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Innovation capabilities of the six EU candidate countries: comparative data based analysis

Contract: INNO-99-02

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Final Version, September 2001

Study commissioned by the Directorate General for Enterprise - European Commission.

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Introduction

This report presents analysis of basic comparative data related to six candidate countries for the EU accession, a group, which includes five central and eastern European economies (Czech Republic, Estonia, Hungary, Poland and Slovenia, subsequently called CC5) plus Cyprus (CC5 plus Cyprus subsequently referred to as CC6). The aim of the report is to analyse the innovation capability of six candidate countries, factors that affect it, and compare both to those of the EU economies. Analysis is based on quantitative indicators and complements qualitative in-depth analysis of innovation issues of individual CCs undertaken in other reports of this study. In addition, we construct the CC innovation scoreboard which is comparable to the EU Innovation Scoreboard prepared under 'European Trendchart on Innovation' project. The indicators in this report are organised along several groups, which form the basis of Innovation Scoreboard. However, our analysis and data used go beyond the scoreboard categories. The groups are:

1. Markets and output (GDP and productivity, macroeconomic conditions, energy efficiency of output, degree of internationalisation)
2. Human resources (structure of qualifications and structural features of employment based on economically active population data),
3. Knowledge creation and investment in broad sense (research output - patents and scientific papers; investment – tangible, intangible, innovation finance),
4. Transmission and application of knowledge (; information and telecommunication infrastructure; innovation and inventive activities)

The underlying conceptual model of this grouping starts with human resource indicators as critical for technology creation and absorption. The relevance of this group has been confirmed widely in growth literature. Also, historical evidence suggests that catching-up processes have been accompanied by the fast improvement in the education levels of population and labour force. Human resources mainly approximate the absorptive capacity of countries (Group 2). In addition, growth requires increasing explicit technological effort through R&D and industrial innovation, and diffusion of the existing knowledge through economy. These areas are represented by a variety of S&T indicators which approximate knowledge creation (Group 3). In the next stage, we discuss transmission and application of knowledge (Group 4). The 'distributive capability' of economy or its capability to diffuse information and knowledge through sectors and economy at large stands as an important feature of successful economies. Group of indicators 'Markets and outputs' (Group 1) takes into account that the innovation is an economic process, which does not depend only on investment in new and its transmission knowledge. A variety of factors come into play when enterprises make decisions how much to invest in knowledge creation or absorption. This group of indicators takes into account the economic outcomes of economic activities and shows that many of the problems related to innovation are non-technological.

The quantitative nature of this analysis conveys important features of innovation capability of candidate countries. However, we should bear in mind that full understanding of innovation issues in CC6 would require a deeper understanding of the qualitative aspects of innovation process like organizational structures at the microeconomic level, or the complicated interface between political, economic and cultural change in individual economies. Some of these issues have been addressed in other reports produced within this study.

The CC6 countries are compared to the EU 'cohesion countries' (Greece, Ireland, Portugal and Spain) as well as to the four selected high income EU economies (Denmark, Germany, Netherlands

and UK). The cohesion countries represent the natural reference point for candidate countries. For example, in terms of income per capita these two groups are the closest to each other, with the exception of Ireland. Also, in several other respects, such as R&D, these groups are similar. From the higher income EU economies we have selected two large countries (Germany and UK) and two smaller ones (Netherlands and Denmark). Thus, the selection of countries retains some variety of the countries, which make up today's EU while keeping their number small for ease of comparison. In addition to cross sectional comparisons, we also evaluate the CC across time whenever data allow and analysis justifies it. Due to data availability, the comparison and analysis for Cyprus is not as rich as for the Central European (CC5) candidate countries.

1. Markets, finance and output

The broader economic context represents starting point for our analysis. It affects the innovation process and in turn, equally, improvement in economic condition is strongly affected by the scale of innovation activities.

1.1. Income and Productivity

In terms of population, accession countries fall into three subgroups: small countries (Cyprus, Estonia and Slovenia), which in terms of size are closest to Ireland; medium size (Czech Republic and Hungary), which are of very similar size as Greece and Portugal; and one relatively large country, Poland, which is of similar size as Spain.

However, the comparison becomes more difficult, when we compare levels of development. There are striking differences between GDP per capita in nominal exchange rates based indicators and those based on purchasing power parities (PPP) (see Table 1). The first indicators are more easily available, and therefore widely used and popularised by media. According to this measure, a discrepancy between accession countries and the most developed EU members seems to be extremely wide. For example, a comparison with Denmark shows GDP per capita being 2.4 times higher than in Cyprus and nine times higher than in Estonia.
Yet, the measure is misleading as the exchange rate is strongly affected by the internal price relations between tradables and non-tradables. As such, it does not take into account the fact that the prices of non-tradables are much higher in developed countries and the aggregate measure of costs of living is affected correspondingly. Therefore, to assess the real income gap between countries, one has to take into account the ratio between nominal incomes and nominal prices, i.e. purchasing power of incomes. When PPP data are used, the picture is significantly different. Table 1 (column 3) shows that the average real incomes in some accession countries are higher than in some EU member states. In particular, the average real income in Cyprus is higher than in Greece and Portugal and almost the same as in Spain. The real gap between Denmark and Cyprus (i.e. percentage difference in incomes between these two countries) is still high, but shrinks to 31.6%. The difference between the exchange rates measures and purchasing power parity measures is even more dramatic for Central and East European candidates. In PPP terms, the real income in Slovenia is higher than in Greece and almost the same as in Portugal. The percentage difference between Greece and the Czech Republic shrinks to 12%. While the discrepancy continue to decrease in time, it is still large for the three other accession countries. The percentage difference between Greek and Hungarian GDP per capita is 25%, and the difference is 45% for both Poland and Estonia. Thus, despite country differences, the six candidate countries (CC) are at the lower end of the EU ranking in terms of income per capita. Czech Republic, Hungary, Estonia and Poland with incomes per capita in the range of Euro 7,700-12,500 are below per capita levels of the southern EU economies (Spain, Portugal and Greece).

These income differences suggest that maintaining momentum in growth rates, which are higher than the EU average would be essential for cohesion of an enlarged EU. In the case of persistent slowdown in growth, the relatively poor CC economies are likely to increase pressure for budget transfers from the EC, which could have major implications not only for economic cohesion but also for European social stability. Thus, the speed of convergence matters greatly. Table 1 shows average growth rates over the 1990-99 period - a comparison, which is unfavourable for the economies of Central and Eastern Europe, as it includes the period of 'transitional recession' during the initial phase of post-communist reforms.

During the 1990s, the growth of the CC5 diverged in the range from average negative growth for Estonia to average very high growth for Poland. Despite a short but profound transitional recession at the beginning of the 1990s, Poland has managed to become the second fastest growing European economy in the 1990s, with an average growth rate of 4.5%. This is significantly behind the phenomenal average growth rate of Ireland of 6.9% but still visibly ahead of EU rates generally and significantly higher than the other CC5 economies. Slovenian growth is also impressive, given initial recession and additional disruption caused by breaking links with federal Yugoslavia after independence.

Table 1. Economic outcomes: aggregate output indicators

	(1) Population Mn1999	(2) GDPpc EUR, 1999	(3) GDPpc PPP,EUR,1999	(4) GDP 1990-1999 Average%growth
Candidate countries				
Cyprus	0.76	12,800	17,100	2.7%[a]
Czech Rep	10.20	4,800	12,500	0.8%
Estonia	1.40	3,300	7,700	-1.3%
Hungary	10.10	4,500	10,700	1.0%
Poland	38.70	3,700	7,800	4.5%
Slovenia	2.00	9,400	15,000	2.4%
Cohesion countries				
Greece	10.50	11,181	14,200	2.2%
Ireland	3.80	23,072	23,600	6.9%
Portugal	10.00	10,558	15,900	2.5%
Spain	39.40	14,197	17,300	2.2%
High income				
Denmark	5.30	30,852	25,000	2.4%
Germany	82.10	24,146	22,700	1.3%
Netherlands	15.80	23,388	23,800	2.7%
UK	59.5	22,735	21,600	2.5%

[a] 1990-98

Source:: Eurostat, , *Yearbook* 2001 and *Statistics in Focus*, 27/2000and 40/2000 and own calculations

In the last five years Hungary was also achieving stable growth rates. Hungary's 1995-96 recession was caused primarily by macroeconomic imbalances. It was overcome and the economy has started to grow at rates above 4% annually, driven primarily by exports and restructuring brought by foreign direct investment. Since 1995, Estonia has made a sharp break from the transitional recession and the economy has started to grow at high rates, though interrupted in 1999 by the effects of Russian financial crisis. After the 1996-97 slowdown, the Cypriot economy started to grow again at rate close to 5%. It is only Czech Republic that entered into a temporary, relatively shallow recession, between 1997 and 1999.

Once growth in CC5 economies resumed, it has been continuously accompanied by high growth rates (above 5%) of labour productivity (see Table 2). The process was somewhat delayed in Estonia, which was hit by a more severe 'transitional recession', similar to other former Soviet Union republics and again by slump in external demand after 1998 crisis in Russia.

However, strong fluctuations in rates of labour productivity growth suggest that improvements are probably still driven more by uneven paths of layoffs, closure of unproductive lines of businesses and reactive restructuring than by continuous technological improvements.

Table 2. Changes in labour productivity in manufacturing (%)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CYP					6.4	3.4	4.3	4.2	2.9	
CZR	0.6	-19.3	-0.2	-0.5	7.9	11.1	9.6	11.1	5.6	2.2
EST		-3.2	-30.3	-5.1	0.9	3.8	7.8	2.3	11.4	-10.6
HUN	-4.0	-8.3	4.0	16.3	14.7	9.8	3.3	13.0	10.1	0.2
POL	-19.7	0.0	12.5	13.8	13.0	7.0	10.0	12.1	4.7	9.5
SLO	-7.9	-2.0	-3.0	6.7	11.4	8.3	6.7	4.5	5.4	1.8

Source: EBRD, For 1995-99, *Transition Report* 2000, for 1990-1994, *Transition Report* 1999. For Cyprus, Eurostat, *Statistical Yearbook on Candidate and South-European Countries*, 2000. For Cyprus figures refer to the ratio of industry value added at constant 1990 prices and the number of persons employed.

Moreover, five out of six CCs have recently recorded a slowdown in rates of growth of labour productivity (Table 2). The only exception is Poland, which experienced an impressive increase in productivity. However, that came at cost of significant increase in unemployment. Poland may be atypical, as due to its structural characteristics (primarily high share of agriculture) it has higher growth potential for reallocation of resources. Yet, general trend for Central European CCs might suggest that the initial sources of growth and productivity may be soon exhausted and that the issue of technical change as the major source of long-term and sustainable growth will inevitably become part of the policy agenda in CC5 economies. In the past 10 years innovation policy was considered as secondary to transition related concerns. However, the exhaustion of growth and productivity improvements based on non-investment related reallocations will bring the issues of innovation and industrial upgrading into the policy focus.

1.2 Macroeconomic Conditions and Finance

In CC5, economic policy during the 1990s was strongly focused on achieving macroeconomic stability and on progress in institutional change towards a market economy. Macroeconomic stability was essential for successful operation of newly introduced market mechanisms as well as for attracting foreign direct investments. Table 3 below, shows that CC5 went through a period of high inflation following price liberalisation during the early 1990s. This initial adjustment affects the aggregate measure of average inflation for 1990-99, which ranges from 8.5% in Czech Republic to 28% in Slovenia. Most of the CCs followed an apparently successful strategy of slow downward adjustment of inflation rates. From very high levels at the beginning of the 1990s inflation in CC5 has reached levels of around 10%, which is a considerable improvement. Research shows that inflation of this range does not have a negative impact on growth. Cyprus's inflation has been much lower, comparable with well performing EU economies.

