be on the catching-up process. We will nevertheless also touch upon the impact of (the lack of) catching-up on convergence or cohesion inside the EU.

In addition to this *Introduction,* the Report consists of six chapters. Chapter II provides an overview of the theoretical and empirical literature on catching-up, growth and the key flanking conditions for success of a knowledge-based catching up process. Chapter III zooms in on the specifics that apply to our sample of catching-up countries, namely the process of transition and EU-accession. Both of these processes have had an impact on the scope for a knowledge-based catching up process. Chapter IV provides empirical evidence on catching-up and convergence in the EU, both in terms of catching-up in GDP per capita or real convergence, as well as catching-up on knowledge indicators. It also provides evidence on the contribution of knowledge to growth. Chapter V provides empirical evidence on how the catching-up Member States are scoring on the flanking conditions for an innovation-growth nexus. Chapter VI brings together the empirical evidence of Chapters IV and V, in an attempt to explain the observed heterogeneity across countries in knowledge based catching-up. Chapter VII concludes with a summary of main findings and addresses policy implications at the national and EU level.

II. Catching-up, growth and the Knowledge Economy: a review of the literature

2.1. Convergence and growth

One important implication of the neoclassical assumption of diminishing returns to capital is that it leads to convergence. Solow (1956) using the standard neoclassical growth model assumptions, demonstrated that a unique and globally stable growth path exists to which the level of labour productivity and income per person will converge. If all economies have the same preferences and the same technology, the backward countries, with a lower capital-labour ratio will convergence to the steady-state.

The empirical analysis did however not provide support for this convergence process. Barro and Sala-i-Martin (1992), Mankiw, Romer and Weil (1992), Islam (2003). Barro and Sala-i-Martin (2004) argued that the only convergence that occurs is so-called conditional convergence, by which they meant convergence after controlling for differences in steady states. The further an economy is 'below' its steady state, the faster it should grow and vice versa; the further an economy is 'above' its steady state, the slower the economy should grow. This suggests that the economic growth is a much more complex country- specific process, or grouping of countries' specific process (cf also the notion of 'club convergence').

2.2. Innovation and growth

Unlike the exogenous neoclassical models that predict convergence, many of the endogenous growth models suggest that countries develop along their own growth path. Through the presence of increasing returns, most often included in the model by broadening capital to including knowledge or human capital, it is possible to offset the tendency toward convergence. Increasing returns or externalities generate perpetual growth by keeping the marginal productivity of the accumulated factors from going to zero.

The endogenous growth literature (see Romer, 1994; Grossman and Helpman, 1991; Aghion & Howitt 1998) identifies commercially oriented innovation efforts as a major engine of technological progress and productivity growth. The rate of growth of a country is determined by its initial level of development, the creation of new knowledge within the country and the absorption and exploitation of knowledge independently of where it is created. While knowledge creation "shifts a notional technological frontier outward" knowledge absorption "moves the firm closer to the frontier". "Examples of knowledge absorption include: adopting new products and manufacturing processes developed elsewhere, upgrading old products and processes, licensing technology, improving organizational efficiency, and achieving quality certification (Worldbank, 2008). Particularly knowledge spillovers have been identified as important drivers for development in endogenous growth models (a.o. Grossman & Helpman (1991)).

2.3. Innovation and growth in catching-up countries

One of the stylized facts about catching-up countries is the lack of frontier technological competencies. This consequently means that technological progress in these countries occurs mainly through the adoption and adaptation of pre-existing technologies that are new to the country or to the company into which they are transferred. *Foreign trade* is an important channel through which embodied technological knowledge is transferred between "catching-up" countries and their technologically more advanced foreign partners. Through imports of technologically intensive products the "catching-up" countries can raise the quality of their products / services as well as the efficiency in which they are being produced. On the exports side, new technology is being absorbed through a learning-by-exporting process whereby quality, procedures and other kinds and specifications required for access to global market are being provided directly by foreign customers and competitors. But there are other means through which technological knowledge can flow across national boundaries. An obvious alternative is *foreign direct investment* (FDI). Although the entry of foreign affiliates increases the competition for local producers, the production and/or research activities undertaken by multinational affiliates can confer "spillover" benefits to the local economy. Knowledge may flow from the affiliate to local producers through formal and informal contacts, or trained affiliate personnel switching jobs to the local economy.

But access to foreign technology does not necessarily generate catching-up. The National Innovation System literature stresses the importance of interactions between actors in the system for effectively absorbing and learning. Freeman (1987) describes a national system of innovation as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies." Thus, institutions are the social capabilities of a nation and reflect the potential of firms to create and absorb new technologies. Sustainable growth depends on the co-evolution of technology and institutions and the role given to institutions and public policy (Nelson, 1993).

Also the evolutionary literature stresses the importance of institutions in explaining growth for catching-up countries. Abramovitz (1986) asserted "technological backwardness is not usually a mere accident." Without the social capability to take advantage of the technological opportunity created by backwardness, it may not be possible to catch up. David and Abramovitz (1996) define social capability as the "attributes, qualities, and characteristics of people and economic organization that originate in social and political institutions and the influence of the responses of people to economic opportunity." Thus, technologically backward countries "have the potentiality for generating growth more rapid than that of more advanced countries, provided their social capabilities are sufficiently developed to permit successful exploitation of technologies already employed by the technological leaders" (Abramovitz 1986: 225). The realization of this potential for catching up therefore depends on the presence of social capability and the size of the technology gap.

2.4. Country factors driving catching-up towards a knowledge economy

Drawing on various strands of the literature (see sections 2.1-2.3), we can identify a number of critical factors explaining cross-country differences in their innovation-growth nexus. A first factor is a country's **inital level of development**. Technological diffusion is slow at very low levels of development, in part because of difficulties in affording new

technologies, in part because low levels of human capital severely constrain technological progress. At some level of development, however, the pace of technological diffusion becomes less obvious, with a high cross-country variance in technology adoption, even across countries at similar development level.

One explanation for this heterogeneity in diffusion rates at higher income levels is the divergence in the countries' **ability to effectively absorb new technologies** (Lall 2002). Accessed knowledge needs to be combined with a sufficiently developed "absorptive capacity" (Cohen & Levinthal, 1989) or "social capability" (Abramovitz, 1986) in order to deliver growth. This absorptive capabilities depend on many factors, including the extent to which a country has a technologically literate workforce and a highly skilled elite; promotes an investment climate that encourages investment and permits the creation and expansion of firms using higher-technology processes; permits access to capital; and has adequate public sector institutions to promote the diffusion of critical technologies where private demand or market forces are inadequate (Worldbank, 2008).

Another set of factors explaining the divergence in countries' performance is **own indigenous innovative capacity**, which becomes increasingly important as a country progresses closer to the technology frontier (Hoekman, Maskus & Saggi (2005)). First, own R&D complements the adoption of existing technology because it is a component of absorptive capacity. Foreign technologies frequently need to be modified so that they are suitable for domestic circumstances. Countries tend to acquire technology more readily when domestic firms have R&D programs and when public research laboratories and universities have relatively close ties to industry.

At higher levels of development, own R&D increasingly may also start to substitute adoption of existing technologies, allowing generation of new technologies. At this stage, countries require capabilities for innovation, but they also need to have the conditions creating the incentives or rewards for innovation. In well functioning *product markets*, with sufficient openness ensuring competition among incumbent firms and entry from new firms, incumbent firms will have incentives to innovate to improve their competitive position, while new firms, embodying new ideas, can flow into the market. This also requires a *large base of customers* willing to pay for innovative products and effective *intellectual property rights* (IPR) schemes. Furthermore, new business opportunities can only be taken advantage of if appropriately educated and skilled workers can be hired under the right conditions. This requires availability of skills and well functioning *labour markets* providing innovators access to researchers and skilled human capital. Similarly, well functioning (risk) *capital markets* assure innovators access to financial capital to finance their risky projects. Especially high-tech start-ups, often an important source of breakthrough innovations, need access to *venture capital*.

Which mix of flanking conditions is to be applied depends on the level of development of countries, and more specifically on the level of their knowledge economy gap vis-a-vis the benchmark economies. Countries with large gaps will need to focus on improving their technology absorption while more successful catching up MS will have to start putting more efforts on how to sustain productivity growth through own innovations (WB, 2008, p.2).

Verspagen (1991), setting up a simple bifurcation model, represents the catching-up process as three phases. During the first or pre-catching-up phase, the country is building intrinsic

learning capabilities such as a better education system and a better infrastructure. In the second or actual catching-up phase, technology spillovers gradually increase until they reach their peak, then decline gradually. Finally, there is a post-catching-up phase where the backward country begins to develop the capability to conduct its own research and development. He showed that "countries with relatively low levels of intrinsic learning capability and a large technological distance face a high probability of falling even further behind, while countries with relatively high levels of intrinsic learning capability and a small technological distance are more likely to catch up."

2.5. Empirical evidence on catching-up towards a knowledge economy

Empirical evidence confirms the importance of innovation for catch-up. Fagerberg et al 2007 and Fagerberg & Srholec (2008) for a large cross-section of countries, find significant effects of technological capacity (both creation and absorption) to be significantly related to growth. But although a well functioning innovation system seems critical for development, they also confirm the importance of governance and the quality of institutions as flanking conditions for catching-up.

Another result from empirical studies is no or little support for openness to trade and foreign direct investment to matter for innovation and catching-up (Fagerberg & Srholec (2008)). Although many endogenous growth models have emphasized international technology spillovers as a vehicle for catching-up (e.g. Grossman and Helpman, 1991), the empirical evidence zeroing in on the effects of international technology transfer is less clearcut (Hoekman & Smarzynska Javorcik, 2006). More recent studies using panel data sets, correcting for firm or sector specific fixed effects, find no positive within-industry spillover effects for catching-up countries (e.g. Görg and Greenaway (2003)).

One explanation for the difficulty to find evidence of positive spillovers from openness is the confounding impact of competitive effects from open markets. In addition, the potential benefits from FDI may not materialize, as multinational firms may protect their core know-how from dissipating to local rivals (Veugelers & Cassiman (2004)). An additional critical factor to exploit spillovers is the technological capability of indigeneous firms (Blomström and Kokko, 1998). Most of the empirical studies on catching-up countries have failed to find robust evidence of positive knowledge spillovers from multinational investment, accounted for by the lack of absorptive capacity in these host countries (*e.g.* Aitken and Harrison, 1999, Narula & Dunning (2000) Damidjan et al (2003))

Overall, the literature paints a complex relationship between indigenous efforts of technology development (technology make) and the acquisition and absorption of externally developed (foreign) technologies (technology buy) along the development path of a country. R&D, innovation and openness to foreign know-how, seem important for development, but are no panacea for success. Depending on the initial country conditions, flanking conditions shaping the adaptive and innovative capacity of catching-up countries need to be factored in.

III. Specific issues determining "catching-up" towards the knowledge economy for Member States of the EU: transition and accession

There are a number of specific issues that govern the process of reducing the knowledge economy gap of "catching-up " countries in our sample. First, a number of catching-up countries (SI, CZ, SK, HU, PO EE, BG, LT, RO, LV) have witnessed a process of transition, i.e. transformation of their economies from planned to market economies. Secondly, all of our catching-up countries have undergone at different instances the process of accession to the EU. Both processes affect the broader economic and political economy setting, with implications on the flanking conditions discussed in Chapter II for catching-up towards the knowledge economy.

3.1. Transition from planned to market economy

A majority of "catching-up MS" are transition countries, i.e., have gone through a process of transformation of their economic systems from planned to market economies and of their political systems from communist ones to democracies of a capitalist-type. Specific patterns of the transition process have strongly and uniquely influenced the overall development of these NMS over the last two decades and consequently also their path towards the knowledge economy.

3.1.1. The impact of transition

The long-term goal of transition is similar to market economic reforms elsewhere, i.e., to build a market economy capable of delivering long-term growth and living standards. What distinguishes transition countries from reforms in other low and middle-income countries is their starting point as centrally planned economies and consequently the deepness of the required changes. Transition involves the dismantling of one system and its replacement by another. This, of course, means that fundamental reforms must penetrate to the rules of the economy and society as a whole as well as to the institutions that shape behaviour and guide organisations (Allsopp and Kierzkowski, p. 5).

All Member States with a transition origin have experienced a substantial decline in recorded GDP in the early years of their transition. The initial output loss reflected: (i) the introduction of price and exchange rate liberalism resulting in a significant cut of domestic purchasing power, (ii) general collapse of the former system of enterprise linkages and finance, and (iii) the breakdown of the socialist trading block. Through this deep recession, a highly distorted structure of centrally-planned economies with exceptionally high shares of industry and depressed services sector has been transferred in an economic structure more in line with the usual distribution of GDP across sectors.

The transition literature (see, for example Blanchard (1996)) as well as reports of various institutions (e.g. Transition Report of the EBRD) have identified a number of factors that can be associated with successful transition, summarized in Box 3.1.[1]

[1] The Initial Washington Consensus (originating from the IMF, Worldbank and US government) focused on fiscal discipline, tax reforms,competitive exchange rates, liberalised interest rates, trade and FDI, privatisation, deregulation and property rights. The Augmented Washington Consensus, inspired by a more micro-oriented policy perspective, added corporate governance, anti-corruption, open trade agreements, competition policy.

Box 3.1: Key factors for successful transition

- ***Macro-economic stability***
- ***Quality of institutions***
- ***Structural Reforms***
  - ***Price/trade liberalisation***
  - ***Restructuring/reform of the economic system***
  - ***Competition policy***
  - ***Banking sector reform***
  - ***Political reforms***
  - ***International integration (trade, FDI, capital, labour, ..***

Many of these factors are also present in the factors identified for an innovation-based growth process. Important to note is that these factors should not be seen in isolation, but as part of a system of key factors. Carlin, Schaffer and Seabright (2004) look particularly at the relationship between competition, innovation, and growth in transition economies: by using empirical evidence from the BEEPS survey, they show the importance of a competitive output market for innovation in transition countries, but conditional on the presence of a well performing financial system. More particularly they demonstrate how competitive pressures raise innovation in both new and incumbent firms, subject to hard-budget constraints for incumbent firms and availability of financing for new firms.