A second element of the macroeconomic environment is government deficit (Table 3, column 4). Inability of the government to contain its expenditures within manageable boundaries is a continuous source of instability and increases the general cost of finance. In this respect, CC5 economies have attained levels of government deficit similar to that, which was experienced by the

EU economies on the eve of their joining the EMU. Thus, the share of government deficit in CC5 is below 2%, except a temporary rise in Hungary. It makes Hungary similar to Cyprus, where government's deficit was 5.3% in 1997, which is comparable to the high deficit of Greece in 1997.

Development of the financial system represents a very important framework element for innovation activities and innovation policy. If the financial system is undeveloped than the burden of many supporting activities for innovation inevitably shifts to the government and other public organisations. A developed financial system takes over many of the activities, which support innovation, such as innovation assessment, venture capital financing, long-term finance, preferential loans, etc.
Domestic credit provided by the banking sector is one of the leading indicators of the degree of development of the domestic financial system (Table 3, column 7). In this respect all of CC5 is significantly behind EU economies, including cohesion countries. The share of domestic credit provided by the banking sector in GDP in CC5 ranges between 34.6% in Estonia to 62.7% in Czech Republic. In the reference group of EU economies, the share is above 90% of GDP, with the exception of Denmark. This suggests that, when compared to the EU, the financial system of CC5 is still undeveloped though privatisation of banking is changing that situation.

Because of the undeveloped financial system, the cost of finance in CC5 is comparatively high. Interest rate spread (difference between lending rates and deposit rates) is high in CC5, except Hungary, which has the most open banking system, above EU levels (Table 3, column 6).

The need to raise finance is one of factors that motivate companies to go to the stock market. However, stock market capitalisation in CC5 is still small. These economies are clearly at the lower end of European ranking in this respect. Estonia and Hungary have relatively the most developed stock market, with market capitalisation in 1999 of 34% of GDP. Yet this is still behind the Irish stock market capitalisation indicator, relatively the smallest EU stock market in the cohesion group (Table 3, column 8).

High unemployment shows to what extent human resources in economy are under-utilised. In addition to its significant human costs it also has an impact on the economic situation through the fiscal burden it imposes. Reduced unemployment is also an objective of the innovation policy, primarily through supporting diffusion of new technologies and their effect on employment generation. In CC5, unemployment rates are similar to EU levels except in Poland where it shows no signs of receding. In this respect the Polish situation is similar to that in Spain, where economic growth has been accompanied by restrictive labour market institutions and high unemployment. On the other hand, Polish unemployment is affected by the pace of structural change, which is faster than in the neighbouring countries, with rapid decreases in employment in primary sectors (agriculture, mining) and heavy industry (steel, etc.) and growth in services. That in turn results from the fact that Polish economy has been structurally different from other CC at the beginning of transition.

Table 3. Macroeconomic and financial indicators

	(1) Invest--ment % GDP 1999	(2) Gross Dom.Inv Av.an. %growth 1990-99	(3) Inflation, Average 1990-99	(4) Govern. Deficit %GDP 1998	(5) Unemploy--ment rate 1998	(6) Interest rate spread (lend.-dep. Rate), %, 1999	(7) Domestic Credit provided by banking sect%GDP, 1999	(8) Stock Market Capitalis/ PPP GDP 1999
Candidate countries								
Cyprus	25%***		2.2%***	-5.5%	3.3%*			19.76%***
Czech R	28%	5.1%	8.5%	-1.6%	6.5%	4.2	62.7	22.2%
Estonia	25%	-2.3%	25.3%	-0.1%	9.6%	4.5	34.6	34.2%
Hung	29%	9.4%	21.5%	-6.2%	7.8%	3.1	52.1	33.7%
Poland	26%	10.6%	27.8%	-1.0%	10.5%	5.8	39.3	19.1%
Sloven	28%	10.8%	28.0%	-0.8	7.7%	5.1	43.4	10.9%
Cohesion countries								
Greece	23%	5.5%	9.8%	-4.4%	10.3%**	6.3	94.8	163.3%
Ireland	23%	8.9%	2.1%	0.7%	7.8%	3.2	93.8	45.5%
Portug	25%	4.1%	4.8%	-1.2%	5.0%	2.8	103.9	58.5%
Spain	24%	1.7%	3.9%	-2.9%	18.8%	2.1	108.9	72.4%
High income								
Denm	20%	4.4%	2.0%	-1.7%	5.5%	4.7	57.4	60.4%
Germ	22%	1.1%	2.4%	-0.9%	9.7%	6.4	145.2	67.8%
Netherl	22%	2.2%	2.4%	-1.6%	4.4%	0.7	126.8	176.6%
UK	18%	4.0%	2.9%	-0.6%	6.1%	2.7	127.0	203.4%

Source: World Bank., *CDROM World Development Indicators* 2001; except unemployment from: ILO, 1999, *Yearbook of Labour Statistics*, For Cyprus, inflation rate for 1998 from Eurostat,, 6/2000. *Statistics in Focus*, Cyprus and EU. For government deficit *Cypriot Statistical Services*.

* Registered unemployment. ** 1997 *** 1998.

1.3. Internationalisation of Output Structures

The external opening of CC6 countries has made the structure of their inputs as well as outputs more compatible with world demand and market costs. Economies, which were previously semi-autarchic, have been pushed to improve their competitiveness, in terms of both quality and cost-efficiency.

The basic indicator of successful internationalisation of output of CCs is exports, especially given their relatively small size of those economies (with exception of Poland). Column 1 of Table 4, below, shows trade in relation to GDP levels. Small countries tend to have more links with the world economy and so do more developed countries. Thus, it is appropriate to make some comparisons between countries of similar size. A comparison between Poland and Spain shows that the former is still significantly less integrated into the European and the world economies, despite the fact that it experienced an unprecedented increase in exports during the last decade, successfully overcoming the pre-reform state of communist semi-autarchy. On the other hand, both the Czech Republic and Hungary are already characterised by levels of trade in goods that are slightly higher than for Portugal (all three specialising in manufacturing) and much higher than in Greece. Estonia and Slovenia, are both the smallest and the most open amongst candidate countries. Ireland may not serve as an appropriate reference point here, as its economy is characterised by an unprecedented degree of openness and has been pursuing (unlike Slovenia) a

long-term strategy of growth based on foreign direct investments (FDI). The value of trade in goods of the smallest candidate country, Cyprus, is much lower, due to its specialisation in services.

A high share of industry in the economic activities of the CC5 countries (see 2.2. above) is reflected in their exports, where manufactured exports account for between 69% (Estonia) and 90% (Slovenia) of merchandise exports. The exports of Cyprus fall into a different category with the share of manufactured products at 54%, very similar to Greece (Table 4, column 2).

Export is increasing at rates around 10%. However, those rates are not stable and do not give a clear indication of what the future trends in this respect will be. Persistently high export rates are one of the main features of growth of catching up economies. In this respect, the evidence from CC5 has been mixed so far. Exports from Cyprus are growing at very low rates of below 2%, which reflects the country's economic structure, with a low share of industry and high share of agriculture.

Table 4. Economic outcomes: international aspects

	(1) Trade in goods, %PPP GDP, 1999	(2) Manufactured Exports as % of Merchandise Export, 1999	(3) High-tech export as % of Manufacturing Export, 1999	(4) FDI inflow, % GDP 1997-98 Average	(5) Tariff in % of Manufacturing Prod., Weighted mean, 1999
	(1)	(2)	(3)	(4)	(5)
Candidate countries					
Cyprus	34.6%*	54%*	3*	0.9%	-
Czech Rep	41.6%	88%	9	3.5%	5.9
Estonia	58.5%	69%	13	8.5%	0.5 (1995)
Hungary	46.1%	85%	23	4.3%	9.7 (1997)
Poland	22.4%	77%	3	3.8%	7.9 (1996)
Slovenia	58.5%	90%	4	1.3%	10.8 (1998)
Cohesion countries					
Greece	25.5%	50%	10	0.9%	3.0
Ireland	120.1%	85%	47	3.6%	3.0
Portugal	38.9%	87%	5	1.7%	3.0
Spain	35.8%	78%	8	1.6%	3.0
High Income					
Denmark	67.8%	66%	20	2.7%	3.0
Germany	52.0%	84%	17	0.5%	3.0
Netherlands	101.4%	70%	33	5.6%	3.0
UK	44.8%	83%	30	4.0%	3.0

* 1998

Source: For (1)-(3) and (5) World Bank, *World Development Indicators* 2001. For (4) World Bank, *CDROM World Development Indicators* 2000

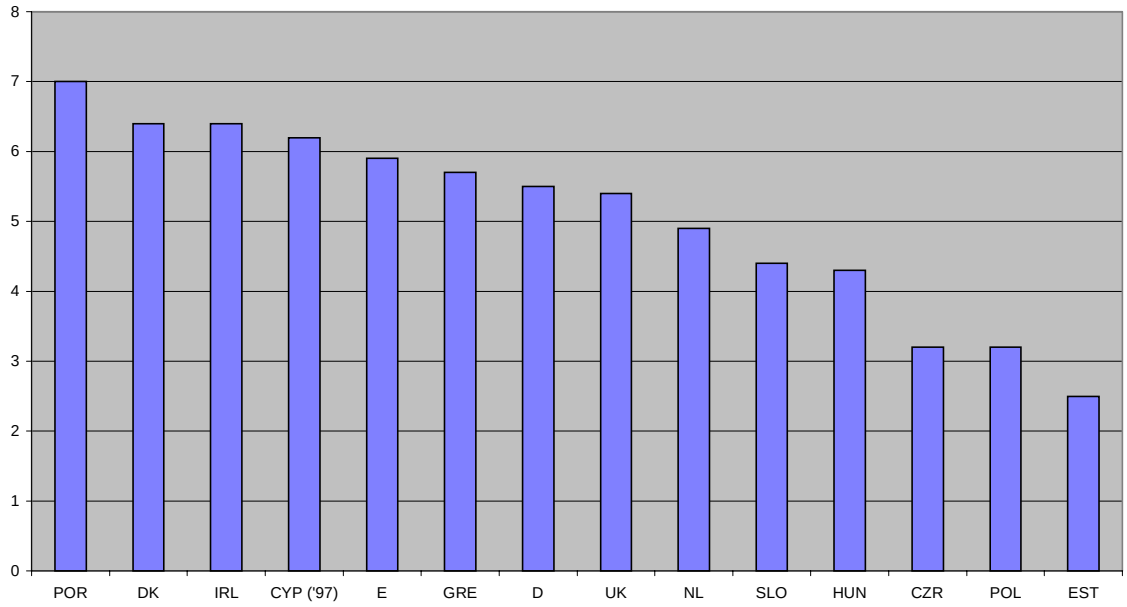
Foreign trade statistics for CC5 show significant improvements in terms of competitiveness through increases in unit prices (Landesmann and Burgstaller, 1997). The structure of exports has initially moved towards labour intensive industry products. However, since the mid-1990s, this trend has been reversed and the share of skill, capital and technology intensive products has increased (Urban, 1999).

In terms of share of high tech exports in manufactured exports, CC5 countries, with the exception of Hungary, are broadly similar to Southern EU countries. Shares of high tech exports in manufacturing range from 3% (Poland) to 13% (Estonia). Hungary is a clear outlier with the share of high tech exports amounting to 23% of manufactured exports. This share is driven by foreign direct investments and Hungary ranks fourth out of the fourteen countries analysed here, with only

Ireland, Netherlands and United Kingdom ahead. Thus, the Hungarian economy is to some extent imitating the pattern of development of Ireland: Irish export is also predominantly driven by multinational companies (MNCs) and has the highest share of high tech export in Europe (47%). It is important to bear in mind that high tech industries are high growth industries. This fact alone, even in the absence of spillovers from MNCs, should ensure high growth in Hungary in the near future. According to the UN data (1999, p. 230), world exports of primary products grew at a modest 2.3% annually during 1980-1990 and at only 1.4% over the 1990-1995 period. At the other end of the spectrum, high technology products grew at around 12% per annum (compound in both periods).

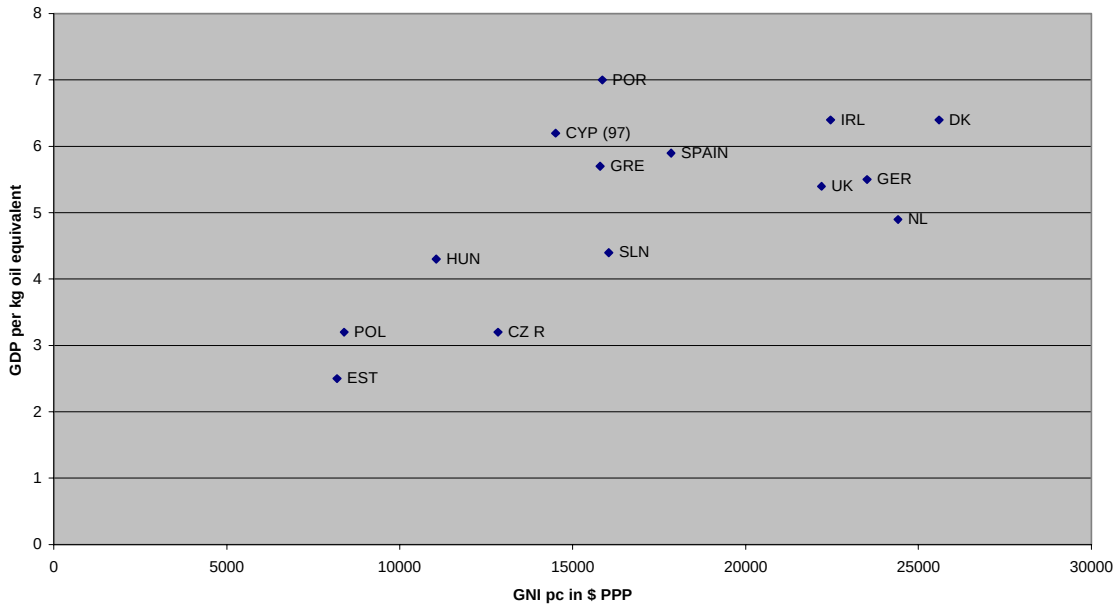
We may expect that as FDI continue to penetrate the other CC5 economies this will improve the technological structure of their exports (at least in terms of introducing more medium technology products) which may feed back to growth. However, in the long term it is also essential to nurture spillovers from exports and foreign investors to the domestic producers.

Figure 1. GDP (PPP) per kg of oil equivalent, 1999



1.4. Energy-Efficiency

Figure 2. Level of income and consumption of energy



Energy efficiency in CC5 is still relatively low when compared to EU economies, both high income and cohesion economies. Energy efficiency could be approximated by the ratio of the value of GDP to the total consumption of energy, measured in oil equivalent (Figure 1 below). Based on this measure all CC5 are at the low end of the EU ranking. Cyprus ranks favourably on this scale, primarily because this measure is also affected by (i) the economic structure, and (ii) the income level (positively related to the energy-intensive consumption, including for instance domestic electric equipment, passenger cars, etc.) A combination of these two factors generates that the relationship between GDP per capita and energy efficiency is non-linear (see Figure 2). For example, Portugal has the highest value of GDP in relation to the energy input (oil equivalent) largely due to both its low share of industries which are energy- and capital- intensive and to its middle income levels. Low ranking of the CC5 countries reflects both their economic structures characterised by a relatively high share of industry (heavy industry in particular) and relatively low energy efficiency. This implies that the economic importance of process innovations in industry for CC5, especially in reducing energy consumption, is much higher than for South EU economies. This has been confirmed by innovation survey data on CC5 countries (see Radosevic, 1999b) where reduction of material and energy consumption as an objective of innovation stands higher than in the EU.

2. Human resources

Human resources are essential to growth and innovation. They determine absorptive capacities of economies that is capacities to receive, transmit and diffuse new technologies. Also, knowledge creation is constrained by the quality and structure of skills of active population. In this section we compare CCs with the selected EU economies in terms of sectoral and educational structure of economically active population.

2.1. Structure of Production: Economically Active Population

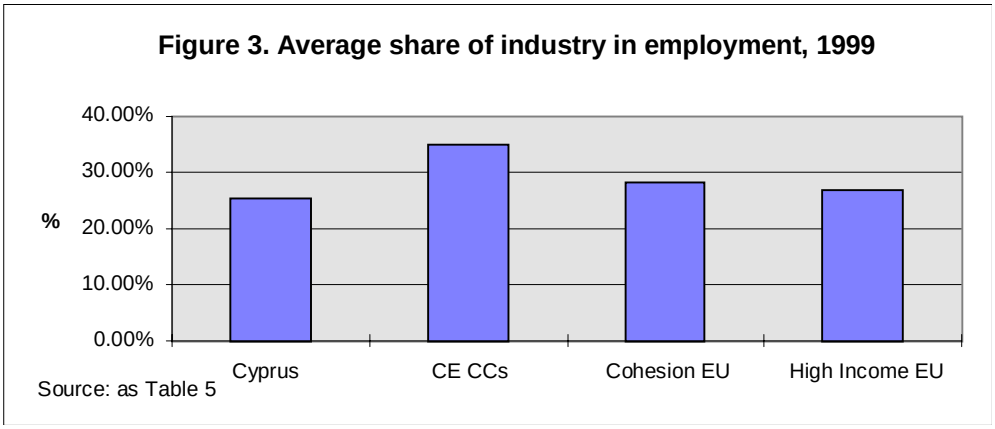
Among the different structural aspects, we will examine ISIC-3 level employment structure of the economically active population. The data on the structure of employment are presented in Table 5.

Post-socialist CC5 has undergone significant scaling back of its industrial activities and expansion of service activities. This was necessary, due to the weak competitiveness of many industries during the socialist period and neglect of services. Despite these changes, CC5 countries are likely to continue to be economies with relatively high shares of industry. Countries that have successfully reoriented their exports towards the EU have also preserved and modernised manufacturing sector. Industrial employment as a share of the total employment remains at a level, which is both above the EU cohesion and above the EU high-income economies (Figure 3 and Table 5; also: EBRD, 2000, p. 89, chart 4.2.).

Table 5. Structure of employment, ISIC-3, 1999

	CYP	CZR	EST	HUN	POL	SLO	GRE	IRL	POR	E	DK	D	NL	UK
Agriculture, Fishing	10.7%	5.1%	8.8%	7.1%	19.2%	10.8%	19.8%	8.5%	13.6%	7.3%	3.6%	2.8%	3.2%	1.5%
Mining	0.3%	1.6%	1.4%	0.6%	2.5%	0.7%	0.4%	0.4%	0.3%	0.5%	0.1%	0.4%	0.1%	0.4%
Manufacturing	15.4%	27.3%	20.9%	24.4%	20.9%	31.1%	14.5%	18.3%	21.0%	19.1%	19.1%	23.4%	14.9%	17.8%
Utilities	0.5%	1.7%	3.0%	2.4%	1.7%	0.9%	1.1%	0.7%	0.8%	0.6%	0.8%	0.9%	0.6%	0.7%
Construction	9.0%	9.3%	6.5%	6.6%	7.0%	5.0%	6.5%	8.9%	9.1%	10.6%	6.6%	8.6%	6.1%	7.0%
Industry subtotal	*25.2%*	*39.9%*	*31.8%*	*34.0%*	*32.1%*	*37.7%*	*22.5%*	*28.4%*	*31.2%*	*30.7%*	*26.6%*	*33.4%*	*21.7%*	*25.9%*
Trade & Repair	26.2%	13.4%	14.5%	13.6%	13.8%	12.2%	16.7%	14.0%	14.0%	16.4%	13.6%	14.3%	16.5%	15.5%
Hotels & Restaur		3.3%	2.1%	3.5%	1.4%	3.8%	6.0%	6.5%	4.8%	6.1%	2.6%	3.3%	3.6%	4.2%
Trans & commun	6.5%	7.8%	8.9%	8.1%	6.2%	6.0%	6.4%	6.0%	3.9%	5.8%	6.7%	5.4%	6.0%	6.6%
Finance	7.9%	2.1%	1.4%	2.1%	2.3%	2.4%	2.5%	3.8%	2.7%	2.6%	2.9%	3.5%	3.6%	4.3%
Real Est. & Busin.		5.5%	6.6%	4.8%	3.0%	5.5%	4.2%	8.5%	4.8%	6.7%	8.4%	7.5%	11.3%	10.9%
Public Admin.	22.4%	7.1%	6.4%	7.9%	5.1%	5.5%	7.2%	4.7%	7.0%	6.4%	6.2%	8.7%	7.1%	6.0%
Education		6.2%	8.9%	8.1%	6.3%	6.7%	6.0%	6.3%	6.6%	5.8%	7.4%	5.4%	6.3%	8.0%
Health & Soc. Ser.		6.0%	5.7%	6.3%	6.9%	5.0%	4.4%	7.5%	4.6%	5.4%	17.0%	10.1%	13.9%	11.0%
Other Services		3.5%	4.8%	4.5%	3.6%	4.0%	3.3%	4.7%	4.2%	3.7%	4.4%	5.2%	4.3%	5.2%
Private Househ. Employees		0.0%	0.0%	0.1%	0.1%	0.0%	1.1%	0.5%	2.6%	2.8%	0.2%	0.4%	0.3%	0.5%
Internat. Organis.		0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	2.2%	0.1%
Not classified	1.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.2%	0.0%	0.0%	0.3%

Source: International Labour Office.
Notes: Cyprus, Poland, Greece, Portugal, Denmark, Netherlands – 1998. Cyprus - ISIC-2, missing entries included in upper category.



Out of four industrial sectors (mining, manufacturing, utilities and construction), CC5 has visibly higher shares in the first three, compared with the EU economies. The share of employment in manufacturing is above 30%, which is still above or equal to the shares in both high and low income EU economies, except Germany. This structural feature of CC5 suggests that its restructuring has been as much of intra-manufacturing as of inter-sectoral character. Large scale changes in the relative importance of industry and services have been accompanied by similar changes within manufacturing. The structure of industry in Cyprus is similar to Greece with a high share of small service firms and agriculture.

2.2 Level of Qualifications

In terms of educational structure of the economically active population of the CC5 differs from Cyprus as well as from the EU cohesion economies in several important aspects (Table 6). The educational structure of CC5 countries does not reflect their current income levels but has a few unique features. The education systems are relatively strong and better developed than average for countries with similar levels of GDP per capita. This makes the situation of CC5 resemble that of Ireland, at the time of its early years of EU membership. Retrospectively, the Irish government gave a clear priority to its education system, at the cost of social welfare, the health system, and infrastructure development.

Table 6. Economically Active Population by the level of education, 1999

	(1) 1st and less	(2) 2nd,1st stage	(3) 2nd,2st stage	(4) 3rd	(5) Not defined
			Candidate countries		
CYP	31.6%	9.0%	36.8%	22.6%	0.1%
CZR	0.3%	9.5%	79.0%	11.3%	0.0%
EST	1.1%	11.8%	46.3%	40.8%	0.0%
HUN	1.0%	18.6%	64.8%	15.6%	0.0%
POL	18.3%	0.0%	66.8%	14.8%	0.0%
SLO	2.9%	18.8%	62.5%	15.9%	0.0%
			Cohesion countries		
GRE	35.0%	10.7%	29.2%	25.1%	0.0%
IRL	14.4%	20.3%	27.7%	33.8%	3.7%
POR	67.1%	13.5%	10.8%	8.5%	0.0%
E	29.2%	27.3%	18.2%	25.3%	0.0%
			High income		
DK	0.0%	22.8%	52.2%	24.7%	0.3%

D	1.7%	16.2%	58.3%	23.8%	0.0%
NL	8.8%	22.7%	42.7%	25.5%	0.2%
UK	12.4%	6.0%	47.1%	25.4%	9.1%

Note:: DK, GRE, NL, PL, POR - 1998, CYP – 1992. *Source:* ILO.