3.1.2. The Transition Reform Process

The most comprehensive tool for assessing the overall progress achieved by individual countries in the transition reform process has been developed by the EBRD. The institution has designed a rating system, assessing annually how well markets, enterprises and institutions function and measures progress against a benchmark level, achieved by industrialised market economies.

The evidence from this yearly EBRD reports shows how the speed of transition reforms has been very different across different areas. Reforms involving liberalisation, i.e., elimination of government imposed restrictions on prices, trade and the market for foreign exchange, have seen very rapid progress in the early years of transition. Areas of reforms in which transition requires redistribution of assets, especially privatisation, have on average moved more steadily over the period. A third set of areas of reforms are those that involve building and/or rebuilding of institutions, such as competition policy and financial sector transformation. In these areas of institutional reforms, the process of catching up with the benchmark of market economies has been the slowest and has not been completed yet. It is particularly in these areas that flanking conditions for a knowledge-based catching up process are rooted.

Table 3.1 shows that EU transition countries have reduced significantly the gap towards the matured market economies with respect to institutional reforms (competition policy and financial market reforms). All these countries have started the transition process with institutions that were completely inappropriate for a market economy and consequently also for the knowledge economy. During the last two decades these countries have adjusted their legislation and put in place the institutional framework for their implementation. In general terms, advancements have been more significant in the area of financial sector reform

where the gap to the market economies has been largely eliminated while with respect to competition policy some further catching up still has to be done.

Table 3.1: Progress of transition MS with respect to institutional reforms*

	Competition policy			Financial sector reform		
	1989	**1998**	**2008**	**1989**	**1998**	**2008**
Bulgaria	1	2	3	1	2,67	3,33
Czech Republic	1	3	3*	1	3	4*
Estonia	1	2,67	3,67	1	3,33	4
Hungary	1	3	3,33	1	4	4
Latvia	1	2,67	3	1	2,67	4
Lithuania	1	2,33	3,33	1	3	3,67
Poland	1	3	3,33	1	3,33	3,67
Romania	1	2	2,67	1	2,33	3,33
Slovakia	1	3	3,33	1	2,67	3,67
Slovenia	1	2	2,67	1	3	3,33

* The measurement scale ranges from 1 to 4,33, with 1 representing little or no change from the old regime and 4,33 representing a standard that is in place in a mature market economy

Source: EBRD, Transition Report, various editions

Estonia and Hungary have been the most successful among the MS in closing the institutional gap toward the market economies (with 11 and 15 per cent gap respectively) while Slovenia, Romania and Bulgaria are the three laggards in this respect (the first two with 31 per cent and the last one with a 37 per cent gap).

3.2. The process of EU integration

Accession of a new member country to the EU involves a complex process of its adjustment to the "rules of the game" that have been established among the incumbent MS throughout the decades. From the point of view of this Report, there are three main channels through which the EU integration process has influenced and continues to influence the knowledge economy catching up process of new member states. The first channel refers to the continued commitment of new members to the reform process. This commitment is reflected through the "acquis" ex ante and the Lisbon strategy / National Reform Programs post-accession. The second channel is the EU budget, through pre-accession funds in the period prior to a candidate country's accession to the EU and through structural funds, and other funding sources in the period of full membership of these countries. The third one is their integration into the single European market.

3.2.1. The EU reform process

(i) Transposition of the acquis

In the period before 1990, there was no formal criteria defined for a candidate country to join the EU. In the early nineties, when it became more and more obvious that at least some of the countries embarking on a transition from planned to market economy would eventually join the EU, it was decided that formal EU accession criteria should be articulated. These criteria known today as the 1993 Copenhagen criteria, request from a

candidate country to ensure the existence of a functioning market economy as well as the capacity to cope with competitive pressure and market forces within the Union and to fully harmonize its legislation with the "acquis". The transposition effort urged new members to adopt modern regulatory frameworks in areas such as financial markets, company law, competition policy, accounting, IPR. These are all areas which create a better environment for innovation and growth in the private sector.

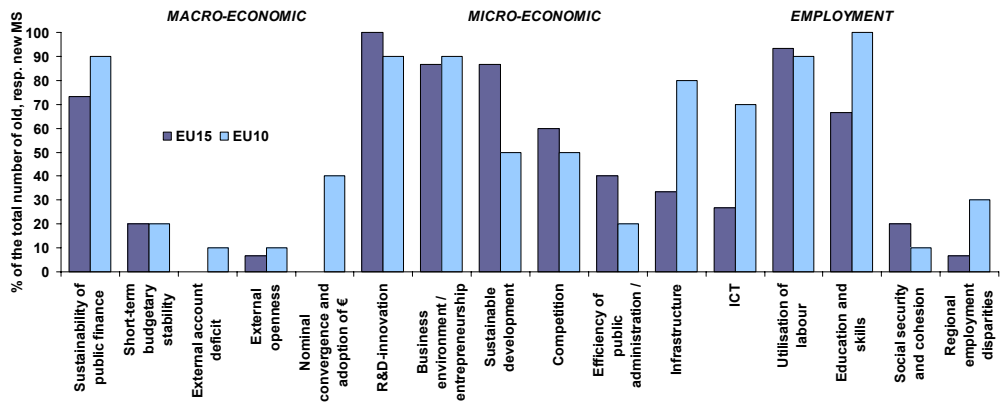
The New Member States (NMS) have made rapid progress in implementing the EU acquis in national legislation. By Spring 2006, for nearly all Directives that had to be implemented, national implementation measures had been notified. This high degree of notified measures is even slightly above the average for all Member States. Experiences from the accession of the 10 transition economies clearly confirm that it has been much easier for them to meet the criteria of proving to be a market economy than the criteria determining their capacity to cope efficiently with strong competitive pressure on a single European market. Only in the area of competition, NMS still showed a certain lag of transposition vis-à-vis the average of all MS (in line with the EBRD transition report results).

But even in the areas with a high compliance in terms of notified measures, experience show that NMS have had more problems in implementing new legislation. It is for this reason that the methodology of the accession negotiations with new candidate countries puts now more emphasis on implementation rather than the adoption of legislation.

(ii) Lisbon Strategy

Beyond the transposition in the context of the "acquis", all the NMS are, post-accession, in the process of completing reforms as specified in the National Reform Programs (NRPs) of the Lisbon Program. The Lisbon Strategy is a program for structural reforms of EU Member States to tackle particularly key challenges for a knowledge based growth process, in the areas of ICT, skills development, R&D and innovation, business environment & entrepreneurship. Compared to the EU-15, the NMS have identified in key economic challenges in their National Reform Programs, prepared in the autumn of 2005 (Graph 3.1). These include beyond sustainability of public finances, all knowledge based economy areas such as infrastructure, ICT and skills development, but also business environment, R&D and innovation.

Graph 3.1 : Key challenges in NRPs, EU-15 and new Member States



Source: EC (BEPA-ECFIN), 2006

On knowledge and innovation, the most common instrument envisaged by NMS in their NRP is to increase public spending on R&D. Nevertheless, NMS have also announced measures to increase the leverage of private business R&D, and more generally promoting favourable conditions for R&D activities. But interim evaluations indicate that there is clearly room for improving further conditions for private R&D spending (BEPA-ECFIN, 2006).

3.2.2. EU Budget

Already before May 2004 the EU supported financially the preparations for accession of the 10 new member states. The annual amount has been increasing over time reaching just over 2% of NMS-10 GDP in 2005. The disbursements to the new Member States represented 6.9% of the EU budget, which is more than those States' GDP share in the EU (4.7%). The transfers mainly occurred via 3 vehicles, namely Phare, ISPA and SAPARD[2].

Post-accession, the NMS have access to the EU budget. There is one heading in the 2007 – 2013 financial perspective that is of particular relevance for funding projects and programs that would qualify as expenditures aimed at reaching knowledge economy objectives articulated in the Lisbon strategy: "Sustainable development". This heading consists of two sub-headings, "Competitiveness" and "Cohesion" with the two of them having very different operational objectives, instrument and modes of implementation.

"Competitiveness" funds, equivalent to EUR 74 bn, are being largely allocated for innovation purposes mainly within the framework of FP 7 channels. The basic criteria applied for allocation of these funds is excellence. This means that selection of programs and projects under FP 7 as well as allocation of EU financial support money under this scheme is being done on the basis of public tendering where participants from all EU member states are eligible to participate. Application of the principle of excellence means that projects and programs are entrusted to best qualified bidders. Experience shows that these bidders are largely located in the more advanced MS.[3]

The main objective of "Cohesion" funds, their total amount being equivalent to EUR 308 bn over the 2007 – 2013 period, is to reduce disparities between more and less developed areas of the EU. In contrast to the "Competitiveness" subheading where funds are being allocated on the basis of the excellence principle, the resources under the "Cohesion" subheading are channelled to geographical areas of the EU that meet precisely determined

[2] The Phare programme, the largest of the three, was aimed at supporting institution building (strengthen public administrations and prepare for the adoption of EU legislation) and supporting economic and social cohesion designed in a National Development Plan that each country was required to draw up, a precursor to the EU Structural Funds. ISPA (Instrument for Structural Policies for Pre-Accession), like Phare, aimed at economic and social cohesion, but focuses exclusively on environment and transport infrastructure. SAPARD (Special Accession Programme for Agriculture & Rural Development) fostered structural adjustment in agricultural sectors and rural areas.

[3] In some programs, the problem of poor participation of participants from less advanced MS in allocation of EU budget funds for innovation purposes has been addressed to a limited extent through a condition whereby the winning bidder is obliged to include in the project implementation also partners from this group of MS (Molle, 2008).

eligibility criteria. Based on this "country envelope" principle, a large majority of cohesion funds is being channelled to "catching up MS".

Experience from the last EU medium-term financial perspective negotiations have shown that even though Lisbon strategy objectives were considered by all MS a policy priority for the forthcoming period, it was precisely on the Lisbon strategy where the largest budgets cuts have been made. This can be explained by the fact that national interests expressed primarily through net budgetary positions of individual countries have strongly dominated the negotiations (Mrak and Rant, 2007).

Counterbalancing this negative message of a drastically reduced volume of "Competitiveness" funds was probably one of the driving forces for a strong "lisbonisation" of cohesion policy in the 2007 – 2013 period. The 2006 Community Strategic Guidelines prepared by the Commission as a guiding document for the new programming period set high ambitions concerning the contributions the structural funds are expected to provide for Lisbon strategy objectives. [4]

3.2.3. EU market integration

The EU single market project aims at removing barriers to a free flow of products & services, capital and labour inside the EU countries.

Already before the enlargement, the prospect of EU accession resulted in increased *trade* integration within the EU-25 area. Although the NMS were already very open economies before accession, trade between the NMS and EU-15 intensified even further after enlargement.[5]

Since the mid-1990s the presence of foreign firms in the new Member States has grown rapidly[6]. With a share of three quarters of the total *FDI*, the old Member States are the main investor into the new Member States. [7] While in the Baltic States and to a lesser extent in Poland FDI is still concentrated in traditional industries like food processing, textiles and wood products, in Hungary and the Czech Republic foreign investors focus on modern manufacturing sectors (office machinery, computers, telecommunication, cars).

Given that barriers to trade, foreign direct investment and other capital movements had already been removed prior to enlargement, the free movement of persons and workers constituted the most significant dimension of economic integration on 1 May 2004. However, given the sensitivity of the discussion on free circulation of labour the Accession

[4] For the so-called convergence regions, i.e., NUTS – 2 regions with per capita GDP below 75 per cent of the EU average in PPP terms, over 60 per cent of total structural funds interventions are expected to be allocated for measures aimed at reaching these objectives.

[5] Trade (exports plus imports) represented an average of 93% of GDP in EU-10 compared with an EU-15 average of 55%. The EU-15 share in total EU-10 trade has risen from about 56% in 1993 to 62% in 2005. The EU-10 market share in EU-15 imports has also increased by 8 percentage points to about 13% over the period 1993-2005 (excluding intra-EU-15 trade).

[6] The stock of foreign direct investment (FDI), which was virtually non-existent some ten years earlier, reached 40% of local GDP by 2004

[7] Germany is the top investor and is particularly active in the Czech Republic, Hungary, Poland and Slovakia while the Nordic countries are the main investors in the three Baltic States. The largest part of FDI (55%) is invested in services, followed by manufacturing (37%).

Treaty of 2003 allowed during a nine year transition period a derogation from the principle of the free movement of persons.[8]

Studies before accession on potential migratory flows and the experience so far, indicate a limited impact on the labour market. The migration potential for the EU is estimated at 2-4 % of the source population in the new Member States. Cumulated over 15 years, this amounts to 1.2 % of the projected EU-15 working age population in 2020. Actual migratory flows from the EU-10 have in general been small, even towards countries that have allowed unrestricted movement of workers In 2005, the highest shares of non-nationals in the working age population (about 10 %) are observed in Austria and Germany, of which 1.5 % and 0.6 %, respectively, come from EU-10. The largest EU-10 representation of about 2 % is found in Ireland. (BEPA-ECFIN 2006).

* * *

To conclude, the accession process has contributed to a more favorable process of knowledge based catching-up. This holds particularly for the New Member States entering during the last enlargement process. At the time of their EU accession, these new entrants had more appropriate macroeconomic, human capital and infrastructure indicators than was the case with old cohesion countries at the time they were joining the EU. But at the same time, the *acquis communitaire* was much more demanding for these new entrants. NMS had to harmonise their economies to the EU standards prior to accession to a much larger extent than the old cohesion countries (Varblane and Vahter, 2005, p. 42), be it that the adjustment of the NMS to the requirements of the acquis has been extensively supported with pre-accession funds.

[8] Only Ireland, Sweden and the United Kingdom, decided not to make use of the possibility to impose restrictions, while the other old Member States maintained a work permit regime, sometimes combined with a quota system.

IV. Empirical evidence on the catching-up and convergence processes of less developed MS of the EU towards the knowledge economy

The main objective of this chapter is to provide empirical evidence on how catching-up countries in the EU are performing with respect to (i) per capita GDP as a key economic convergence indicator as well as to (ii) various knowledge economy indicators. The chapter discusses whether gaps are closing, and if this is the case, at what speed.

Much of the empirical analysis of catching-up adopts the idea of *ß*-convergence and σ-convergence across countries. *ß*-convergence occurs when poor economies grow faster than rich ones and catch up in terms of per-capita income. σ-convergence occurs when the dispersion, measured for example by the standard deviation of the logarithm of per capita income across a group of economies, decreases over time (Quah, 1996). ß-convergence is a necessary, though not sufficient condition for σ-convergence (Abramovitz and David (1996)).

As mentioned in the Introduction, catching-up MS in this Report are the 10 transition countries (SI, CZ, SK, HU, PO, EE, BG, LT, RO, LV) and the 4 former cohesion countries (IE, SP, PT, GR) and MT & CY. Frontier countries are the 11 MS which are not catching-up countries. When individual countries are documented, we do not report MT, CY nor LU.

4.1. Real convergence of "catching-up MS": GDP per capita

Table 4.1: Per capita GDP in 1993 and 2008 (as % of EU-27 average; growth rates)

	GDP per capita 1993		GDP per capita 2007		GDP per capita growth 93-2007
EU-27	12.8 (0.45)	100	24.9 (0.45)	100	4.4 (0.41)
Frontier countries	17.6	137	29.5	119	3.4
Catching-up countries	8.6	67	19.0	77	5.3
Transition	6.4	50	15.6	63	5.9
Former Cohesion	12.4	97	26.5	107	5.0

Note: arithmetic averages; in between brackets: coefficient of variation;
Source: EC-Eurostat; downloaded 11/2008;

Catching-up is demonstrated by the catching-up countries' higher growth rate in GDPpc (5.3%) as compared to the frontier countries (3.4%) (Table 4.1). As a consequence, GDPpc as a percentage of EU-27 GDPpc has increased from 67% in 1993 to 77% in 2007. Estimating the β coefficient measuring β-convergence on our sample (EU27 countries in the

period 93-08) yields a value of -0.317 (0.057)***, confirming that countries with lower initial GDPpc have a significantly higher growth rate of GDP[9].

In terms of convergence/cohesion, the data show no evidence on reduced **dispersion** in GDPpc levels. The average σ-coefficient, measuring dispersion, over the time period 93-07 amounts to 0.45, with very little movement over time.[10]

Within the group of catching-up countries, particularly the group of **transition countries** have a higher growth rate, but they also have the lowest initial levels. For the transition Member States, the post 1989 output developments followed a U-shaped pattern with a minimum point reached in 1992 or 1993. Since then, the GDP of these countries as well as their per capita GPD has been continuously increasing, as Table 4.1 documents. By 1998, all of them had mostly recovered from the collapse. Although strong economic recovery has resulted in a substantial convergence of these countries towards the per capita GDP level of developed EU MS, gaps for many countries remain large.

The speed of convergence has varied significantly across these transition countries. As shown in Table 4.2, real convergence went fastest in some of the least developed transition countries, especially in the three Baltic states. These dynamics has been slower in the more developed transition countries, such as Slovenia and Czech Republic, all conform β-convergence. An outlier on the β-convergence pattern, is the strong growth performance of Slovakia, and the less impressive growth of Bulgaria, Hungary and Romania[11].

Table 4.2: Real convergence of "catching-up MS" expressed as per capita GDP in PPP

	1993	1998	2003	2007	93-07	Years to catch-up
EU – 27	100.0	100.0	100.0	100.0	3.9	
Bulgaria	31.7	26.9	32.5	38.1	5.2	77
Czech Republic	71.6	70.5	73.4	81.7	4.9	21
Estonia	35.3	42.3	54.4	70.8	8.9	7
Latvia	31.7	35.6	43.3	58.0	8.3	13
Lithuania	38.3	40.1	49.1	60.3	7.2	16
Hungary	52.2	52.7	63.2	63.4	5.3	34
Poland	40.3	47.8	48.9	53.8	6.0	30
Romania	27.7	27.7	31.3	40.6	6.2	41
Slovenia	70.6	78.6	83.4	91.2	5.8	5
Slovakia	45.0	52.1	55.5	68.5	7.0	13
Greece	84.7	83.3	92.1	97.5	4.9	3
Ireland	94.3	121.5	140.8	146.2	7.1	-12
Portugal	75.5	76.6	76.7	74.8	3.9	∞

[9] The β-coefficient results from the following regression: log (GDPpc08/GDPpc93) = c + β log (GDPpc93) + error term;

[10] The σ-coefficient is defined as the coefficient of variation of GDPpc : √VAR/MEAN

[11] Empirical calculations based on standard deviations calculations for two sub-groups of MS, namely for the Luxembourg group (Slovenia, Poland, Hungary, Estonia and Czech Republic) and the Helsinki group (Lithuania, Latvia, Bulgaria, Romania and Slovakia), have shown that convergence within the Luxembourg group countries has been significant between 1995 and 2005 while the Helsinki group has experienced no intra-group convergence in this very same period (Varblane and Vahter, 2005, p. 18-19).

Spain	92.3	95.5	101.2	106.9	5.0	-6

Note: Years to catch-up to EU-27 average from 2008, are calculated, extrapolating the 93-07 growth rates.
Source: Eurostat, downloaded 11/2008

The most interesting heterogeneity can be observed inside the **former cohesion countries**. As table 4.2 documents, Ireland is the positive outlier, with an impressive growth rate of 7.1% even though it already had in 1993 the highest level of GDPpc among catching-up countries. On the other extreme, is Portugal, with the lowest growth rate among the former cohesion (even among all catch-up) countries, even falling further behind although it had the lowest initial GDPpc level among the former cohesion countries and therefore the largest room for catch-up. [12]

4.2. Drivers of Potential Growth for catching-up: the importance of TFP

Table 4.1 documented the strong recovery of the transition economies following strong output losses during the early 1990s. This recovery has been associated with productivity increases although factors contributing to this upward trend have changed over time. In the first half of the 1990s, productivity gains were mostly independent from capital investment. Higher productivity was achieved primarily through further reduction of redundant labour and through better utilisation of existing manufacturing capacities. Later on, the source of rapid productivity growth has been more investment related, reducing the incremental capital-output ratio through either replacement of the existing capital stock or through its expansion.

Beyond factor accumulation, growth can also be driven by changes in Total Factor Productivity (TFP) . As a "residual", it basically accounts for effects in total output growth not caused by capital and labour, but by factors such as technological change and efficiency. TFP is commonly interpreted as a measure of the technology of production and its rate of growth as a measure of technical progress (Worldbank, 2008, p. 54).

Table 4.3 shows the potential growth rates for EU-27 Member States and the contribution of TFP to potential growth since 1998. Two sub-periods are considered, the first covering mostly the pre-accession period.

Table 4.3: Potential growth and TFP of "catching up MS between 1998 and 2008

	Potential Growth 1998-2002	**Potential Growth 2003-2008**	**TFP Contribution 1998-2002**	**TFP Contribution 2003-2008**
US	3.2	2.5	1.3	1.1
EU-27	2.45 (0.62)	2.26 (0.89)	1.17 (0.83)	0.97 (0.96)
Frontier	2.18 (0.46)	1.91 (0.51)	1.16 (0.48)	0.95 (0.56)
Catching-up countries	3.8 (0.42)	4.02 (0.48)	1.26 (0.88)	1.09 (0.94)
Transition	3.5 (0.43)	4.89 (0.34)	2.13 (0.45)	2.20 (0.35)
Former Cohesion	4.0 (0.57)	3.66 (0.45)	0.88 (1.66)	0.60 (1.30)

Note: In brackets: coefficient of variation

[12] Although Italy formally does not belong to the catching up countries in the EU, its has been falling behind in growth performance, to such an extent that its GDPpc has fallen below the EU-27 average by 2008.

Source: Own calculations on the basis of EC-ECFIN Ameco, downloaded 11/2008; the 2008 is a predicted value.

Potential growth in the catching-up countries has been higher in the second subperiod than in the first, indicating an acceleration in catching-up, particularly as the frontier countries have witnessed a deceleration in growth. This is a composed effect of an acceleration in the transition economies and a deceleration in the former cohesion countries, all conform β-convergence.

But again, there is lots of country heterogeneity. The coefficient of variation (σ-convergence) has increased over time inside the EU-27. This is mostly because of divergence across groups, as within groups, variation has decreased, with the exception of the frontier countries, where the coefficient of variation has increased (with Italy and Germany bottom performers in terms of potential growth in the considered period).

Overall, **TFP** is more important for growth for the frontier countries, where it accounts on average for 53% of potential growth [13] than for the catching-up countries, where it accounts for 38% of growth. Nevertheless, TPF is a major growth factor for transition countries, accounting on average for 43% of growth.

The coefficient of **variation** is higher for **TFP contribution**, indicating that countries are more diverse with respect to the contribution of TFP to growth, particularly among the catching-up countries. Furthermore, this variation has increased over time, not only for the catching-up countries, but also for the frontier countries. The highest variation can be found inside the former cohesion countries, where for Spain, TFP only accounts for 5% of growth versus 40% for Ireland. Also inside the frontier countries, there are substantial differences, with TFP accounting for 60% of growth in Sweden & Finland, 70% in Germany versus 10% in Italy. Inside the transition countries, there is less variation in the contribution. The highest scores are found for the Czech Republic and Slovakia (resp 63% and 55%), the lowest value for Bulgaria (24%).

All this indicates that technological progress, as proxied by TFP, is important for growth, but there is substantial variance across countries in the relative importance of TFP for growth. Furthermore, there is a large heterogeneity across countries in what this "residual" TFP component entails. When talking about technological changes as a source of TFP growth one has to make a more precise assessment of what these changes are really about. The next section will analyse in more detail how the catching-up countries are doing on various knowledge economy dimensions composing TFP growth.

4.3. Knowledge economy convergence of "catching-up MS"

For assessing innovative capacity, defined as the ability of a system not only to produce new ideas but also to bring them to markets and translate them into economic growth, a range of factors deemed important for effective innovation effort is required, going beyond data and indicators in the area of R&D inputs only.

[13] This is excluding Italy & Luxemburg as two outliers among the frontier countries with low contribution of TFP: Italy with low growth, Luxemburg with high.

From this broader perspective of innovative capacity, country differences with respect to innovation and growth might reflect not just different assets in terms of labour, capital and stock of knowledge, but also varying degrees of capacity to leverage knowledge into growth (the efficiency of the innovation system).

This chapter starts in section 4.3.1 with a discussion of the widely used Enterprise Innovation Scoreboard (EIS), which provides a composite assessment of innovation inputs, outputs and drivers. Although the EIS tries to capture the various dimensions of relevance for a country's innovation potential into a single innovation index, its "composite" character masks interesting underlying trends in the individual components, which may be of particular relevance for the catching-up process [14]. We therefore prefer to turn to the analysis of the most important subcomponents of the innovation system directly. This chapter will examine in detail the various dimensions of a country's innovation input and output performance (section 4.3.2), summarizing the information in one composite innovation performance indicator in section 4.3.3. The drivers or flanking conditions for turning innovation into growth will be examined in Chapter V.

4.3.1. Convergence in EIS: a Summary Innovation Index

The EC's Europe Innovation Scoreboard (EIS), provides a summary assessment of the innovation performance of EU MS and some other countries. Its Summary Innovation Index (SII) is a composite indicator on the basis of 25 individual innovation indicators, capturing innovation inputs (like expenditures on R&D), innovation output (like patents, trademarks, sales of new products, high-tech exports). It also includes flanking conditions/innovation drivers (like tertiary education, venture capital financing, ICT and broadband penetration). Appendix A.1 provides a detailed description of the variables included.

Based on their SII scores (over a 5 year period), EU MS are divided into the following groups.

- *Innovation leaders*, with SII scores well above that of the EU27 and most other countries. Sweden has the highest SII of all countries. Beyond Sweden, this group also includes Finland, Denmark, Germany, the UK and the US.
- *Innovation followers*, with SII scores below those of the innovation leaders but equal to or above that of the EU27. To this group belongs Ireland.
- *Moderate innovators* with SII scores below that of the EU27. This includes Spain and from the Transition countries, Estonia, Czech Republic and Slovenia. Also Italy belongs to this group.
- *Catching-up countries*. Although their SII scores are significantly below the EU average, these scores are increasing towards the EU average over time. This group includes Lithuania, Hungary, Portugal, Slovakia, Poland, Bulgaria, Latvia and Romania. Greece also belongs to this group although it shows no sign of catching-up over time.

[14] The composition is a simple average of individual components. The weights do not reflect country-differences in the importance of subcomponents. The trends in the overall SII is sensitive to the selection of individual indicators, which may be driven by data-availability considerations, rather than by conceptual considerations.

These country groups appear to have been relatively stable over the last five years. Within these groups, countries have changed their relative ranking but it is rare for a country to have moved between groups. Appendix A.1 shows the SII scores of the EU-27 MS over the period 2003-2007. It shows for most countries only modest changes over time.