The specific characteristics of the CC5 educational outcomes are as follows:

- First, when compared to EU economies, CC5, with exception of Poland, has a very low share of population with the 1st level of education and lower, ranging from 0.3% in the Czech Republic to 2.9% in Slovenia. This share is similar or better than in the high-income EU economies and greatly below the share in low-income (South) EU economies. Only Poland has the share of 18.3%, which is similar to Ireland (14.4%) but still significantly below the share in Southern EU economies (Table 6, column 1).

- Second, there is a very high share of the economically active population with second stage secondary education in CC5. It ranges from 46.3% in Estonia to 79.0% in Czech Republic. It is higher than in any other comparator country, including high-income EU economies. The share of economically active population with the secondary level of education is well above the cohesion countries and in the range of high income EU economies (Table 6, sum of columns 2 and 3).

- Third, with the exception of Estonia, CC5 has a low share of population with the 3rd level education. In our sample of the EU high and low income economies, this share is, with exception of Portugal (8.5%), between 24% and 34%. In CC5, this share ranges from 11% to 16%. Estonia has the highest share amongst the countries analysed (41%), which, together with the high share of secondary level education, gives it the best education structure.

This suggests that the structure of education in CC5 is compressed on the edges, with low shares of both least educated and people with higher education.

The educational features of CC5 have several implications for innovation policy:

- First, the low share of economically active population with 3rd level education (with the exception of Estonia) may represent difficulties in absorption and diffusion of new IT based technologies in services and industry, especially in adoption of IT. On the other hand, large share of 2nd level education may guarantee sufficient capacity in use of well-established IT.
- Second, the high share of population with secondary level education in CC5 have undergone vocational education, i.e. their skills are relatively specialised which may present problems in economy-wide restructuring.
- Third, the favourable structure of the general level of education in CC5 is a necessary but not sufficient condition from the point of view of the absorbtion and diffusion of IT. It has to be accompanied by training and retraining programmes. On average, workers in CC5 in foreign affiliates would need around 6 months of training to achieve the level of productivity comparable to Western Europe. (EBRD, 2000). They lack general adaptability and flexibility, which higher levels of education develop. Also, their technical and IT education is considered as insufficient (EBRD, ibid.). In contrast to foreign investors, domestic enterprises and public institutions have not been able so far to promote retraining activities to the extent required by the scale of restructuring challenges. Insufficient commitment to adult education is also reflected in national statistics of CC5 – data is scarce.

The data on new start-ups shows the significance of education for entrepreneurship (Table 7). People with higher education establish new enterprises relatively more often in all five Central European economies. The relative overrepresentation of people with higher education among new entrepreneurs is particularly high in Slovenia, Poland and Hungary, which may indicate higher innovative potential of the new firms in those two countries. In Czech Republic and Estonia the relative propensity to establish enterprise is more balanced when compared to skewed distribution of education of economically active population. The record of people with secondary education is uneven, which may reflect the deficiencies in flexibility of secondary education programmes, in particular vocational.

Many start-ups are triggered by the 'push' factors, not the 'pull' factors, i.e. by founders who wish to escape/avoid unemployment status. Overrepresentation of least educated as well as of those with the 1st stage of the second level among entrepreneurs is particularly high in Czech Republic. Czech Republic has a well-documented record of successful active labour market policy (Mickiewicz and Bell 2000), and the distribution of new start-ups shows high share of entrepreneurs in relatively disadvantageous groups (Table 7).

Table 7. Distribution of new active enterprises by the level of education of the founder/ manager, 1998

	Percentage of enterprises				Percentage of enterprises/Percentage of Economically active population in a given educational category			
	1st and less	2nd,1st stage	2nd,2st stage	3rd	1st and less	2nd,1st stage	2nd,2st stage	3rd
CZR	7.8%	38.9%	40.4%	12.9%	1300.0%	392.9%	51.1%	122.9%
EST	5.0%	5.3%	46.8%	42.9%	384.6%	46.1%	101.7%	104.1%
HUN	3.4%	21.3%	36.5%	38.8%	261.5%	93.8%	58.9%	277.1%
POL	4.6%	25.0%	45.6%	24.8%	26.1%	70.8%	143.4%	162.1%
SLO	3.0%	24.2%	32.3%	40.5%	96.8%	118.6%	51.9%	283.2%

Source: Eurostat, *"New Enterprises in Central European Countries in 1998"*.

2.3 Unemployment and education

The data on the educational structure of the unemployed in CC6 (Table 8, below) confirm that active labour market policy and retraining is much bigger problem in the case of 1st level and the first stage of the 2nd level than in the case of 3rd level and 2nd stage of 2nd level. The largest group in CC5 (with the exception of Poland), is 2nd stage 2nd level group, whose unemployment rates, with the exception of Estonia, are all below 10%. The educational structure of the economically active population of Cyprus is very similar to Greece. In that respect, the implications for its innovation policy should be different than for the CC5. The focus of Cyprus's innovation policy should be much more on general upgrading of skill levels than on restructuring and retraining, as is needed in the CC5.

Table 8. Unemployment rates by level of education, 1998

	1st and less	2nd,1st stage	2nd,2st stage	3rd
Candidate countries				
CYP	3.5%	4.8%	4.3%	3.4%
CZR	24.7%	16.8%	6.6%	2.6%
EST	16.0%	16.2%	11.4%	5.4%
HUN	28.2%	12.0%	7.3%	2.1%
POL	14.4%	12.5%	9.6%	4.2%
SLO	16.7%	9.0%	7.9%	2.1%
Cohesion countries				
GRE	6.5%	12.2%	14.5%	10.4%
IRL	15.5%	10.7%	5.5%	3.4%
POR	4.6%	6.2%	6.8%	3.4%
E	17.8%	21.7%	19.9%	16.1%
High income				
DK		8.3%	5.0%	3.7%
D	21.7%	14.8%	9.9%	5.3%
NL	11.0%	5.8%	3.4%	2.4%
UK	12.4%	10.0%	5.6%	13.1%

Source:: ILO

3. Knowledge creation: investment – tangible and intangible

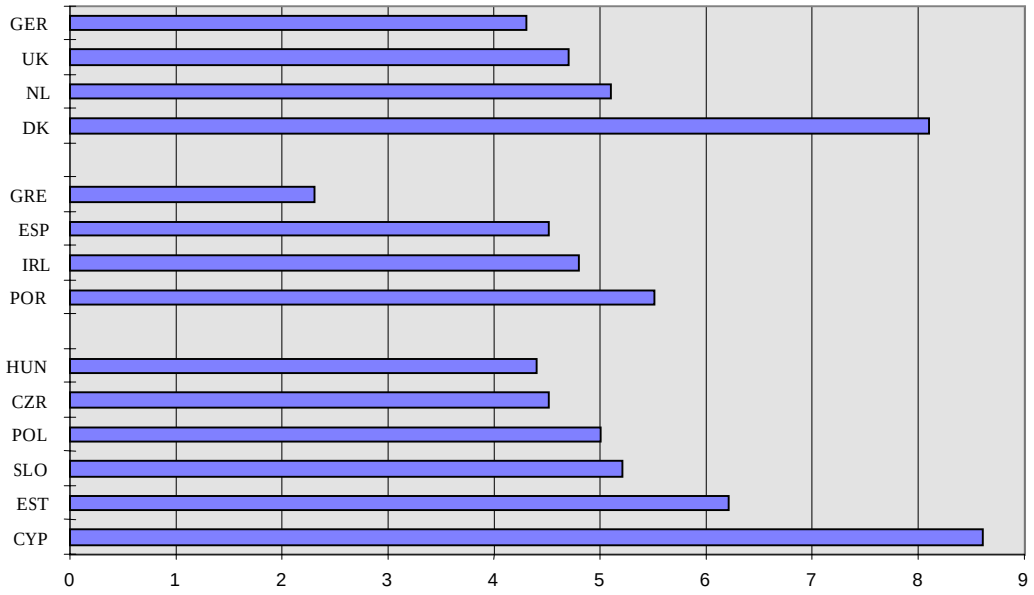
The ability to generate investments, both tangible and intangible, for a prolonged period of time is essential for the CC to catch-up and to grow. As the EU innovation surveys suggest, around half the cost of innovation is related to physical investments or investments in embodied technology. A CC5 innovation surveys suggest even higher importance of tangible investments in innovation (see Radosevic, 1999b). In this section we overview the position of CC with regard to a variety of different forms of investments, mainly intangible, and organisational investments like new enterprises.

3.1. Intangible investments: education and R&D

The share of physical investments in GDP of the CC ranges between 25% and 28%, which is somewhat higher than in EU economies (Table 3, column 1). Also, the rate of growth of investments during the 1990s is higher in the CC than in the EU economies. In particular, rates of 10.2% and 11.5% in Slovenia and Poland respectively, are substantially above EU rates, and are even higher than the 8.9% rate of Ireland. This is encouraging, as in the longer historical perspective, the share of investment is still lower than shares of investments of catching up economies which are above 30% levels. The rate of growth in investment, which is faster than that of GDP, if continued will lead to increased share of investment.

However, in an increasingly knowledge based economy, the structure of investments may be more important than their levels. The data only allow us to look at R&D and educational investments, which is far from sufficient for understanding the importance and contribution of intangible investments to growth.

Figure 4. Total expenditure on education as % of GDP, 1999



Source: World Bank, 2001 World Development Indicators. For Cyprus, Statistical Services.

It is encouraging that expenditures on education have not been substantially reduced in relation to GDP during the transition period in CC5, except in the case of Hungary (Figure 4, below). Levels of investment in education are generally either around the EU average or, as in the cases of Estonia, above 6% GDP, among the highest. The shares on education in total government expenditures in Estonia and Poland stand at 25% of total government expenditures, among the highest in Europe (1998). CC5 governments, with the exception of Hungary, have to compensate for the lack of other alternative sources of funding on education by direct spending on education, the share being at least as high or higher than in comparative EU economies. In Cyprus, the share of education expenditures in GDP has been growing steadily during the 1990s rising from 5.6% (1990) to 8.6% Until 1994-1995, the expenditures on R&D had been decreasing sharply in CC5. Since than expenditures have stabilised or even started to grow again. In Estonia, Poland and Hungary, relative expenditures on R&D are similar to the level of the Southern EU cohesion countries. Slovenia and the Czech Republic show even higher levels, being at the EU average.

Generally, there is a strong relationship between the income per capita and the level of expenditures on R&D. Rich countries are typically spending more on R&D than developing economies. Yet, CC5 countries are spending relatively more resources on R&D activities than countries with similar levels of GDP per capita. We checked this formally by regressing R&D/GDP ratio against income per capita for 84 countries, for which data are available. As expected, all transition countries, except Hungary, have positive residuals, i.e. their expenditures on R&D are higher than would be expected given their income levels. Amongst the CC5 candidate countries, Slovenia has the highest positive residual, i.e. its level of spending on R&D is significantly above what might be expected based on its level of income.

Expenditures in Cyprus on R&D are extremely low and stand at 0.23% of GDP in 1998 (Table 9). In this respect, Cyprus is similar to the Southern EU cohesion countries, which do not spend much on R&D. In fact, in the regression exercise discussed above, Greece and Portugal have the largest

absolute negative residuals in the sample of 84 countries. Also, Spain does not perform much better.

In terms of relative number of researchers, CC5 countries are also at the level of Southern EU economies (Table 9), with the exception of Slovenia and Estonia who managed to preserve their research potential at the level of the EU average.