Although there is relative stability in a country's ranking and the country groupings, over a longer time period there is a general process of convergence, with the countries showing below average EU innovation performance moving towards the EU average. This catching-up is also partly realized by some of the leaders, falling behind on their SII. [15]

4.3.2. Individual components of innovation convergence

(i) Catching-up and convergence in innovation inputs: R&D expenditures

As stated in the Ahö report, "resources for R&D and innovation at a globally competitive level are a prerequisite for Europe to move forward". This has been recognised in the renewed Lisbon agenda with knowledge and innovation for growth, including the 3% target for R&D, being the first pillar. R&D activity is important not only because it generates new knowledge, but also because it enhances the ability to understand and apply existing knowledge, and is therefore an important component of "absorptive capacity". A large proportion of R&D activity in the catching-up MS is of this second type.

Table 4.4: R&D intensity of "catching-up MS" in 1998, 2002 and 2006

	GERD % GDP 1998		GERD % GDP 2002		GERD % GDP 2006	
US	2.61	147	2.64	140	2.61	142
EU-27	1.78 (0.84)	100	1.88 (0.99)	100	1.84 (0.90)	100
Catching-up countries	0.80 (1.16)	44	0.86 (1.27)	47	1.00 (0.99)	57
Transition	0.75 (1.14)	40	0.75 (1.29)	43	0.83 (1.11)	52
Former Cohesion	0.83 (0.16)	47	0.92 (0.31)	49	1.08 (0.29)	59

Note: in brackets: coefficient of variation
Source: GERD: Gross Expenditures on R&D. Own calculations on basis of Eurostat

With R&D intensity more or less stagnating over the last years, the EU as a whole continues to lag behind the US. But there is considerable variation among EU countries, both in levels of R&D intensity and in dynamics. And this variation seems to have increased over time.

[15] Using a simple linear extrapolation of current performance levels and growth rates, the EIS 2008 has also made an estimate for how many years it would take countries to reach the EU knowledge economy average. For five moderate innovators, Estonia, Czech Republic, Cyprus, Latvia and Slovenia, the period required to close the gap is expected to be between 9 and 13 years, while for the others it is expected to be much longer, in many cases over 20 years (EIS, 2008, p.12-14).

At the frontier are Sweden and Finland which have a R&D intensity level substantially higher than the US and who have increased their lead over other EU-27 countries over the total time period considered. At the bottom of the frontier countries is Italy, which shows no sign of catching-up on R&D intensity with the EU average.

Catching-up countries have on average a lower R&D intensity than the frontier countries [16], but the gap is closing over time, although slowly (from 44% in 1998 to 57% in 2006). This holds for both Transition and Former Cohesion countries. Among the former cohesion countries, the two countries at the bottom, Portugal and Greece, have not been able to catch-up faster than Ireland and Spain. The dispersion is the highest among the Transition countries and has not diminished over time. Looking at changes over the period 1998 to 2006, some transition countries have fallen further behind (like Romania, Poland, Slovakia and Bulgaria) while others have forged ahead (Slovenia, Czech Republic, Hungary and the Baltic States).[17] The best Transition countries, Slovenia and the Czech Republic outperformed in 2006 the Former Cohesion countries (incl Ireland) on R&D intensity; and even some "frontier" countries, like Italy.

Overall, the results indicate some convergence in R&D intensity. More formally, the β-coefficient for measuring β-convergence in R&D intensity applied to the sample is estimated at -0.178 (0.07)**. Although this is significantly negative, suggesting that on average countries with lower initial R&D intensity have grown faster in R&D intensity, the coefficient is much smaller than for real convergence (cf supra), suggesting a more slower process of catching up in R&D intensity than in GDPpc. The most important outliers in the regression are Estonia (positive) and Poland (negative).

Table 4.5 Gap in GERD as % of GDP (EU-27=100)

	1998	2002	2006
EU – 27	100	100	100
Sweden	199	219	203
Finland	161	179	188
Italy	60	60	60
Slovenia	76	79	86
Czech Republic	65	64	84
Slovakia	44	30	27
Hungary	38	53	54
Poland	37	30	30
Estonia	32	38	62
Bulgaria	32	26	26
Lithuania	31	35	43
Romania	28	20	24

[16] Note that for fast GDP growing countries, GERD as a % of GDP will need to grow at very high rates to close the R&D intensity gap.

[17] Catching-up MS lag also behind the EU-27 average on some other dimensions of science and technology activities. An obvious example is human resources available for research purposes. All catching-up MS were below the EU average, but the intensities have increased in relation to previous years what indicates that some catching-up has been achieved in this area. Also within this group there are big differences. While Greece, Czech Republic, Slovenia, Estonia and Hungary are characterized with R&D personnel intensity of over 1.25 per cent of total employment which is very close to the EU-27 average there are others, such as Romania, where R&D participated with less than 0.5 per cent in total employment (Eurostat, 2008).

Latvia	22	22	38

Ireland	66	59	72
Spain	49	53	65
Portugal	37	40	45
Greece	29	31	31

Source: Own calculations on basis of Eurostat

The business sector is the sector which is mainly responsible for the R&D intensity gap of the EU relative to the US. When zeroing in on the business component of R&D expenditures (BERD), again the best performing "frontier" countries in the EU-27, Sweden and Finland, have also the best BERD-intensity performance, again even better than the US. Their lead in BERD intensity is even higher than their lead in GERD intensity (as the last column of table 4.6 makes clear)

All the catching-up countries are lagging behind the EU-27 average in Business R&D intensity. The gap is even more substantial in BERD than in GERD. Also the process of convergence in BERD intensity is slower than the convergence in GERD: the β-coefficient measuring the β-convergence in BERD intensity for the sample (excl LU, MT, CY) is -0.134. This is much smaller than the GERD coefficient (cf supra) and furthermore with much more variance (0.079), leaving an effect which is only significant at the 10% level. With the exception of Slovenia, Slovakia and the Czech Republic among the transition countries and Ireland among the former cohesion countries, all other catching-up countries have at the end of the observation period a gap in BERD intensity that is wider than their GERD intensity gap.

Table 4.6: Gap in BERD as % of GDP (EU-27=100)

	1998	2005	BERD gap relative to GERD gap 2005
EU – 27	0.98=100	1.00=100	1.00
Sweden	245	248	1.20
Finland	186	232	1.22
Italy	45	43	0.73

Slovenia	73	80	1.00
Czech Republic	71	76	0.99
Slovakia	41	19	1.00
Hungary	25	37	0.72
Poland	26	19	0.61
Estonia	14	36	0.71
Bulgaria	14	14	0.51
Lithuania	18	16	0.38
Romania	21	15	0.68
Latvia	9	19	0.63

Ireland	83	72	1.05
Spain	44	51	0.85
Portugal	14	29	0.66
Greece	12	18	0.57

Note: the last column gives the ratio of the BERDgap (ie BERDintensity of country j as share of EU-27 relative to the GERDintensity of country j as share of EU-27; a value larger (smaller) than 1 indicates a better (worse) performance of the country on BERDintensity than on GERDintensity
Source: Own calculations on basis of Eurostat

When looking closer at the successful countries on BERD intensity (Sweden and Finland for the frontier counties, Ireland for the former cohesion countries, and Slovenia and the Czech Republic for the transition countries), we see that only a limited number of sectors (and often also actors) have played a key role in the growth of BERD (EC-RTD Key Figures 2007).

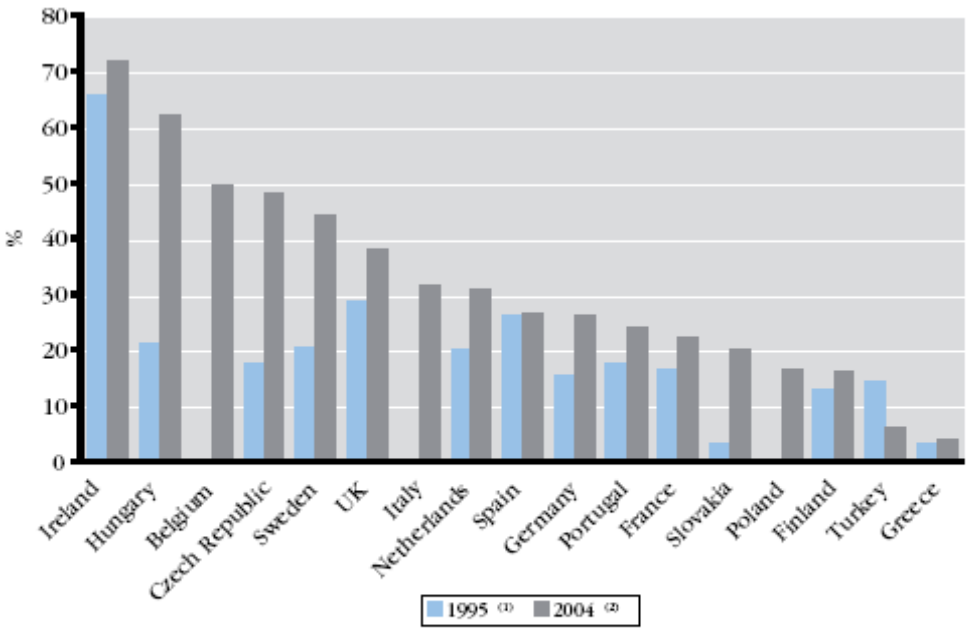
In Finland the rise of BERD is explained by one sector: radio, TV and communication equipment. This sector alone accounts for 45 % of BERD in 2004 (compared to 15 % in 1990). In Sweden, business expenditure on R&D more than doubled during the 1990s, thanks to three sectors: radio, TV and communication equipment, pharmaceuticals, and motor vehicles. In Ireland, the share of computer and related services in BERD has risen rapidly and represents about 1/3 of BERD in 2004. In Slovenia, the share of the pharmaceuticals sector almost doubled in a decade, reaching 41% of BERD in 2004. Without the strong growth that Slovenia experienced in the R&D expenditure of the pharmaceuticals sector, especially in recent years, its total BERD would be lower now than in 1991. The two sectors which successively played a key role in the growth of BERD in the Czech Republic are motor vehicles, in the second half of the 1990s, and computer and related services more recently. These two sectors represent 35 % of total BERD in 2004 (compared to 25% in 1995).

Although their contributions to the growth of BERD vary from country to country, the same key sectors show up (pharmaceuticals; motor vehicles; radio, TV and communication equipment; computer and related services), suggesting the importance of specializing in the "right" sectors, i.e. the high-tech, high-growth ones.

As far as the ICT sector is concerned, Estonia, Slovenia, Hungary and the Czech Republic, are better positioned than the remaining ones in terms of ICT industry developments and of the relative weight of these sectors in the domestic economy (share in GDP, in manufacturing, in FDI, in export, etc..) (EC-JRC-ITPS 2007).

For many of the catching-up countries, FDI plays an important role in sector developments and business R&D growth. A notable example is Ireland, where the key development factor was the attraction of foreign direct investments (FDI) into a number of high-tech sectors. But also in other catching-up countries, the share of foreign affiliates in total business R&D has expanded significantly, especially in Czech Republic, Hungary, Poland and Slovakia. In 2004, foreign affiliates accounted for over 60 per cent of business R&D in Hungary, around 50 per cent in Czech Republic and around 20 per cent in Slovakia, Poland and Portugal (Key figures, 2007, p. 77).

Graph 4.1: Share of foreign affiliates in total BERD



Source: DG Research
Data: OECD (Activity of Foreign Affiliates database)
Notes: (1) CZ, SK: 1996; NL, FI, TR: 1997; PT: 1999.
(2) EL: 1999; NL, TR: 2002; DE, IE, IT, HU, PT, SE: 2003.

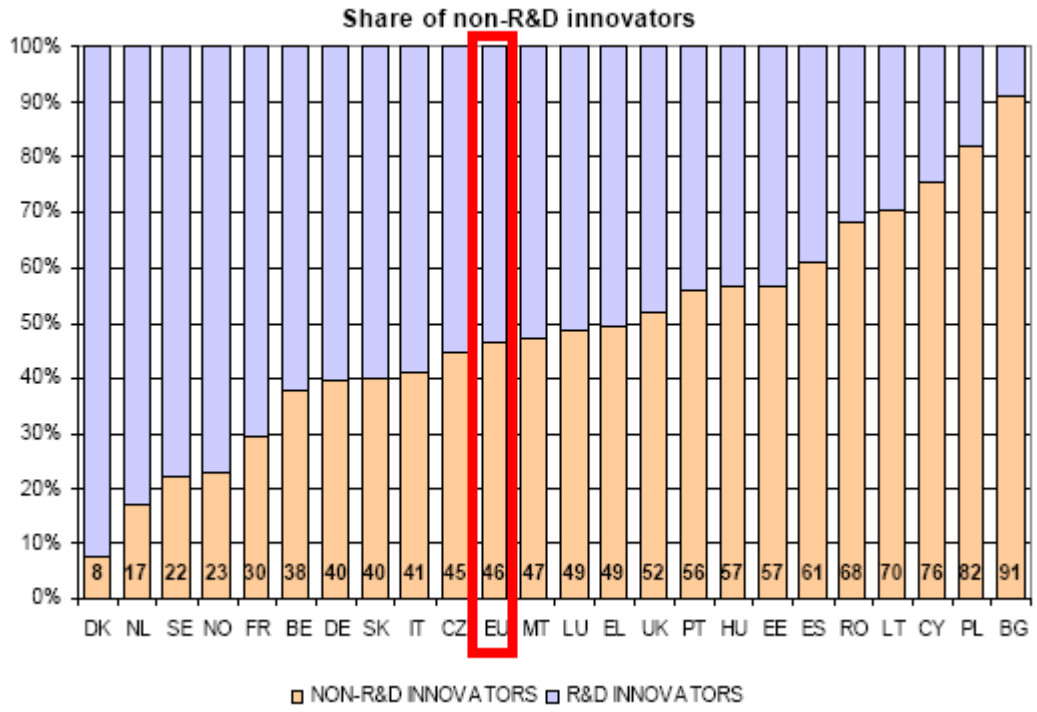
Key Figures 2007

(ii) Catching-up and innovation inputs: Technology adoption versus creation

Although R&D is vital for many innovation activities of firms and the competitiveness of an industry and a country, for countries in the earlier stages of catching-up, absorptive capacity rather than creative innovative capacity may be more important. This absorptive capacity is more difficult to document empirically, particularly as regards changes over time. The Community Innovation Survey shows that almost half of the European innovators do not conduct intramural or in-house R&D. Such non-R&D innovation includes the purchase of advanced machinery and computer hardware specifically purchased to implement new or significantly improved products or processes, the purchase of rights to use patents and non-patented inventions, licenses, knowhow, trademarks and software, internal or external training activities for firm's personnel aimed at the development or introduction of innovations, and internal and external marketing innovations aimed at the market introduction of new or significantly improved products.

As the following graph shows, the shares of non-R&D innovators tend to be higher in the new Member States. Non-R&D innovators are concentrated in low technology manufacturing and service sectors. The distribution of these non-R&D innovators is also skewed towards small and medium sized firms.

Graph 4.2: Share of non- R&D innovators in EU-27



Source: EIS 2008

(iii) Catching-up and convergence in innovation outputs: patents

Patent-based indicators are among the most frequently used proxies to measure technological output. There is a strong and positive relationship between the number of registered patents per capita in a country and the level of its business R&D intensity. MS with high levels of business R&D expenditure relative to GDP, such as Germany, Sweden, Finland and Denmark, are also countries with the largest numbers of patent applications per million inhabitants. In contrast, "catching up MS" are lagging behind (see Table 4.9). In 2005, all of them were significantly below the EU-27 average. The best performing country is Ireland, but Portugal and Greece score very low, even below the average score for transition countries. Among transition countries, the closest to the EU average but still very far below is Slovenia. If the figures for 2005 are compared with the ones for 2000, there is some limited catching-up, but the gaps are still substantial.

(iv) Catching-up/convergence in scientific publications

In contrast to patent registrations, smaller gaps and more convergence have been achieved by the catching-up MS in the area of scientific output (see Table 4.9). The smaller gaps in scientific publications relative to patents, are reminiscent of the supra reported larger gaps in Business R&D expenditures as compared to total expenditures on R&D (private and public). While patents reflect inventive and innovative activities that are proprietary in nature and mainly developed for commercial purposes, scientific publications informs mainly about the activities of the academic community and is predominantly financed from public R&D resources.

Overall, we see that the EU-27 has managed, on the back of a larger annual average growth in scientific publications, to catch-up and jump the US in terms of scientific publications. If we look inside the EU-27, the most dynamic are the catching-up countries. Although they report a 4 times higher average annual growth rate, they nevertheless represent slightly less than 20% of all EU-27 scientific output. Most of this comes from the former cohesion countries.

Table 4.7a : Scientific production of EU & US (as% of world)

	1995	2000	2005	AAGR95-05
World	100	100	100	2.3
US	34.2	30.6	28.9	0.6
EU-27	34.7	35.3	33.1	1.8

Table 4.7b : Scientific production of EU Member States (as% of EU-27)

Frontier	85.9	83.7	80.8	1.2
Catching-up	14.1	16.2	19.1	4.9
Transition	6.1	6.6	7.3	3.6
Former Cohesion	8.0	9.5	11.8	5.7

Source: Own calculations on the basis of NSF, S&E Indicators 2008

If we look at the individual countries, we see that all former cohesion countries report substantially above average growth rates, with this time Ireland as the "lesser" performing country, particularly taking into account its potential for growth, given its lower base level. The transition countries display a wide heterogeneity in growth performance, with as positive outliers Slovenia, Lithuania and Estonia, while Slovakia, Latvia and Bulgaria witnessed a decline in scientific production. [18]

Table 4.8: Scientific production of EU catching-up member states

	Share in EU-27 1995	Share in EU-27 2000	Share in EU-27 2005	Average annual growth (95-05)
SLOVENIA	0.2%	0.4%	0.4%	8.7%
LITHUANIA	0.1%	0.2%	0.2%	8.2%
ESTONIA	0.1%	0.2%	0.2%	7.1%
CZECH	1.0%	1.3%	1.3%	4.8%
POLAND	2.3%	2.9%	2.9%	4.1%
HUNGARY	0.9%	1.1%	1.1%	3.9%
ROMANIA	0.3%	0.4%	0.4%	2.3%
SLOVAKIA	0.6%	0.4%	0.5%	-1.6%
LATVIA	0.1%	0.1%	0.1%	-2.0%
BULGARIA	0.5%	0.5%	0.3%	-2.3%
PORTUGAL	0.5%	1.2%	1.2%	10.8%
GREECE	1.1%	1.8%	1.8%	7.3%

[18] Scientific profile of articles published by researchers from transition NMS show a high level of similarity. It typically consists of a large cluster relatively specialised in physics and astronomy, mathematics and statistics and chemistry. To a lesser extent, these countries are also relatively active in engineering sciences. With this scientific activity profiles, transition NMS show some similarities with those of the southern European countries of Greece, Portugal and Spain (Key figures, 2007, p. 93).

IRELAND	0.6%	0.9%	0.9%	5.5%
SPAIN	5.8%	6.6%	7.8%	4.8%

Luxemburg, Malta & Cyprus with < 100 ISI publications: not reported
Source: Own calculations on the basis of NSF, S&E Indicators 2008

4.3.3. A summary of Catching-up in Innovation Inputs and Outputs

In this section, we summarize the information on catching-up in innovation inputs and outputs. For inputs we use the GERD information, for outputs we use both S&E articles and EPO applications, as these are standard statistics available over time and all countries. The information on technology acquisition, which is for most catching-up countries more relevant than technology creation, is unfortunately not time comparable, and can therefore not be included in our summary innovation performance index. Nevertheless, creative capacity is also an important component of absorptive capacity needed for an effective technology acquisition strategy.

Table 4.9 Catching-up in Innovation Inputs and Outputs

	GERD		S&E Articles		EPO		INN		Years to Catch-up
	1998	2006	1995	2005	1995	2005	T=1	T=2	
Former Cohesion Countries									
IRELAND	0,66	0,72	0,81	1,08	0,42	0,61	0,63	0,80	8
SPAIN	0,49	0,65	0,70	0,89	0,15	0,28	0,45	0,61	14
PORTUGAL	0,37	0,45	0,24	0,58	0,02	0,07	0,21	0,37	14
GREECE	0,29	0,31	0,47	0,81	0,04	0,06	0,27	0,39	20
Average	***0,45***	***0,53***	***0,55***	***0,84***	***0,16***	***0,25***	***0,39***	***0,54***	
Transition Countries									
ESTONIA	0,32	0,62	0,38	0,68	0,03	0,05	0,24	0,45	10
CZECH	0,65	0,84	0,47	0,65	0,03	0,07	0,38	0,52	18
SLOVENIA	0,76	0,86	0,54	1,08	0,19	0,30	0,50	0,75	6
LITHUANIA	0,31	0,43	0,12	0,25	0,01	0,01	0,15	0,23	28
SLOVAK	0,44	0,27	0,49	0,36	0,02	0,06	0,32	0,23	∞
POLAND	0,37	0,30	0,29	0,37	0,01	0,03	0,22	0,23	246
LATVIA	0,22	0,38	0,17	0,12	0,01	0,05	0,13	0,19	43
HUNGARY	0,38	0,54	0,42	0,54	0,08	0,07	0,29	0,38	31
ROMANIA	0,28	0,24	0,07	0,09	0,01	0,01	0,12	0,11	∞
BULGARIA	0,32	0,26	0,28	0,21	0,01	0,01	0,21	0,16	∞
Average	***0,41***	***0,47***	***0,32***	***0,43***	***0,04***	***0,07***	***0,26***	***0,33***	

Note: GERD refers to a country's gap in GERD(as% of GDP) relative to the EU-27 average. S&E articles refers to the a country's gap in the ratio of S&E articles per mill inhabitants, relative to the EU-27 average. EPO refers to a country's gap in the ratio of EPO applications per mill inhabitants, relative to the EU-27 average. INN refers to the average of the three gaps in GERD, S&E articles and EPO applications[19].

[19] Given more weight to the BERD gap (e.g. by adding next to the overall GERD gap, also the BERD gap in the INN composition), gives very similar average results. (E.g. for Transition Countries an average score on INN of resp 0.27 (T=1) and 0.33 (T=2) and for Former Cohesion Countries 0.39 and 0.51).

Source: Own calculations on the basis of Eurostat and NSF

As the table indicates, none of the catching-up countries, including the former cohesion countries, have caught up with the EU-27 average on innovation. The gap is largest on EPO patent applications and furthermore most difficult to close. Only Ireland and Slovenia have made some progress here. For S&E articles the gap is smaller and easier to close.

Particularly Romania and Bulgaria face serious gaps on all innovation dimensions and furthermore, are increasing their gap. Also Slovakia is increasing its gap, while Poland fails to progress. The better performing countries are Slovenia and Czech Republic, both in terms of catching-up and in lowest gap remaining at the end of the observed period. Also Estonia is a star performer in terms of growth. Although Portugal has progressed on innovation performance particularly on the public sector part, it nevertheless remains at a serious gap relative to the EU-27 average.

Overall, the analysis confirms a substantial heterogeneity among catching-up countries on (improvements in) innovation in-and outputs, a heterogeneity that is larger than the patterns in GDPpc and furthermore rather persistent over time. Also among the former cohesion countries, there remains a large heterogeneity in innovation performance.

V. Analysing the scope for catching-up MS on their way towards closing their knowledge economy gap: assessing flanking conditions for building a Knowledge Economy

Having documented the performance of catching-up MS on growth in GDPpc and innovation inputs and outputs in the previous chapter, this chapter will assess how catching-up countries in our sample are performing on the flanking conditions for a successful innovation-growth nexus. A country's performance on these flanking conditions can inform on the long-term sustainability and robustness of their path towards a knowledge based economy.

5.1. Indicators to measure the key factors/pillars for building a Knowledge Economy

As reviewed in previous chapter, the key drivers for establishing a successful knowledge-for-growth nexus, particularly those relevant for catching-up countries, are:

- Institutional quality, Financial Market Sophistication and Macro-economic stability
- Product Markets, Competition, International Openness, FDI
- Absorption of new technologies and ICT availability and use
- Education and human resource development (such as secondary & tertiary enrolment, quality of education and training)
- Creative capacity drivers (such as availability of scientists, quality of the public research institutes, University-Industry links, venture capital availability, IPR protection)

.

To measure these dimensions, we will use various factors used in the 2007 World Economic Forum- Global Competitiveness Indicators. This database has the advantage of covering all countries. The WEF indicators are a mixture of hard data and information from the WEF Executive Opinion Survey. Although the latter information is subjective, it nevertheless allows assessing dimensions that are hard to cover with hard data and it provides the view from important innovation actors. It can however not be compared over time[20].

A closely related exercise is the World Bank's Knowledge Economy Index (KEI). The KEI is a composite measure of a country's performance on 4 pillars which they consider as key for driving a Knowledge Economy

(i) economic incentive and institutional regime (EIC),
(ii) education (EDU),
(iii) innovation (INN), and
(iv) ICT.

[20] Although the GCI has been published since 2002, there are major changes in the methodology over time that do not allow for meaningful comparisons over time. More particularly, in 2006, the WEF-GCI adopted a new methodology developed by Sala-i-Martin to compose the overall GCI score, while up till then it had been using a methodology developed by Jeffrey Sachs. On the subcomponents, only the last versions of the data are available on the internet.

Economic Incentives is based on Tariff & Non-Tariff Barriers, Regulatory Quality, Rule of Law; *Innovation* is measured through Royalty and License Fee Payments & Receipts, USPTO Patent Applications and Scientific and Technical Journals; *Education* uses Adult Litteracy, Secondary & Tertiary Enrollment; *ICT* is Telephone, Computer and Internet penetration.

Availability of data across countries and time restricts the construction of the KEI indicator. The Innovation Pillar is measuring innovation output[21], not innovation drivers and ICT only measures the adoption of ICT technologies by the population, not the business sector adoption of new technologies. The KEI-scoreboard has however the advantage that it allows comparisons among all countries for 1995 and 2008 (or latest year available), and therefore to discuss progress on KEI factors. Because of this time comparison advantage we will discuss the WB-KEI results first, before analyzing our own KE factors in section 5.3.

5.2. Catching-up on Knowledge Economy drivers

Appendix A.2. contains the WB-KEI scores for 1995 and 2008. As we are interested in the actual KE drivers excluding the innovative performance (INN), we calculate the countries' average score on the 3 subpillars EIC, EDU & ICT, and label this score as KEI_d.

All the NMS covered in the sample have advanced on their KEI_d score between 1995 and 2008 (see Appendix). They have all reduced their gap vis-a-vis the leading EU countries. This closing of the gap is partly because the leaders have lost momentum (exc Sweden). Old MS have seen their KEI_d index reduced, particularly France. Italy was the bottom country among leading EU countries in 1995 and by 2008, its gap has increased even further.

Ireland is among the former cohesion countries, the strongest and more or less stable performer on the KEI_d index, with Spain second. Portugal and Greece, already lowest among the cohesion countries in 1995, have seen their KEI_d deteriorating in the 1995 – 2008 period, leaving a much higher heterogeneity among cohesion countries in 2008 than in 1995.

Among the transition MS, the progress of the Baltic States is remarkable. Estonia has almost no gap left on EIC & ICT. Together with Slovenia, it is the KEI_d leader among the transition MS. Also Romania has made strong improvements, but nevertheless, continues to be the bottom performer.