Table 9. Expenditures on R&D and Number of Researchers

	GERD/ GDP 1998	% of R&D by business sector, 1998 or nearest year	Researchers per million Inhabitants, 1998 or nearest year
Candidate countries			
Cyprus	0.23	13.9	209
Czech Rep	1.27	64.6	1222
Estonia	0.62	19.6	2017
Hungary	0.68	38.4	1099
Poland	0.73	41.5	1358
Slovenia	1.42	53	2251
Cohesion countries			
Greece	1.51	25.6	773
Ireland	1.4	73.1	2319
Portugal	0.63	22.5	1182
Spain	0.9	48.8	1305
High Income			
Denmark	1.93	62.6	3259
Germany	2.29	67.9	2831
Netherlands	2.04	54.2	2219
UK	1.82		2251

Source:: Eurostat, OECD. For Cyprus, Statistical services.

CC5 countries have much higher numbers of R&D personnel than their levels of GDP per capita would suggest. Again, we checked this formally by regressing the R&D personnel/1,000 population against GDP per capita. All CC5 candidate countries have personnel figures above those predicted by the equation, except the Czech Republic, which has a small negative residual. Estonia and Slovenia have the largest residuals amongst this group. CC5 compares favourably with the South European cohesion countries, which have large negative residuals, i.e. they have small numbers of researchers given their GDP per head level.

As already pointed out, the structure of investments is as important as their relative and absolute levels. In this respect, foreign direct investment is an important ingredient of the investment process as it brings in not only new equipment but also new intangible investment in the form of management competencies, market access and greater financial backing. With the exception of Slovenia, the share of FDI in GDP in CC5 countries is amongst the very high or the highest in Europe (Table 4, column 4, above). When compared to Southern EU economies, CC6, except Slovenia and Cyprus, are significantly more integrated into the world economy via FDI. Big strides have been made in the process of integration of CC5 into EU production networks, which are reflected in an increasing number of sectors in which foreign investors control a significant share of production, employment and investments. Cyprus is lagging significantly behind in attracting FDI

and, given its geographical position, is not exploiting the advantages that FDI could bring to economy.

3.2. R&D and inventive activity: outcomes and orientations

The R&D systems of CC5 have undergone downsizing and functional, funding and organisational restructuring (Radosevic, 1999). The changes have affected the type and quantity of the R&D output. From a statistical point of view, we are able to capture the outcomes of R&D very partially, in the form of either papers or patents. The number of resident patent applications fell sharply in the transition period. It seems that this decrease has stopped or at least is continuing at a much slower rate. With the positive exception of Slovenia, the number of resident patent applications per capita in CC5 is at a similar level to Southern EU economies. Similar pattern applies to the number of US patents per capita (Table 10, columns 1 and 2). The average number of resident patents per 10,000pop for CC5 is 0.7 compared to 0.3 for Southern EU economies. This suggests that the domestic technological activity is relatively more developed in the CC5 than in Southern EU economies. However, the international relevance of these innovation activities is rather limited. At 0.03 US patents per 10,000 population, US patenting is very marginal and similar in both CC5 and in Southern EU. Ireland and Cyprus are both located on opposite sides of this spectrum in terms of both resident and US patenting.

As CC5 have modernised their patent legislation, the protection of intellectual property rights (IPRs) has become an important policy and management issue. Large MNCs usually initiate protection in all countries of the region simultaneously. This has resulted in very similar absolute levels of non-resident patent applications in countries of very different sizes, for instance, Poland and Slovenia. Therefore, per capita measure is misleading in this case (Table 10, compare: columns 3 and 4).

Table 10. Inventiveness, patents

	Resident patent applications per 10,000 of population, 1998 (inventiveness coefficient)	US patents Per 10,000 of population, 1998	Nonresident patent applications per 10,000 of population, 1998	Nonresident patent applications Total, 1998
	(1)	(2)	(3)	(4)
Cyprus	0.0	0.00	1.2	87
Czech Rep	0.6	0.02	37.5	38555
Estonia	0.1	0.00	244.7	35479
Hungary	0.8	0.05	37.5	37956
Poland	0.6	0.00	10.1	38942
Slovenia	1.4	0.10	181.6	36001
Greece	0.1	0.02	105.8	111271
Ireland	2.6	0.22	300.0	111145
Portugal	0.1	0.01	39.1	38942
Spain	0.7	0.08	36.8	144770
Denmark	5.0	0.94	270.6	143460
Germany	7.6	1.17	16.5	134981
Netherl.	3.3	0.88	69.6	109325
UK	4.5	0.63	24.9	147298

Source: OECD MSTI, US PTO, Estonian Patent Office, World Bank, *World Development Indicators 2001*; Population: from Eurostat..

Note: Cyprus – resident and non-resident applications, 1997 data.

Due to the multifaceted nature of science and technology (S&T) inputs and outputs, the issue of productivity of countries' innovation systems is extremely complex. Outputs of innovation activities are not only in the form of products, such as patents, papers, or tangibles (machinery and equipment), but even more important, in the form of a wide range of know–how capabilities and skills. We should bear this in mind when trying to understand the issue of productivity of innovation activities. Any indicator is inevitably very partial and can be understood only in a specific national context.

Table 11 shows the ratio between resident patents and S&T journal articles per $1mn GERD(PPP) and per 1 Research Scientist and Engineer (RSE). This indicator measures more than the productivity of the R&D system: it is also an indicator of the relative orientation of formal R&D activities, in particular whether they are more research oriented (S&T journal articles) or more innovation/invention oriented (resident patents).

Table 11. 'Productivity' and orientation of R&D systems

	Resident Patents/GERD, 1998 or nearest year	Resident Patents/ R&D personnel 1998 or nearest year	S&T journal articles/ GERD 1998 or nearest year	S&T journal articles/ R&D personnel 1998 or nearest year
	(1)	*(2)*	*(3)*	*(4)*
Candidate countries				
Cyprus	0.00	0.00	-	-
Czech Rep	1.02	0.03	3.21	0.09
Estonia	0.76	0.00	7.66	0.05
Hungary	2.64	0.04	6.02	0.08
Poland	2.36	0.03	3.93	0.05
Slovenia	1.25	0.04	2.27	0.06
Cohesion countries				
Greece	0.13	0.00	3.92	0.11
Ireland	0.98	0.10	1.15	0.09
Portugal	0.16	0.01	1.86	0.06
Spain	0.66	0.03	2.39	0.12
High income countries				
Denmark	0.97	0.08	1.32	0.12
Germany	1.54	0.15	0.82	0.08
Netherlands	0.77	0.07	1.62	0.13
UK	1.30	0.11	1.69	0.14

Source:: Calculated based on WB *CDROM World Development Indicators 2001,* OECD *MSTI 2000,* Slovenian Statistical Office data, and for Estonia on Hernseniemi (2000)Table 6 - 'Productivity' and orientation of R&D systems

As measured by patents and S&T journal articles, the productivity of CC5 countries' R&D systems is high, when related to their gross expenditures on R&D (GERD). The comparison looks favourable, both in relation to the cohesion countries and high-income EU economies (Table 11, column 1 and 3). However, these data are not in purchasing power parities and thus overestimate the 'productivity' of CCs. Nevertheless, we would expect that the relative ranking would remain similar. When measured in terms of patents per full-time equivalent (FTE) researcher, the 'productivity' of CCs countries is significantly lower than in high-income EU economies (Table 11, columns 2 and 4 and Figure 5a) but similar to 'productivity' of Southern EU economies and with very small dispersion.[1] In relation to the relative numbers of S&T journal articles CC5 are below the average 'productivity' levels of both high income and cohesion economies. However, this lag is not present in all CC5 (Table 11 and Figure 5b).

We may conclude that, in terms of 'productivity' or efficiency of their R&D systems are not lagging behind as was often assumed at the outset of transition for CC5. Given their expenditures on R&D and number of researchers, their R&D systems are producing outputs broadly comparable to cohesion EU economies. This in particularly applies if we take into account differences in income levels, which inevitably affect the capital intensity of countries' R&D systems and than the quality and number of R&D outputs.

[1] Figures 5a and 5b represent maximum (top line), minimum (low line) and interquartile range val ues (50% of all cases located in the box with mean in the middle). The outlier in figure 5a (circle) is Cyprus.

Figure 5a. Between-group differences for Patents/Personnel

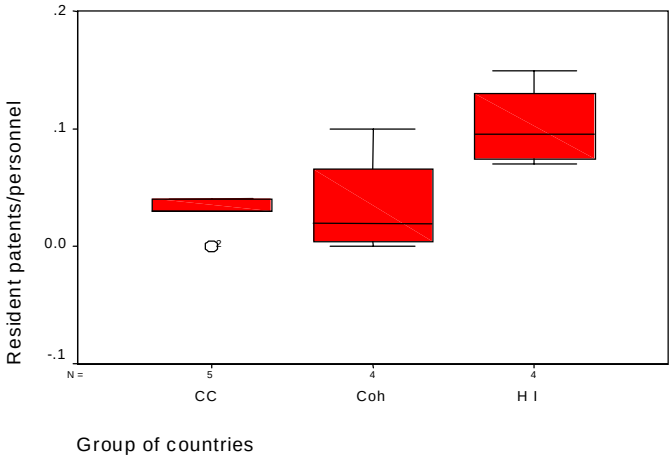
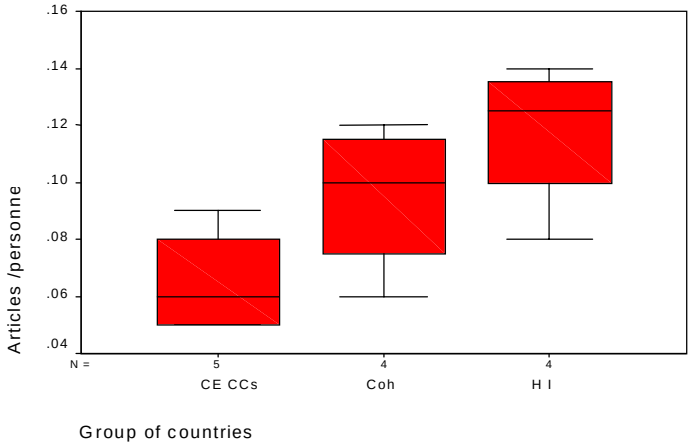


Figure 5b. Between-group differences for Articles/Personnel



However, the data in Table 11 shows not only relative productivity, but also the dominant orientation of R&D systems in candidate countries. In Table 12a, we compare average R&D 'productivities' of the CC5 to those of the EU cohesion and high income economies. In relation to cohesion EU, R&D systems of the CC5 are relatively more oriented towards technology as their relative 'productivities' in terms of patents are better than in terms of papers. This applies in terms of both GERD and R&D personnel. We find the opposite situation when CC5 are compared to high-income EU economies. Thus, in terms of both, GERD and R&D personnel, CC5 R&D systems are more research or science rather than technology oriented when compared to high-income EU. In terms of orientation, CC5 R&D systems fall somewhere between EU 'High income' and EU 'Cohesion' (see table 12b). This intermediate position of Central Europe is an important feature of its industry structure, which according to Urban (1999) also falls in-between EU 'High-income', and EU 'Cohesion' countries.

Table 12a. Productivity indices of R&D systems in selected groups' countries

	Patents / GERD	S&T journals / GERD 1998 or nearest year	Patent applications / R&D personnel FTE	S&T journal articles / R&D personnel, FTE
Candidate countries*	1.60	4.62	0.03	0.07
Cohesion countries	0.48	2.33	0.04	0.09
High Income	1.14	1.36	0.11	0.12

* without Cyprus

Table 12b. Relative orientation of R&D systems of CE candidate countries (cohesion or high income =1)

	Patents / GERD	Paper / GERD	Patents / Personnel	Paper / Personnel
Cohesion EU	**3.33**	1.98	**0.80**	0.69
High Income EU	1.40	**3.39**	0.27	**0.56**

Source:: Based on Table 11

Comparable data on Cyprus are not available. However, very low levels of patenting compared to journal articles suggest that its R&D system is relatively more oriented towards research than to innovation. In that respect Cypriot R&D system shares features of the EU 'South'.