Regressing the initial position of our countries on the KEI_d indicator to the catching-up performance on this indicator, results in a significant negative coefficient -0.359(0.061)***, supporting β-convergence on the drivers for a Knowledge Economy among EU countries. Positive outliers in the regression, i.e. countries that are growing faster than what could

[21] Innovation Performance is measuring highly specific dimensions, which are not close to those relevant for countries catching-up on the technology frontier (Royalty and License Fee Payments & Receipts, USPTO Patent Applications and Scientific and Technical Publications)

have been expected for our catching-up countries sample, are the Baltic States, Lithuania and Latvia. Negative outliers are Portugal and Greece[22].

In summary the KEI results indicate that although the best performing countries in terms of GDPpc are also these ones with the highest KEI_d scores, the knowledge economy ratings do not follow a simple newMS – old MS divide. While the strongest Knowledge Economy countries are all found in Scandinavia, the weakest group of countries, does include most transition economies, starting with Romania and Bulgaria, but it also includes some of the older MS, most notably, Portugal and Greece (and Italy). At the same time, some of the transition countries, i.c. Estonia, Slovenia and Czech Republic, have already made it into the lower-middle group of KE countries, while Ireland has already made it into the middle group of KE countries. [23]

5.3. Catching-up countries' performance on key KE drivers

Unlike the WB-KEI exercise, or the EC-EIS, we will not attempt to summarize the information on KE drivers in a composite indicator, as we are mostly interested in the underlying factors. We will discuss (i) Institutional quality, financial market sophistication and macro-economic stability; (ii) Product Markets, Competition and Openness; (iii) absorption of new technologies; ICT; (iv) Education and Training; (v) Creative capacity drivers (IPR protection, availability of scientists, quality of public research institutes, venture capital availability) separately.

In the tables we report the catching-up EU countries, split into (former) cohesion countries and EU transition countries. For the latter group of countries, the average score, average gap relative to the frontier countries and the standard deviation is also reported.

5.3.1. Institutional quality, Financial Market Sophistication and Macro-economic stability

Table 5.1. Institutional quality, Financial Market Sophistication and Macro-economic stability

	Institutions	Corruption	MEstability	FinMarkSoph
EU Cohesion				
IRELAND	5,39	7,50	5,33	5,68

[22] A higher score on the drivers for a Knowledge Economy (KEI_d) leads to higher scores on Innovative Performance (INN). Regressing the countries' INN08 on their KEIz95 score gives a coefficient of 1.00(0.06)***. And also improvements in KEI drivers are positively related to improvements in Innovative performance. Regressing the countries' ΔINN95-08 on their ΔKEIz95-08 score gives a coefficient of 0.77(0.165)***

[23] Similar results where also found by the EIS exercise (see appendix) and by Radosevic (2004)). In addition to a high-tech "north" cluster composed of four MS with the highest national innovation capacities in EU (Finland, Sweden, Denmark and UK), he obtained two other clusters comprised of the majority of the catching-up MS as well as some other MS. One cluster is composed of the 3 cohesion states (Spain, Portugal and Greece) and 6 less advanced NMS (Slovakia, Romania, Latvia, Lithuania, Poland and Bulgaria). They are characterized by rather weak national innovation capacities. The 4 more advanced NMS (Czech Republic, Slovenia, Estonia and Hungary) together with 6 old MS (Austria, Belgium, Germany, France, Italy and Ireland) form a kind of a "middle level" group of the EU.

SPAIN	4,59	6,70	5,53	4,93
PORTUGAL	4,75	6,50	4,74	4,71
GREECE	4,10	4,60	4,37	4,29
EU-Transition				
ESTONIA	4,85	6,5	5,72	5,08
CZECH	3,67	5,2	5,37	4,65
SLOVENIA	4,40	6,6	5,48	4,67
LITHUNIA	4,19	4,80	5,23	4,50
SLOVAK	3,85	4,90	5,31	5,04
POLAND	3,63	4,20	5,26	4,28
LATVIA	4,05	4,80	4,91	4,80
HUNGARY	3,94	5,30	4,20	4,42
ROMANIA	3,63	3,70	4,85	4,42
BULGARIA	3,28	4,10	5,21	4,18
Mean Transition score (stdev)	**3,95 (0.45)**	**5,01 (0.95)**	**5,15 (0.42)**	**4,60 (0.30)**
Mean Transition gap	**0.72**	**0.62**	**0.95**	**0.87**

Notes:
Countries are ranked inside each group on their overall WEF-GCI index. Top and bottom performers in each group are colored. Gap is relative to EU-leading countries.
Institutions is composed out of public institutions (75%) (property rights, ethics, undue influence, government inefficiency, security) and private institutes (25%) (corporate ethics, accountability) WEF-EOS
Corruption: A country or territory's degree of public corruption (0 = highly corrupt, 10 = highly clean); Transparency International
Macro-economic stability: government surplus/deficit, national savings rate, inflation, interest rate spread, government debt;
Financial Market Sophistication: Efficiency 50% (financial market sophistication, financing through local equity market, ease of access to loans, venture capital availability, restriction on capital flows, strength of investor protection); Trust & confidence 50% (soundness of banks, regulation of securities exchanges, legal rights index);

Source: Own calculations on the basis of WEF, GCI 2008

As macro key factors for a Knowledge Economy are included: Quality of institutions, Corruption, Macro-economic stability and Financial market sophistication. On all of these indicators, catching-up countries are still lagging behind the EU leading countries. But particularly on Macro-economic stability and Financial Market Sophistication the gap in 2008 is relatively small, and also with relatively little dispersion within the group. Only on corruption, the gap is still high and with a high variance, with Romania at the bottom and Slovenia the top transition country. On Institutions, Corruption and Financial Market Sophistication, Bulgaria, Romania and Poland are the lagging countries. For Macro-economic stability, the bottom country is Hungary. Within the group of former cohesion countries, Portugal and especially Greece, are the lagging countries.

5.3.2. Product Markets, Competition, International Openness, FDI

Table 5.2: Product Markets, Competition, International Openness, FDI

	Market Size	Days StartBus	Local Competition	Trade Openness	FDI openness
IRELAND	4,22	6.3	5,4	5,73	6,5
SPAIN	5,47	4.2	5,8	5,34	5,5
PORTUGAL	4,32	6.7	5,3	5,08	5,3
GREECE	4,52	4.8	5,2	5,20	5,3

ESTONIA	3,04	6.7	5,6	5,20	5,7
CZECH	4,45	6.1	5,8	5,61	5,7
SLOVENIA	3,44	3.4	5,1	5,71	4,3
LITHUNIA	3,51	5.5	5,4	5,52	4,9
SLOVAK	3,94	5.6	5,7	5,67	6,4
POLAND	5,00	5.2	5,3	5,12	4,7
LATVIA	3,24	6.1	5,1	4,88	5,5
HUNGARY	4,28	6.1	5,4	5,46	6
ROMANIA	4,38	6.3	4,7	4,27	4,9
BULGARIA	3,83	5.2	5,0	4,11	4,3
Mean Transition Score (stdev)	**3,91 (0,62)**	**5.6 (0.91)**	**5,3 (0,34)**	**5,16 (0,57)**	**5,24 (0,72)**
Mean Transition Gap	**0,77**	**0.89**	**0,92**	**0,87**	**0,90**

Market size: domestic market size (75%) and foreign market size (25%); hard data;
DaysStart: Days required to start a business (Doing Business Worldbank)
Intensity of Local Competition; Competition in local market is 1=limited in most industries and price-cutting is rate, 7= intense and market leadership changes over time)
FDI: Foreign ownership of companies in your country is (1 = rare, limited to minority stakes, and often prohibited in key sectors, 7 = prevalent and encouraged)

Source: Own calculations on the basis of WEF-Global Competitiveness Report information

Also on product market openness, all catching-up countries score lower than EU leading countries, but again the gaps are not substantial. This is reminiscent of the already historically internationally open nature of most of the catching-up countries. But on FDI, as well as on easy of entry, important levers for technological progress in catching-up countries, there is a large heterogeneity among transition countries, with Estonia scoring high, while Bulgaria and Slovenia scoring low.

5.3.3 Absorption of new technologies and ICT

Catching-up countries are typically not at the frontier of technological know-how. This consequently means that technological progress in these countries occurs mainly through the adoption and adaptation of pre-existing technologies that are either new to the country or to the company into which they are transferred. Whether this occurs depends on (i) whether the companies have access to the latest technologies and (ii) are willing to adopt.

Particularly Information and Communication Technologies (ICT) are a technological backbone for innovations. The impact of ICT industries as well as ICT applications for innovations in other sectors of the economy is significant. There are basically three channels through which ICT affects productivity and growth. First, rapid technological progress in the production of ICT goods and services contributes to productivity growth. Second, investment in ICT contributes to the overall capital deepening and therefore helps raising labour productivity in investing sectors. And third, greater use of ICT may help individuals to increase their overall (innovative) efficiency. It is the latter two mechanisms, i.e. ICT investment and use, that we want to measure here.

Table 5.3: Absorption of new technologies and ICT

	Latest Technology Availability	Firm level Technology Absorption	ICT Availability & use
IRELAND	5,5	5,5	4,84
SPAIN	5.2	4,8	4,83
PORTUGAL	5,7	5,2	4,68
GREECE	4.7	4,4	3,92
ESTONIA	5,8	5,5	5,40
CZECH	5,1	5,3	4,44
SLOVENIA	5,1	4,8	4,88
LITHUNIA	5,0	5,1	4,38
SLOVAK	5,1	5,3	3,86
POLAND	4,4	4,5	3,76
LATVIA	4,7	4,7	3,90
HUNGARY	4,7	5,0	4,21
ROMANIA	3,9	4,4	3,58
BULGARIA	3,8	3,6	3,54
Mean Transition Score (stdev)	**4,8 (0,60)**	**4,8 (0,56)**	**4,20 (0,60)**
Mean Transition Gap	**0.76**	**0.80**	**0.85**

Latest Technologies: In your country, the latest technologies are (1 = not widely available or used, 7 = widely available and used)
Firm technology absorption: Companies in your country are (1 = not able to absorb new technology, 7 = aggressive in absorbing new technology)
ICT availability and use: Broadband internet subscribers, internet users and main telephone lines per population.

Source: Own calculations on the basis of WEF-Global Competitiveness Report information

On both dimensions of availability of latest technologies (access) and effective absorption of new technologies, former cohesion countries and transition economies are trailing behind the EU leading countries, particularly the Scandinavian countries. But the variation is considerable, with the top performing countries, Ireland and Portugal and Estonia, Czech Republic, Slovakia and Lithuania. Portugal's low innovative & growth potential seems not not related to low availability or adoption of existing technologies, as Portugal is scoring good on these indicators. Bottom countries are Bulgaria, Romania, and Poland, but also Greece.

In the areas of ICT use, Ireland and Spain are frontrunners among the former cohesion countries, with Greece seriously trailing behind (like also Italy among the EU leading countries). But the transition countries are on average not trailing behind too much, particularly relative to the former cohesion countries. Nevertheless, there is an important variation across countries[24]. Czech Republic, Estonia, and Slovenia are better positioned than other transition MS, with Estonia an extreme positive outlier, while Bulgaria and also Romania are bottom countries.

[24] Even higher disparities can be observed when concentrating on broadband penetration. While the number of dedicated, high-speed connections per 100 inhabitants, increased in EU-15 almost 10 times in only 6 years; from 2.3 in 2002 to 20.8 in 2007, the disparity among the old but also among the transition MS is large. Estonia has almost closed the gap while there are 4 new MS together with Greece with rates below 7 (Eurostat, December 2008).

5.3.4 Education and human resource development

Education and training policies are of vital importance for the creation and transmission of knowledge and are at the same time a determining factor of a society's potential for innovation.

As shown in the EDU pillar of the World Bank's KEI (see Appendix 2.A), the three Baltic states, Czech Republic and Slovenia have by 2008 almost closed the educational gap vis-à-vis the leading EU countries, while most of the other "catching-up MS have reduced the gap significantly between 1995 and 2008. Among the former cohesion countries, Spain and Greece have also caught up, while Ireland had already closed the gap earlier. The only negative outlier is Portugal for which the educational gap has even increased.

Table 5.4: Education and Training

	Tertiary Enrol	Quality of Education	Training	Brain Drain
IRELAND	4.7	5,6	5,0	5,1
SPAIN	5.3	3,8	3,9	4.5
PORTUGAL	4.4	3,5	3,8	3.6
GREECE	7.0	3,3	3,7	3.4
ESTONIA	5.1	4,5	4,6	3.8
CZECH	4.2	4,7	4,7	4.0
SLOVENIA	6.3	4,4	4,3	3.9
LITHUNIA	5.8	3,7	4,4	3.0
SLOVAK	3.9	3,4	4,4	2.7
POLAND	5.2	3,8	3,6	2.7
LATVIA	5.7	3,7	4,0	3.5
HUNGARY	5.3	3,2	3,4	3.0
ROMANIA	4.3	3,6	4,1	2.6
BULGARIA	3.9	3,3	3,1	2.1
Mean Transition Score (stdev)	**5.0 (0,85)**	**3,8 (0,53)**	**4,1 (0,53)**	**3.1 (0.64)**
Mean Transition Gap	**0.97**	**0.75**	**0.78**	**0.68**

Gross tertiary enrolment: the ratio of total enrolment, regardless of age, to the population of the age group that officially corresponds to the level of education, rescaled to 1-7.
Quality of the education system: The educational system in your country (1 = does not meet the needs of a competitive economy, 7 = meets the needs of a competitive economy)
Extent of staff training ("In your country, the general approach to human resources is to invest =1 little in training and development, 7=heavily to attract, train and retain staff")

Source: Own calculations on the basis of WEF-Global Competitiveness Report information

When focusing on Tertiary Enrolment, which is the most important differential factor for a country's path towards the frontier as a Knowledge Based Economy, also here on average the gap of the catching up economies is small, but there is considerable variation between the top and the bottom performer. Slovenia is scoring extremely high (similar to the US), while Slovakia and Bulgaria are trailing behind. Portugal is scoring lowest among former cohesion countries when isolating tertiary education. Greece is scoring almost maximally on gross Tertiary Enrolment, but it is also scoring very low on the Quality of Education and Training, therefore minimizing the impact of education as a flanking condition for a

Knowledge Based catching-up process. Also Hungary and Bulgaria score low on Quality and Training. For Bulgaria and Romania, Brain Drain is an issue restricting their access to skills. In general Brain Drain is an issue where catching-up countries have a large gap relative to EU15. Beyond Bulgaria and Romania, also Poland suffers from Brain Drain. Push factors are clearly important for Brain drain, as the problem becomes less acute for better performing countries. Countries scoring best on Brain Drain are Slovenia, the Czech Republic, and Estonia, who score even better than Poland and Greece and even Italy in the EU15.