3.3. Venture capital

Structure of investments is essential in changing economic and industry structure of candidate countries towards requirements of new competition and knowledge-based economy. Venture capital is an important mechanism for channelling investment into new technological and growth areas like those related to IT, software and Internet.

When compared to other countries venture capital market in candidate countries is relatively undeveloped (with the exception of Poland), (Table 13).

Table 13. Total private equity / venture capital investment

	USD (million)		% of GDP
	1998	1999	1995-99 (b)
Candidate countries (a)			
Cyprus			
Czech Rep	19	31	0.045
Estonia			
Hungary	41	8	0.051
Poland	124	186	0.099
Slovenia			
Cohesion countries			
Greece	22	76	0.028
Ireland	71	112	0.076
Portugal	55	126	0.069
Spain	406	770	0.066
High Income			
Denmark	45	124	0.031
Germany	2 179	3 366	0.079
Netherlands	1 184	1 823	0.263
UK	7 947	12 256	0.502

a 1998-99. Czech Republic, Hungary and Poland: preliminary pilot data.
b Candidate Countries: only for 1998-1999
c Available data refers generally to the "country of management" approach, *i.e.* according to the geographic location of the managing venture capital firms that raise and invest these funds.

Source: Günseli Baygan and Michael Freudenberg, The Internationalisation of Venture Capital Activity in OECD Countries: Implications for Measurement and Policy, STI Working Papers, 7/2000, OECD, http://www.oecd.org/dsti/sti/prod/sti_wp.htm

Research (see Jeng and Wells, 2000) shows that over time initial public offerings (IPO) are the main force behind the cyclical swings in venture capital. This applies particularly to the later stages of venture capital investments. Accordingly, the lacking exit mechanism in the form of strong IPO market is probably one of the major obstacles for venture capital growth in CCs. Venture capital from CCs should aim to be listed on foreign stock markets as has been pursued successfully by the Israeli venture capital industry. The trouble for potential IPO from CC is that the EU venture capital industry has not had many foreign IPOs and costs of such transactions may be high for CC firms.

3.4. Foreign direct investments

The share of FDI as a percentage of GDP of central European countries is now similar to the EU at around 17%. Presence of FDI is very strong in Hungary with their shares in sales and export of 70% and 86% respectively (Table 14). The relative importance of FDI in Hungary is higher than in Ireland. Also, foreign companies have managed to secure a strong presence in sales (40%) and export (52%) in Poland, even if it is the larger and less open economy. The surge in inflows of FDI into Poland has been concentrated in late 1990ties.

Except in Slovenia, MNCs are generating from 60% to 92% of profits. In general, the size of economy is not necessarily an indication of MNCs presence in CC5. Small economies (Slovenia and Estonia) have comparatively low degrees of FDI presence.

Table 14. Penetration of FDI in Eastern European economies

	Share of foreign investment enterprises in manufacturing, per cent, 1998				
	Sales	Export	Profits	Investment outlays	Employment
Czech Republic	32.1	47	92.1	41.6	19.6
Estonia	28.2	35.2	59.2	32.9	20.8
Hungary	70	85.9	88.8	78.7	44.9
Poland	40.6	52.4	66	51	19.2
Slovenia	24.4	32.9	24.9	24.3	13.1

Source: Based on Hunya, Gábor, *International Competitiveness Impacts of FDI in CC5Cs,* Paper presented at the 6th E.A.C.E.S Conference, Barcelona, 7-9 September 2000, (http://eu-enlargement.org/) and on Mickiewicz, Radosevic and Varblane (2001)

FDI bring capital but also transfer assets from less to more efficient owners. This latter aspect is very important in the CC5, where foreign owners have advantages in terms of corporate governance as well as in terms of easier access to capital markets and technology. The result is a big difference in terms of productivity between domestic and foreign owned firms.

Tables 15 and 16 show respectively rough measures of labour productivity (sales per employee) and capital productivity (sales per assets) differences between domestic and foreign firms in candidate countries from CC5.

Table 15. Sales per employee, Foreign Investment Enterprises in per cent of Domestic Enterprises in manufacturing, 1993-1998

	1993	1994	1995	1996	1997	1998	1998/1994
Czech Republic	209.1	186.3	190.5	193.7	188.8	189.0	101
Estonia	.	.	240.7	188.1	160.1	150.2	62
Hungary	151.4	209.0	259.9	281.8	278.9	286.7	137
Poland	158.7	154.5	156.9	185.1	184.5	194.4	126
Slovenia	.	240.9	228.0	217.8	198	197	82

Source: Hunya, Gábor, *International Competitiveness Impacts of FDI in CC5Cs,* Paper presented at the 6th E.A.C.E.S Conference, Barcelona, 7-9 September 2000, (http://eu-enlargement.org/)

In all CC5 labour productivity in foreign investment enterprises (FIEs) varies from 150% (Estonia) to almost 300% (Hungary) of that of domestic enterprises. In that respect, FDI play a very positive direct role in these economies. Productivity in foreign owned sector in Hungary is now higher than in Austria.

In terms of capital productivity, the ratios between foreign and domestic enterprises are either not high or are less than one. This has to do with sectoral structure of FDI. For example, in Estonia FDI are present in only one third of industry and even there the share of foreign investment enterprises (FIEs) in sales is 22.7% (1998). It may also result from relatively recent entry of foreign investors in most of those economies except Hungary.

Table 16. Sales per assets, Foreign Investment Enterprises in per cent of Domestic Enterprises in manufacturing, 1993-1998

	1993	1994	1995	1996	1997	1998	1998/1994, %
Czech Republic	.	124.4	116.2	120.9	124.0	132.8	107
Estonia	.	.	.	43.6	58.9	61.8	142[a]
Hungary	.	.	.	.	.	.	.
Poland	108	96	102	130	119	110	115
Slovenia	.	141	150	140	132	129	91

[a] 1998/1994.

Source: Hunya, Gábor, *International Competitiveness Impacts of FDI in CC5Cs*, Paper presented at the 6th E.A.C.E.S Conference, Barcelona, 7-9 September 2000, (http://eu-enlargement.org/)

This conclusion is confirmed by the fact that in terms of trend, differences between domestic and foreign enterprises are increasing. That relates in particular to countries characterised by a high share of FIEs in sales (Czech Rep., Hungary, Poland). This in turn leads to high differences in profitability and than in investment between foreign and domestic firms. In order to reduce this increasing gap between domestic and foreign controlled firms it is necessary to improve linkages between the two. If dangers of dual economy are to be avoided than the innovation policy has an important role to play in stimulating technological networks between domestic and foreign firms.

3.5. New enterprises

In addition to foreign firms, domestic entrepreneurs are also an important source of innovation. In particular, creation of new enterprises is an important organisational innovation. Establishment of new enterprises may be a decisive factor behind the growth of new, technologically advanced sectors in candidate countries. The data on propensity to create a new enterprise, actual creation of new enterprises and the share of self-employment in total employment is presented below.

Table 17. Enterpreneurship and creation of new enterprises

Country	Propensity to become self-employed[a]	Creation rate of new enterprises, %[b]					Self-employment as % of total employment[c]
		1995	1996	1997	1998	Average	
Czech Rep.	36.8	17.7	12.3	12.3	14.6	14.2	10.7
Estonia	N/a	19.3	11.1	16.5	18.5	16.4	N/a
Hungary	49.8	14.6	10.7	8.8	11.9	11.5	13.9
Poland	79.9	18.8	16.8	22.1	22.3	20.0	30.2
Slovenia	57.8	11.9	9.0	8.8	9.3	9.8	9.8

[a] *Percentage of respondents who would prefer to be self-employed (source : Blanchflower 2001)*

[b] *Source: Eurostat.*

[c] *Source : Blanchflower 2001.*

Table 17 shows that Poland is characterised by exceptionally high propensity to create new firms amongst its labour force (79.9% of respondents). In fact, it is the highest percentage amongst all the countries surveyed, with Portugal and US scoring second and third and Russia, Denmark and Norway being on the other (lowest) end of the spectrum (Blanchflower 2001, Table 1).
This result corresponds to the Poland's highest rate of creation of new enterprises amongst the Central European economies. From the structural point of view, it corresponds to fast rate of employment creation in the 'new' economic sectors, particularly services (Mickiewicz 2001). As a result, Poland has also a largest proportion of self-employment.

Yet, the more detailed analysis provides some qualifications. First, amongst CC, only between one fourth and one half of new (active) enterprises were capable and willing to invest one year after they were founded (Table 18 below). And the share of investing firms is relatively small in Poland. Moreover, it is the only country, where the percentage has been consistently declining. To some extent, the low figure for 1999 in Poland may be explained by the impact of the restrictive monetary policy re-imposed to fight inflationary pressures, and exceptionally high cost of credit. Yet, the trend is worrying and should be monitored further. It seems that entry barriers are low in Poland and the creation of new firms is strong, but there are some specific barriers to their further growth.

Table 18. Propensity to invest among new enterprises

Percentage of active enterprises making investments (of those created previous year)					
	1996	1997	1998	1999	Average
CZR	37.8%	38.6%	36.6%	34.6%	36.9%
EST	32.0%	46.1%	40.1%	45.2%	40.9%
HUN	44.5%	50.6%	48.7%	43.9%	46.9%
POL	35.9%	33.5%	31.6%	27.3%	32.1%
SLO	42.9%	41.1%	44.8%	36.4%	41.3%

Source: Eurostat.

In order to identify these barriers we discuss the main obstacles to development as perceived by the new enterprises. While the supply-side barriers offer less evidence for cross-country systematic differences, there is a very clear pattern in relation to demand-side difficulties. Polish entrepreneurs consistently experience the highest problems on the demand side, as compared with other countries. On one hand, their answers indicate strong competition and downwards pressure on the price, which is efficiency-enhancing. Competition is the most important factor chosen by Polish entrepreneurs, with a percentage considerably higher than in the other economies. On the other hand, the bad financial situation of the clients indicates continuing impact of the disinflation policy.

On the supply side the barriers that are related both to technology and to the level of training are low, as compared with purely financial constraints. Hungary scores best in terms of both access to technology and skills – both are least important barriers as compared with the other countries.

Table 19. Supply side difficulties as perceived by new active enterprises. Average 1995-1998

	CZ	EST	HUN	POL	SLN	Average
Lack of funds	68.0%	54.5%	80.3%	76.0%	65.5%	68.9%
Limited access to credit	31.8%	34.3%	15.3%	33.3%	36.0%	30.1%
Non- or late paying customers	42.0%	40.8%	6.0%	32.0%	51.5%	34.5%
Limited access to trained workers	14.3%	13.0%	5.8%	12.8%	16.0%	12.4%
Lack of technology	6.0%	8.0%	5.3%	11.5%	11.8%	8.5%
Lack of raw materials	4.3%	3.5%	1.8%	4.0%	3.0%	3.3%

Source: Eurostat

Table 20. Demand side difficulties as perceived by new active enterprises. Average 1995-1998

	CZ	EST	HUN	POL	SLN	Average
Clients short of funds	66.0%	56.8%	39.8%	59.8%	58.0%	56.1%
Too much competition	48.8%	65.8%	55.8%	77.5%	60.3%	61.6%
Market price low	16.8%	14.8%	12.0%	46.0%	36.5%	25.2%
Business not sufficiently well-known	39.3%	22.3%	13.8%	32.8%	30.5%	27.7%
Lack of marketing ability	24.0%	19.3%	5.5%	23.5%	20.8%	18.6%

Source: *Eurostat*

4. Transmission and application of knowledge

Innovation capability does not depend only on new knowledge generation but also on the degree to which knowledge is utilised and diffused. Innovative activities of enterprises are essential to this process even when their innovation activities are behind the technology frontier or level of technology in leading economies.