5.3.5. Creative capacity drivers

Table 5.5: Creative capacity Drivers

	IPR Protection	Availability scientists & engineers	Quality of Public Research Institutes	University-Industry Research Cooperation	Venture Capital Availability
IRELAND	5,6	5,3	5,3	4,8	4,5
SPAIN	4,1	4,6	4,1	3,4	3,9
PORTUGAL	4,9	4,5	4,6	3,6	3,4
GREECE	4,7	5,2	3,8	2,9	3,0
ESTONIA	4,8	4,1	4,9	3,9	4,3
CZECH	3,9	5,4	4,9	4,1	3,0
SLOVENIA	4,4	3,9	4,8	3,8	3,5
LITHUNIA	4,0	4,2	4,3	3,3	3,3
SLOVAK	3,7	4,9	3,7	3,7	3,7
POLAND	3,4	4,1	4,1	3,2	3,3
LATVIA	3,6	3,3	3,6	3,2	3,2
HUNGARY	4,1	4,5	5,0	3,8	2,8
ROMANIA	3,5	4,3	3,6	2,8	3,0
BULGARIA	2,9	3,7	3,7	2,7	3,0
Mean Transition Score (stdev)	**3,8 (0,54)**	**4,2 (0,59)**	**4,3 (0,59)**	**3,5 (0,48)**	**3,3 (0,44)**
Mean Transition Gap	**0.66**	**0.81**	**0.79**	**0.72**	**0.78**

IPR Protection: Intellectual property protection and anti-counterfeiting measures in your country are (1 = weak and not enforced, 7 = strong and enforced)
Availability of Scientists: Scientists and engineers in your country are (1 = nonexistent or rare, 7 = widely available)
Quality of Public Research Institutes: Scientific research institutions in your country (e.g. , university laboratories, government laboratories) are (1 = nonexistent, 7 = the best in their fields internationally);
University-Industry Research Collaboration: Companies' collaboration with local universities in R&D in your country is (1=minimal or nonexistent, 7=intensive and ongoing).
Venture Capital Availability: In your country, how easy is it for entrepreneurs with innovative but risky projects to find venture capital? (1 = impossible, 7 = very easy)

Source: Own calculations on the basis of WEF-Global Competitiveness Report information

Overall, catching-up countries score on average still below the EU leading countries on all creative capacity drivers. Venture capital availability has the lowest score, but this holds also for leading EU countries. There is considerable variation across countries. Ireland is among the catching-up countries clearly leading on all creative capacity drivers, having caught-up with EU leading countries in almost all dimensions, and scoring significantly higher than the laggard EU leading country Italy. Greece is with the exception of

availability of scientists and IPR protection, the serious laggard on creative capacity drivers, even scoring below the average score for transition countries.

For the transition countries, gaps are highest on IPR protection and industry-science collaboration. They are smallest for availability of scientists and quality of public research organizations, but there is more variance on these dimensions. Estonia is not top on most of the innovation drivers, particularly the science-based related indicators. Only on IPR and Venture Capital availability, Estonians score highest. Hungary scores high on the supply side factors (availability of scientists, quality of public research institutes) but scores low on the other drivers (particularly venture capital availability).

Summarizing the evidence on flanking conditions for a knowledge based catching-up process, suggests that despite a large heterogeneity across countries, the better performing countries, like Estonia, Czech Republic and Slovenia typically have a good scoring on all indicators reviewed. And similarly, countries at the bottom, such as Bulgaria and Romania for transition countries and Greece among former cohesion countries, score on average also low on most flanking conditions. The evidence from Portugal and Hungary suggests that doing well on some flanking indicators, but not on others, is not likely to lead to an overall good performance. All this indicates that systemic performance on flanking conditions is needed for a Knowledge Based Economy. Consequently, improving performance for lagging countries requires a systemic policy approach.

VI. Assessing the past and future economic and knowledge economy convergence of "catching-up MS"

As the analysis in the previous sections has shown, "Catching-up MS" have been rather successful in achieving real economic convergence of their economies with more developed ones. In contrast to this positive and robust real economic convergence, the performance of the "catching up MS" with respect to their knowledge economy convergence has been not only much slower but has also varied substantially from one country to another. Even though the initial level of economic development and innovation inputs were an important determinant of these countries' performance on knowledge indicators, there have been other factors at work (or not at work) with significant implication on the success / failure of this process.

The matrix below classifies "catching-up MS" according to their performance with respect to achieving both, economic as well as knowledge economy convergence to the more developed MS. Economic convergence is measured with the success of a country in reducing its GDP per capita gap vis-a-vis the EU-27 average in the 1993 – 2007 period (Table 4.2), while knowledge economy convergence is measured with the Innovation Performance Index used in Table 4.9. There are two parts to the matrix. The first part reflects the changes in gaps, i.e. the convergence process, while the second part reflects the size of the gap remaining at the end of the observation period.

Matrix of economic and knowledge economy convergence performance of "catching-up MS"

I. Status of the gap in GDPpc and Innovation at start of the period

GDP per capita gap / Innovation gap	Large	Medium	Small/closed
Large	Romania, Bulgaria, Estonia, Latvia, Poland, Slovak, Lithuania	Portugal, Greece Hungary, Czech, Slovenia	Spain
Medium			Ireland,
Small/closed			

Notes:
GDP per capita gap relative to EU-27 assessed at 1993 (see Table 4.2). Large is <50, Small/closed is >90
Innovation gap relative to EU-27 assessed at start of the period (1998 for GERD, 1995 for EPO and S&E articles) (see Table 4.9). Large is <50; Small/closed is >90
Former cohesion countries are listed in the first line of the cell, transition economies in the second line.

II. Reducing the gap on GDPpc and Innovation

GDP per capita catching-up / Innovation catching up	Negative or status-quo	Modestly positive	Strongly positive
Negative or status-quo		Bulgaria, Poland	Romania, Slovakia
Modestly positive		Greece, Spain Czech, Hungary	Ireland Latvia
Strongly positive	Portugal	Slovenia	Estonia, Lithuania

Notes:
GDP per capita catching-up (93-07) is measured as the change in the gap in GDPpc relative to EU-27 over the period 93-07 as a % of the initial gap in 1993. (see Table 4.2). Strongly positive is above the average for all cohesion/transition countries. Negative or status-quo is for increasing gaps and/or almost stable gaps. Innovation catching-up is measured as the change in the gap in Innovation relative to EU-27 over the period considered (see Table 4.9). Strongly positive is above the average for all cohesion/transition countries. Negative or status-quo is for increasing gaps and/or almost stable gaps

Matrix of economic and knowledge economy convergence performance of "catching-up MS"

III. Status of the gap in GDPpc and Innovation at end of the period

GDP per capita gap / Innovation gap	Large	Medium	Small/closed
Large	Romania, Bulgaria	Portugal Estonia, Latvia, Poland, Slovak, Lithuania, Hungary	Greece
Medium		Czech	Ireland, Spain Slovenia
Small/closed			

Notes:
GDP per capita gap relative to EU-27 assessed at 2007 (see Table 4.2). Large is <50, Small/closed is >90
Innovation gap relative to EU-27 assessed at end of the period (2006 for GERD, 2005 for EPO and S&E articles) (see Table 4.9). Large is <50; Small/closed is >90

Matrix of economic and knowledge economy convergence performance of "catching-up MS"

IV. Time to catch-up to EU-27 average

GDP per capita / Innovation	Indefinite	Long	Medium	Short	Reached
Indefinite		Romania, Bulgaria	Slovakia		
Long		Poland, Hungary	Latvia		
Medium	Portugal		Lithuania, Czech Republic	Greece	Spain
Short			Estonia	Slovenia	Ireland
Reached					

Note: Reached implies the country is at or above EU-27 average in 2007
Short: less than 10 years for catching-up (extrapolating average annual growth rates from the past 93-07); Long: more than 30 years for catching-up. Indefinite: with given growth rates, no catching-up possible.

In the observed period, the "catching up MS" as group have made significant progress in terms of economic convergence, with Spain and Ireland have closed the gap with the EU-27, and Greece, Slovenia and Estonia very close to closing the gap. Only Portugal has failed in reducing its gap in GDPpc.

But their knowledge economy convergence has been more limited. The size of the initial gap was for all countries with the exception of Ireland, sizeable. None of the catching-up countries has managed to close the gap. Only 4 catching-up countries witnessed an important catching-up (Estonia, Portugal, Lithuania and Slovenia). Ireland and Slovenia are the best placed countries at the end of the period, but are still at a considerable gap. And the worst placed countries (Romania and Bulgaria) are even falling further behind.

Linking knowledge economy catching-up to economic convergence in part II of the matrix suggest a positive correlation, but with considerable off-diagonal cases. The strong economic growth performance of Slovakia and Romania, and also the more modest growth performance of Bulgaria and Poland are not related to KE growth, as these countries have witnessed no catching-up on KE dimensions. Also on the KE growth drivers, these countries display bottom performance. This lack of a KE basis to their growth questions the sustainability of their economic convergence, particularly when these countries will move further on their economic development path. Also Greece's catching-up in GDPpc is not on a Knowledge Economy path, as its innovation gap remains substantial and also its scores low/bottom on most knowledge economy drivers.

Another off-diagonal case is Portugal. Although Portugal has managed to improve its innovation gap, it nevertheless fails to reduce its per capita GDP gap. The improvement in innovation is mostly a public sector component, with still a low scoring on business innovation performance. And also the KE drivers important for stimulating business innovation and linking industry to science are feeble, explaining the current weak innovation-growth nexus for Portugal[25].

Among the countries with a stronger innovation-growth nexus, Ireland stands out among the former cohesion countries, and Slovenia and Estonia among transition countries. Ireland is the top overall convergence country. This country has been able to achieve simultaneously strong convergence of their per capita GDP and at the same time it has substantially reduced the knowledge economy gap towards the best performing knowledge economies in EU-27. Its weakest point is however its small internal market and reliance on foreign sources. Also Slovenia is a small, but open (to trade, more than FDI) country. Its good convergence performance correlates with a scoring on most KE drivers which is good, but not excellent, with the weakest point being well functioning local product markets. Estonia's impressive growth performance, again a small country, is also matched by an impressive KE catching-up, nevertheless leaving the latter still at a substantial gap relative to the EU-27 average. Estonia's innovation connection to growth is less related to public research and industry-science links, but more towards private sector ICT and technology

[25] Gaspar & St Aubin (2007) when contrasting the adjustment process to the EURO of Portugal versus Spain, concluded that although the Portuguese policy of increased public spending exacerbated the adjustment process, fiscal policy factors were not sufficient strong explanatory factors. The authors concluded that the differential explanation had to be found in the extensive growth margin, related to differences in investment patterns and labour markets.

adoption by Estonian entrepreneurs. Again the question is whether this pattern will be able to sustain Estonia's growth performance in future.

Overall, the analysis seems to suggest that for several catching-up countries their path to convergence is not build on knowledge-based convergence, and for those countries where economic growth is innovation based, there are still considerable vulnerabilities to a robust knowledge-based economy development.

The matrices also confirm another conclusion, namely that a knowledge economy catching-up process does not follow a simple NMS-old MS divide. Some transition NMS, especially Slovenia and Czech Republic, are catching-up on the knowledge performance dimension and perform better than some of the former cohesion countries, like Portugal and Greece. A more demanding pre-accession process of the fifth enlargement might be related to this, but nevertheless individual country characteristics need to be factored in to explain why this more demanding pre-accession process has not worked for all NMS to the same extent.

VII. Some policy suggestions for strengthening knowledge economy convergence of the "catching-up MS"

The past catching-up experience in the EU shows a strong economic convergence. But on innovation, the gaps are more substantial and convergence much slower. Although there is a positive correlation between innovation and economic growth for all EU countries, there is an important country heterogeneity in innovative performance and the contribution of innovation to economic growth. For several countries their catching-up is not build on knowledge-based convergence, and for those countries where economic growth is innovation based, there are still considerable vulnerabilities to a robust knowledge-based economy development. Particularly their concentration of economic and creative capacity in few sectors, their dependence on foreign markets, foreign investors and foreign know-how sources, make their innovation-growth process more vulnerable, as the current crisis has made clear.