4.1. Innovation and Inventive Activities

The introduction of innovation surveys has allowed the more systematic analysis of the innovation processes than would have been possible a few years ago. However, international comparisons of innovation surveys are still flawed and have numerous methodological and interpretative problems. In addition, national innovation survey data are available only for two candidate countries – Poland and Slovenia - and only for 11 EU countries and Norway. One of the authors (see Radosevic, 1999b) has analysed extensively the results of diverse national and academic innovation surveys undertaken in all CC5 countries and compared them with the EU innovation survey. We partially draw on the results of this work, yet here we will primarily focus on comparisons between the Slovenian and Polish innovation surveys, and the 1997/98 EU innovation survey. We think that some of the results of this comparison have strong relevance for the other CC6, though due to serious problems in international comparisons conclusions should be considered as tentative.

Table 21. Shares of innovative firms in EEA and CC5Cs in manufacturing

Ireland	73.0%
Germany	69.%
UK	59.0%
EEA	53.0%
Slovenia	33.0%
Spain	29.0%
Poland	28.9%

Notes: For European Economic Area (here: EU+ Norway) 1994-96(1995-97); for Slovenia 1998; for Poland 1997-98.

Sources: Frank Foyn, 1999, *Community Innovation Survey*, 1997/98; *Statistics in Focus, Theme* 2-2/1999, Eurostat; GUS, 2000, *Report on S&T in Poland 1999*, Warsaw; Statistical Office of Slovenia, 2000, *23 R&D, S&T, Rapid Reports,* No 81.

Shares of innovative firms in Slovenia (33%) and Poland (29%) are below the European Economic Area (EEA) average of 53%. Their share is similar to Spain's but far from the catching-up innovation activities of Ireland.

In both, the EEA and Poland and Slovenia, as well as in other CC5 countries (see Radosevic, 1999b), the share of innovative firms is significantly higher in large than in small and medium sized firms (SMEs). Despite general support for SMEs, the majority of innovation activities continue to take place in large firms. This result is not surprising, as the sector of small firms is segmented into a relatively small group of dynamic new technology based firms and the majority of SMEs, which are important as employment generators, but are much less innovative. In the CC5, the segment of technology dynamic small firms is marginal. Moreover, it seems that the innovative activity of small firms has substantially decreased in the last 10 years. For example, in Poland, the share of innovative small firms went down from 40% in 1992, to 16% in 1994-96 and to 4% in 1998. A very small share of innovative SMEs in Poland suggests that their dynamism is confined to mainstream business and much less to technical entrepreneurship. In more general terms, it seems that the

problems of innovation in the CC5 are to great extent located in the sector of small firms and its weak links with large firms.

A lower share of innovative firms within the group of large companies, when compared to medium sized firms in Slovenia, probably reflects the scale of the restructuring problems in their several large companies.

Table 22. Number of innovating enterprises by size class in manufacturing. Percentages

Size class	EEA	Slovenia	Poland	Size class
Small (20-49)	44	16.9	4.1	Small (20-50)
Medium sized (50-249)	59	50.6	23.6	Medium (51-500)
Large (250+)	81	32.5	63.6	Large (501-2000)
			78.1	Very large (2000>)

Source: as Table 22.
European Economic Area: here, EU+ Norway.

Despite expectations at the outset of transition that new innovation-oriented SMEs would replace large enterprises, large firms continue to undertake the majority of innovation activities in CC5. Innovation policy has to take this into account and will have to strike a balance between support to SMEs and to large firms, in particular in their role as organisers of subcontracting networks.

Intensity of innovation activities expressed as the share of innovation expenditures in the sales revenue of enterprises is above the EEA average in both Poland and Slovenia (Table 23). In both economies, firms are under the pressure to innovate and they seem to be able to invest in new products and processes. Moreover, annual data on innovation intensity for Poland show a continuous rise during the last 10 years (Table 24). In Slovenia, innovation intensity increased from 3.3% in 1994-96 to 3.9% in 1997-98. This innovation intensity is partly due to the fact that both countries are behind the technology frontier and hence still enjoy significant returns from imitation of foreign technologies and products. Also, relative strong innovation intensity should be squared with the relatively low share of innovative firms. This suggests that innovation activities are disproportionately concentrated in a few firms and sectors in both economies. On the other hand, there are a large number of firms, especially SMEs, which do not innovate. This difference is especially striking when compared to Ireland, which has very high share of innovative firms but relatively low innovation intensity. A low innovation intensity but large spread of innovation activities suggests much more widespread diffusion of technology. In contrast to this, CC5 seems to have strong innovation intensity confined to several large firms and sectors. This suggests that the problems lie in the diffusion and utilisation of new technologies.

Table 23. Intensity of innovation activity.
The share of innovation expenditures in the sales revenue of the enterprises

Germany	4.1
Poland	4.1
Slovenia	3.9
EEA	3.8
Ireland	3.3
UK	3.2
Spain	1.8

Source: as in Table 22

Table 24. Innovation intensity in Poland, 1989-1998

1989	0.8
1990	0.9
1991	0.7
1992	0.2
1993	2
1994	2.2
1995	2.2
1996	3.6
1997	4
1998	4.1

Source:: GUS, 2000, *Report on S&T in Poland 1999*, Warsaw

The shares of new or improved products in turnover in Slovenia and Poland are above and below the EEA average respectively (Table 25). Again, when the low share of innovative firms is taken into account, this suggests that the introduction of new or improved products, similar to innovation intensity, is concentrated in a relatively small number of innovative firms. How to expand the number of innovative firms or strengthen diffusion and utilisation of new technologies beyond the small core of innovation-active firms is a challenge for CC5 innovation policies.

Table 25. Percentage of turnover due to new or improved products in manufacturing

Germany	43.0%
Slovenia	32.2%
Ireland	32.0%
EEA	31.0%
Spain	27.0%
UK	23.0%
France	21.0%
Poland 1998	22.4%
Poland 1996	19.7%

Source:: as in Table 22

A comparison of the innovation activities of EU and CC5 enterprises (see Radosevic, 1999b) on one hand shows differences, which stem from the different business environments and cost structures, but also on the other hand, convergence in the objectives of innovation activities. CC5 enterprises still operate in a different business environment, which influences the pattern of innovation activities. First, access to new markets is a more important objective for CC5 than for EU enterprises. In view of the previous closeness of the CC5 economies as well as the demand problems of CC5 enterprises, this seems logical. Second, the reduction of material and energy consumption stands high as an objective of innovation, while in EU firms it is the reduction of the share of wage funds in costs which typically is high.

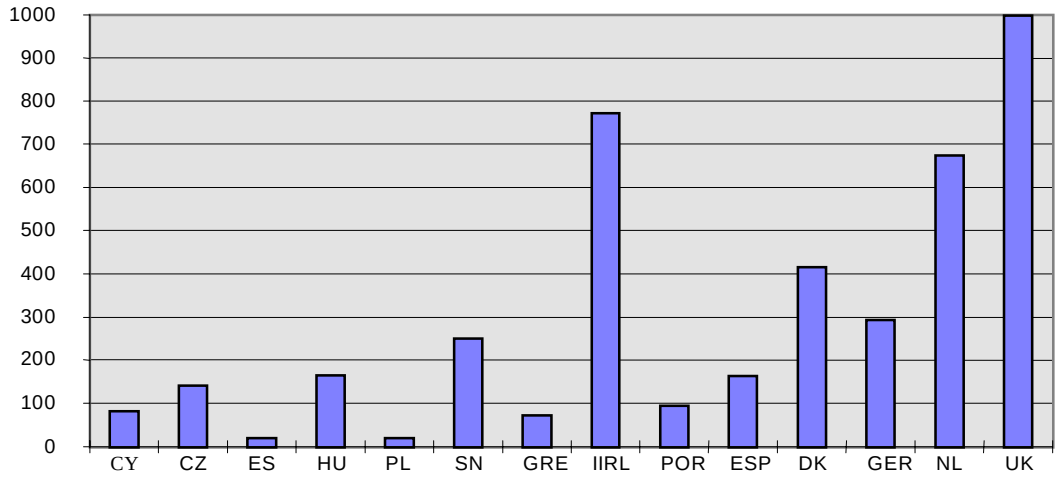
The distribution of innovation costs and the mix of innovative activities are similar over EU economies. In CC5 countries innovation expenditures are devoted significantly more to the purchase of embodied technologies than in the EU. The share of R&D and engineering activities in CC5, which represent the intangible component of investment in innovation, is more than two times smaller than in the EU. This is consistent with the low share of enterprises involved in R&D activities in CC5 countries.

However, there are several features of innovation activities in CC5 countries that have already become similar to those in EU industries. First, the most important objectives of innovation coincide in both regions: product quality, increase in or maintenance of market share and extension of the product range within the main field. Second, the sources of information for innovation are similar in both CC5 and the EU. It is internal sources and customers rather than fairs and exhibitions, which are the most important sources of information for innovation in both the EU and CC5. These similarities show that the behaviour of enterprises in CC5 conform to a market incentive environment.

4.2 Diffusion of quality control techniques

Quality is of paramount importance for the exporters from candidate countries (CCs). Also, with an increasing openness of domestic markets quality has become an essential for successful business on home markets. Innovation surveys in candidate countries show that the highest percentage of companies innovators consider improving product quality as very important objective of their innovation activities. The improved quality depends on introduction and wide diffusion of technology management techniques. Among these, quality standards, industry specific and general standards, play an important role. Both ISO9000 and ISO14000 are known as generic management standards. The definition of quality in ISO9000 refers to those features of a product or service that are required by the customer. The second standard, ISO14000 is primarily concerned with environmental management, i.e. activities to reduce harmful effects on the environment caused by companies' activities. The extent of their introduction in an economy indicates the degree to which companies are concerned with quality management. In turn, this should have positive effects on their export competitiveness and should lead to increased market shares. Table 26 shows the number of ISO900 certificates issued in selected group of countries in 1999 and the average rate of growth in 1994-1999 period. Average rates of growth in 1994-1999 period in candidate countries (235% annually) are significantly higher than rates of growth in selected EU high income (134.7%) and cohesion countries (154.7%).

Figure 6. ISO9000 certificates per 1 mln population, 1998



Source: ISO, 2000, World Bank, 2000

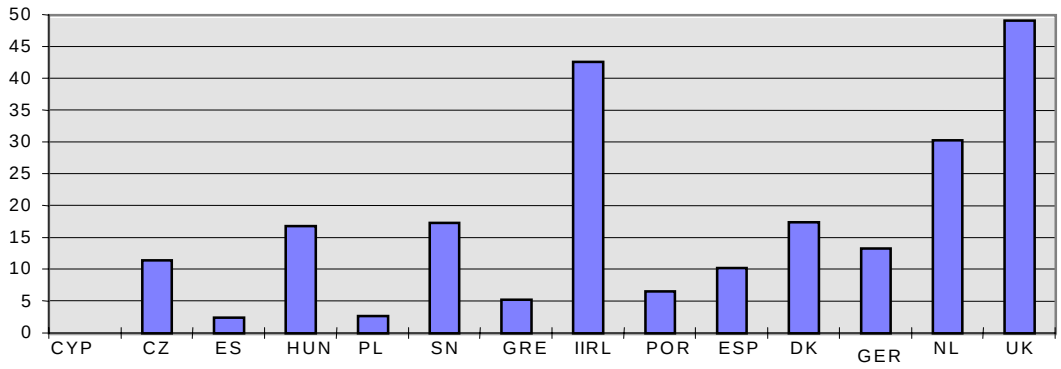
Table 26. Standard Certifications in selected countries

	ISO9000 certificates		ISO14000
		Average Rate	
	1999	*1994-99*	*1999*
Candidate countries		*235.0%*	
Cyprus	184	238.5%	60
Czech Rep	1500	209.0%	60
Estonia	77	238.4%	4
Hungary	3282	228.6%	121
Poland	1012	316.9%	72
Slovenia	521	178.7%	19
Cohesion countries		*154.7%*	
Greece	1050	168.4%	20
Ireland	3100	123.1%	115
Portugal	1131	153.9%	28
Spain	8699	173.4%	573
High Income		*134.7%*	
Denmark	1962	121.6%	430
Germany	30150	164.3%	962
Netherlands	10620	138.5%	403
UK	63700	114.6%	1492

Source:: ISO9000 and ISO14000 in brief, International Standards Organisations, www.iso.ch

However, in terms of relative penetration of ISO9000 standards there are significant differences among candidate countries. In both, per capita and per GNP terms Slovenia, Czech Republic and Hungary are ahead of Poland and Estonia with Cyprus in intermediate position. Also, when compared to cohesion southern EU economies the diffusion of ISO9000 certifications is comparable or higher in top three candidate countries (see Figures 6 and 7). Diffusion of ISO14000 standard is much more recent phenomenon and cumulative numbers in candidate countries have only recently started to surpass 100 (Table 26). Hungary has early start in this respect, which probably reflects that 85% of Hungarian export is driven by foreign direct investments.