Remaining constraints to innovation-based long-run growth for catching-up MS include open product markets, financial market development/venture capital as well as the quality of skill formation and linkages, while the gap in institutional quality bodes badly for a successful implementation of a policy of structural reforms. Experience from the countries whose catching-up process has been the most innovation-based and successful indicates that systemic performance on all flanking conditions for an innovation-growth nexus is needed. Consequently, improving the knowledge-based content of catching-up for lagging countries requires a systemic policy approach addressing gaps on all flanking conditions, but with nevertheless a pivotal role for those reforms needed to incite the private sector to adopt and create new technologies. Addressing the catching-up countries' vulnerability requires having the critical flanking conditions to develop a broader *domestic* capacity, promoting *local* spillovers and *local* absorptive and creative capacity. To this end, reforms aimed at improving (product & financial) market functioning are crucial, particularly as these are pivotal for structural change towards new areas of domestic strongholds. This holds even more so in the current crisis. In presence of weaker financial markets and downturns in the economic cycle, especially credit constrained new local innovators, who are pivotal "change" actors, are at risk.

Major competences for the design and implementation of appropriate policies supporting a knowledge-based catching-up process reside at Member State level. The EU level nevertheless holds some important policy levers to complement Member State policies.

The major EU policy instrument for stimulating knowledge-based growth is the Lisbon Strategy, later relabelled as Growth & Jobs Strategy. A basic hypothesis of this Report is that the historic enlargement with the transition countries has made the implementation of the Lisbon Strategy even more challenging, due to the increased heterogeneity in the level of development among Member States. Yet to ensure a viable future economic, social and political cohesive EU, progress in new Member States towards a knowledge based economy is essential. This calls for specific attention to areas where gaps among Member States can cause delays in the building of an EU wide knowledge economy. Is the Lisbon Strategy in its current form able to cope with this challenge?

When dealing with the idiosyncrasies of catching-up countries and improving convergence and cohesion inside the EU, a number of amendments should be made to the Lisbon

strategy. As far as the governance of the Strategy is concerned, it should include improvements in the Commission's process of National Reform Programs' evaluations through an improved methodology for assessing these programs and through more systematic benchmarking and peer pressure. First, there is very little guidance on how to adapt the general principles outlined in the Integrated Guidelines to differences in initial conditions for individual "catching-up MS" and to differences along their development path. "Catching-up MS" are basically left on their own when drawing up their National Reform Programs on how to design a time-consistent knowledge-based catching-up process. Second, there is very little monitoring, benchmarking and diffusion of best practices among catching-up countries on the specific dimensions that are important for their knowledge-based catching-up process. Crucial empirical evidence and indicators are not systematically collected across countries and time to support such monitoring and analysis of practices. Third, in spite of some implementation improvements, the "open method of coordination" as the softest mechanism of policy coordination among the MS has *de-facto* proved to be a rather weak vehicle for introducing highly needed structural reforms. In contrast to the macroeconomic policy coordination of the EU which is institutionally centralised with the ECOFIN and bears potential sanctions stipulated within the Growth and Stability Pact, the coordination of the Lisbon strategy activities is strongly decentralised and without sanctions. In view of the gap in institutional quality which many catching-up countries face, external pressure remains an important driver for instigating internal reforms.

Even though implementation of the Lisbon strategy agenda is primarily a responsibility of MS and is consequently financed largely from national sources, the EU budget nevertheless represents and important source of funding of knowledge-for-growth investments in the "catching-up MS. The EU budget review currently under way and the forthcoming EU budget negotiations for the post-2013 will be crucial for the success of the post-2010 Lisbon-type strategy of structural reforms in catching-up MS. The EU budget review should make a clear recommendation for a substantial increase of EU funding of knowledge economy measures. The review of the EU budget is also an opportunity to re-assess how EU budget funds should be allocated among the MS to support a knowledge-based growth in countries, taking into account their idiosyncracies and thus avoiding a multi-tier EU. Funds aimed primarily at innovation creation should be channeled to the end users primarily on the "universal excellence principle" basis implemented through public biddings with eligible entities coming from all MS. For most catching-up MS, a more important EU budget component are the funds aimed at innovation absorption and adoption. These funds should continue to be allocated among the MS on the "country envelope principle" and should continue to represent an important component of the EU cohesion policy. The trend of growing participation of Lisbon-type expenditures in overall cohesion policy expenditures is a positive development and should be maintained.

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To conclude, there still remains a long way to go for a knowledge-based catching-up process in the EU. Will the current crisis, which has hit all of the catching-up countries particularly hard, be a threat or an opportunity for these countries to re-adjust themselves during the crisis and to put themselves on track for a post-crisis recovery path that will be more knowledge-based? As a knowledge-based development path provides a better capacity to adapt to global, changing, volatile environments, the more a country's development path is knowledge-based, the more sustainable this path will be in future. But with the benefits of this strategy in the longer term, the question in the short-term is whether the investments

needed for such strategy (both public and private) can be borne in the current crisis circumstances. The Report hopes to have contributed to a better case for such investments.

Appendix

Table A.1: Knowledge economy progress of the "catching-up MS" – SII of the Commission

	2003	2004	2005	2006	2007
EU27	0.45	0.45	0.45	0.45	0.45
BE	0.51	0.49	0.49	0.48	0.47
BG	0.20	0.21	0.20	0.22	0.23
CZ	0.32	0.33	0.33	0.34	0.36
DK	0.68	0.66	0.65	0.64	0.61
DE	0.59	0.59	0.59	0.59	0.59
EE	0.35	0.34	0.35	0.37	0.37
IE	0.50	0.49	0.50	0.49	0.49
EL	0.26	0.26	0.26	0.25	0.26
ES	0.32	0.31	0.32	0.32	0.31
FR	0.48	0.48	0.48	0.48	0.47
IT	0.32	0.33	0.33	0.33	0.33
CY	0.29	0.29	0.30	0.32	0.33
LV	0.16	0.16	0.17	0.18	0.19
LT	0.23	0.24	0.24	0.26	0.27
LU	0.50	0.50	0.53	0.57	0.53
HU	0.24	0.25	0.25	0.25	0.26
MT	0.27	0.27	0.28	0.29	0.29
NL	0.50	0.49	0.49	0.48	0.48
AT	0.47	0.46	0.48	0.48	0.48
PL	0.21	0.21	0.22	0.23	0.24
PT	0.21	0.24	0.23	0.25	0.25
RO	0.16	0.15	0.16	0.17	0.18
SI	0.32	0.34	0.34	0.36	0.35
SK	0.23	0.22	0.23	0.24	0.25
FI	0.69	0.68	0.65	0.67	0.64
SE	0.82	0.80	0.78	0.76	0.73
UK	0.57	0.57	0.56	0.55	0.57

Source: EIS, 2008

The SII 2008 indicators are classified into 5 categories.

- **Innovation drivers** include: S&E graduates per 1000 population aged 20-29; Population with tertiary education per 100 population aged 25-64; Broadband penetration rate (number of broadband lines per 100 population) ; Participation in life-long learning per 100 population aged 25-64; Youth education attainment level (% of population aged 20-24 having completed at least upper secondary education) ;
- **Knowledge creation** includes Public R&D expenditures (% of GDP); Business R&D expenditures (% of GDP); Share of medium-high-tech and high-tech R&D (% of manufacturing R&D expenditures) Share of enterprises receiving public funding for innovation;
- The **innovation & entrepreneurship** dimension includes SMEs innovating in-house (% of all SMEs); Innovative SMEs co-operating with others (% of all SMEs); Innovation expenditures (% of total turnover); Early-stage venture capital (% of GDP); ICT expenditures (% of GDP); SMEs using organisational innovation (% of all SMEs);
- The **applications** dimension includes Employment in high-tech services (% of total workforce); Exports of high technology products as a share of total exports; Sales of new-to-market products (% of total turnover); Sales of new-to-firm products (% of total turnover); Employment in medium-high and high-tech manufacturing (% of total workforce);
- And finally: **intellectual property** including EPO patents per million population; USPTO patents per million population; Triad patents per million population; New community trademarks per million population; New community designs per million population

Figure A.1: Convergence in innovation performance

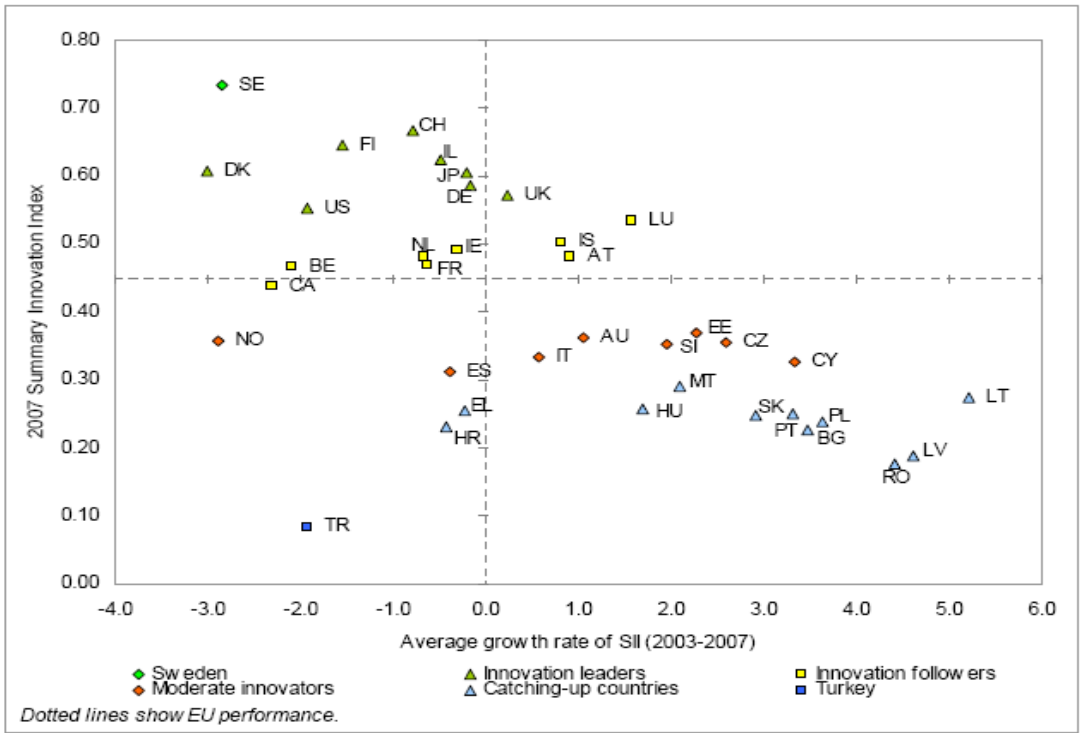

Table A.2: WB-KEI indicators 2008-1995

Country	KEI08z	EIC08	EDU08	ICT08	KEI95z	EIC95	EDU95	ICT95
EU FRONTIER	**8,921**	**8,854**	**8,985**	**8,924**	**9,170**	**9,039**	**9,437**	**9,034**
Ireland	0,995	1,042	1,011	0,933	0,975	1,013	0,978	0,933
Spain	0,928	0,969	0,914	0,901	0,904	0,953	0,905	0,853
Portugal	0,847	0,953	0,760	0,828	0,876	0,955	0,789	0,888
Greece	0,818	0,800	0,913	0,742	0,861	0,905	0,821	0,859
EUCOHESION	0,897	0,941	0,899	0,851	0,904	0,956	0,873	0,883
	0,080	*0,102*	*0,103*	*0,085*	*0,050*	*0,044*	*0,085*	*0,036*
Estonia	0,966	0,980	0,920	0,997	0,897	0,902	0,875	0,915
Czech	0,887	0,930	0,903	0,828	0,839	0,880	0,796	0,845
Slovenia	0,922	0,916	0,917	0,933	0,880	0,881	0,832	0,931
Lithuania	0,902	0,897	0,930	0,879	0,734	0,755	0,786	0,658
Slovak	0,840	0,902	0,777	0,842	0,753	0,706	0,758	0,795
Poland	0,844	0,835	0,884	0,812	0,752	0,646	0,863	0,743
Latvia	0,903	0,908	0,936	0,866	0,765	0,787	0,794	0,713
Hungary	0,869	0,948	0,848	0,812	0,781	0,737	0,801	0,805
Romania	0,740	0,776	0,701	0,743	0,624	0,634	0,656	0,580
Bulgaria	0,776	0,792	0,826	0,709	0,707	0,637	0,768	0,714
EUTRANSITION	0,865	0,888	0,864	0,842	0,773	0,756	0,793	0,770
	0,068	*0,067*	*0,077*	*0,084*	*0,082*	*0,104*	*0,061*	*0,111*

Country	KEI08	INN08	KEI08z	KEI95	INN95	KEI95z
EU FRONTIER	**8,970**	**9,119**	**8,921**	**9,176**	**9,194**	**9,170**
Ireland	0,994	0,991	0,995	0,975	0,979	0,975
Spain	0,919	0,893	0,928	0,902	0,896	0,904
Portugal	0,838	0,815	0,847	0,858	0,804	0,876
Greece	0,823	0,837	0,818	0,847	0,802	0,861
EUCOHESION	0,894	0,884	0,897	0,896	0,870	0,904
	0,079	*0,079*	*0,080*	*0,058*	*0,085*	*0,050*
Estonia	0,930	0,821	0,966	0,852	0,719	0,897
Czech	0,873	0,833	0,887	0,823	0,772	0,839
Slovenia	0,920	0,911	0,922	0,874	0,855	0,880
Lithuania	0,856	0,723	0,902	0,692	0,570	0,734
Slovak	0,817	0,752	0,840	0,756	0,768	0,753
Poland	0,823	0,759	0,844	0,731	0,671	0,752
Latvia	0,852	0,702	0,903	0,693	0,481	0,765
Hungary	0,875	0,893	0,869	0,794	0,833	0,781
Romania	0,710	0,621	0,740	0,598	0,521	0,624
Bulgaria	0,758	0,705	0,776	0,724	0,772	0,707
EUTRANSITION	0,841	0,772	0,865	0,754	0,696	0,773
	0,068	*0,092*	*0,068*	*0,084*	*0,131*	*0,082*

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