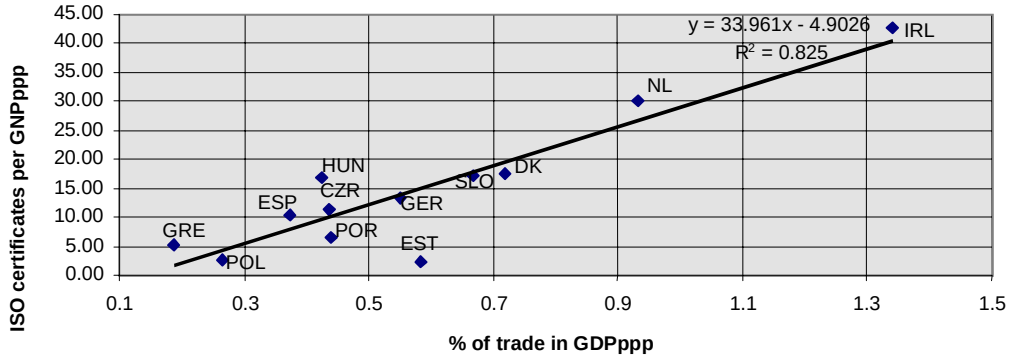
Figure 7. ISO900 certificates per GNP PPP, 1998



Source: ISO, 2000, and World Bank, 2000

However, it is the trade openness, which can explain the greatest part of variations among individual economies. Figure 8 shows that there is a strong correlation between trade openness and ISO9000 certificates per capita and per GNP countries, especially when we drop UK whose number of ISO9000 certificates by far exceeds of what would be expected given its trade openness. In the analysis without UK more than 80% of inter-country variation in the diffusion of ISO9000 standards can be explained by trade openness. This suggests that generic standards, like ISO900, have become a prerequisite for successful exporting. This further reinforces the importance of public programs in candidate countries to diffuse innovation management techniques.

Figure 8. ISO9000 certificates per GNPppp and Trade Openness, 1998



Source: ISO, 2000 and World Bank, 2000

4.3. Information and Telecommunication Infrastructure

Information and telecommunication infrastructure is both an important economic activity by itself as well as an essential prerequisite for the growth of all other sectors. The gap in diffusion of IT and telecommunications between CC5 and the EU was huge in the early 1990s. Due to privatisation and liberalisation in this area (both policies still being gradually implemented), and rising demand, which is also partly driven by foreign investments, this gap has decreased but is still substantial. In terms of number of telephone mainlines per capita CC5 is clearly at the bottom of the European ranking (Table 27).

The sophistication of the telecom infrastructure varies greatly among the CC5 economies when indicated by the share of ISDN lines. This reflects past lags but also some latecomer advantages in replacing rather obsolete technologies with the latest ones.

Diffusion of knowledge in the context of global competition is increasingly dependent on information technology (IT) infrastructure.[2] This does not mean only investments in telecommunications but also investments in IT by business and the population at large.

Apart from Slovenia and Cyprus, the number of personal PCs per capita in CC5 is broadly similar to relative penetration rates in Southern EU economies (Greece, Spain and Portugal). Low levels of

[2] Information technology (IT) refers to the combined industries of hardware for office machines, data processing equipment, data communications equipment and of software and sercices. Information and communication technology (ICT) refers to IT plus teclecommunications equipment and services.

income play an inhibiting role in diffusion of PCs as well as in diffusion of Internet services. The gap between CC5 and South EU on one hand, and high income EU, on the other, is large and shows that the problem of digital divide will increase in enlarged EU.

As development of knowledge based services increasingly depends on the Internet, the diffusion of Internet hosts is important to this process. With the exception of Estonia, the number of Internet hosts in CC5 is similar to those of Southern EU countries (Table 28).

An important factor, which hinders further diffusion of Internet in CC5, is the cost of access to Internet, which, in the case of Hungary, Poland and Czech R is the most expensive in OECD (OECD, 2000). This, combined with the low income, generates a vicious circle between supply and demand which innovation policy in these countries should try to resolve.

Table 27. Information and Telecommunication Infrastructure

	Telephone mainlines per 1,000 people,1999	Network digitisation rate (%), 1999	% of ISDN lines (subs)/ Tot. number of lines*	Personal Computers per 1,000 People,1999
Cyprus	585	100	2.7	14.2 (1998)
Czech Rep	371	72	0.42	107.2
Estonia	357	54	2.0	135.2
Hungary	371	75	2.2	74.7
Poland	263	97 (1998)	0.2	62.0
Slovenia	378	92.7	6.6	251.4
Greece	528		0.4	60.2
Ireland	478		0.56	404.9
Portugal	423		3.9	93.0
Spain	410		1.12	119.4
Denmark	685		4	414.0
Germany	590		8	297
Netherlands	607		7.26	359.9
UK	567		2.6	302.5

Source: IT, World Telecommunication Development Report 2000, EITO 2000, Eurostat

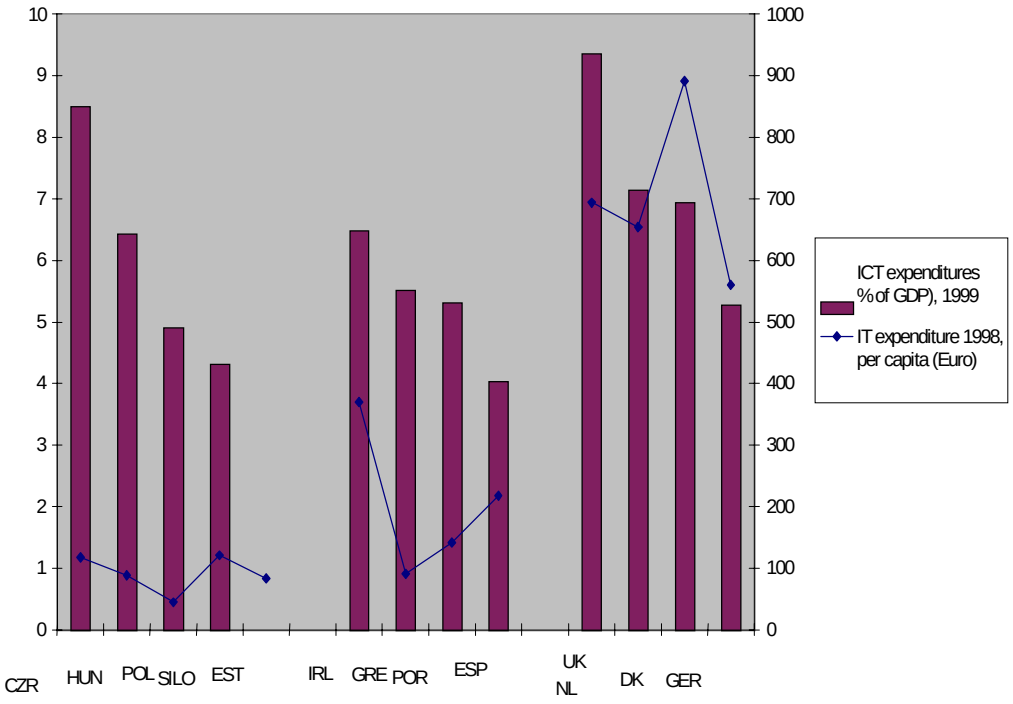
Note : 1999 or nearest year

Table 28. Internet use

	Hosts per 10,000 pop. July 2000	Users per 100 inhabitants, 1999
Candidate countries		
Cyprus		
Czech Rep	134.39	2.5
Estonia	249.29	13
Hungary	129.3	6.0
Poland	67.14	6.0
Slovenia	99.12	13.0
Cohesion countries		
Greece	100.38	7.1
Ireland	227.43	20.0
Portugal	117.25	7.1
Spain	136.51	12.4
High income		
Denmark	692.29	29.4
Germany	233.29	18.4
Netherlands	679.25	21.1
UK	348.34	22.2

Source :: IT, World Telecommunication Development Report 2000

Figure 9. Information and communication technology and IT expenditures



Source: ITU and EITO

Use of ICT is not necessarily linked to the production of ICT and services. Nevertheless, the capacities in producing ICT and related services represent potential advantage in using ICT. In that respect, CC5 have remarkably well overcome the socialist legacy and the share of ICT sector in GDP has in all CC5 economies reached the share of Southern EU. Moreover, the share of ICT sector in Czech Rep. and Hungary is at the EU average or above (Figure 9). However, in terms of IT expenditures per capita CC5 are substantially lagging behind the EU average. Per capita gap in IT is much bigger than income per capita gap.

The weight of ICT sector in CC5 has developed substantially through modernisation of telecoms, introduction of IT related services and the emergence of CC5 as location for manufacturing in IT related sectors.

Table 29. ICT sector intensity ranking

	Employment	Value added	R&D	Trade
	% of ICT in total business sector			% of ICT in tot. trade
Czech Rep	3.3	4.7	4.6	8
Hungary	5.7	9.2	11.3	20.6
Poland			7.6	7.2
Greece			46.9	7.6
Ireland	4.6		47.7	33.1
Portugal	2.7	5.6	23.5	7.5
Spain			21.4	7
Denmark	5.1		21.1	10.4
Germany	3.1	6.1	20.1	9.8
Netherlands	3.8	5.1	19.6	15.6
UK	4.8	8.4	21.8	14.9

Source: OECD

The share of value added in ICT sector in Hungary is among the top three OECD economies (see also OECD, 2000b, figures 2 and 8). Also, relative employment in ICT sector is higher in Hungary than in Finland. This reflects the strong presence of FDI in Hungary which increasingly use Hungary as production location at the lower value added end in electronics and related activities. The role of Hungary as an emerging location in ICT manufacturing can be seen through a very high share of ICT trade as share of total trade. This share is 20%, which is the second in OECD, immediately after Ireland. In 1998, Hungary exported $5bn in PPP terms of ICT goods, significantly more than Czech R ($1.8bn) and Poland ($1.9bn). However, R&D intensity of ICT sector (R&D/VA) is very low. For example, R&D intensity of Finnish ICT sector is 15.7% and of Hungarian less than 1%. This low R&D intensity is not peculiar to ICT sector but reflects generally low R&D intensity of Hungarian industry. Similar conclusions apply to Czech R and Poland whose share of exports in low price/quality segments (downmarket) is very high. Data for 1996, show that the share of downmarket segments in exports of Hungary, Czech R and Poland was 45%, 66% and 66% respectively, by far the highest in OECD and similar to Turkey (66%) and above Greece (41%).

The potential advantage of Hungary as production location for ICT does not yet seem to affect demand or diffusion of ICT where Hungary falls into line with other CC5 countries that do not operate as a location base for component manufacturing in ICT. This clearly suggests that the weak R&D intensity of industry and weak diffusion of ICT are major issues for Hungarian innovation policy.

5. Innovation scoreboard: conclusions

In this section we bring together several indicators analysed in the previous sections and expand with several new indicators with the aim to try to construct innovation scoreboard. As a model we use Trendchart model of innovation scoreboard. Unfortunately, the lack of fully comparable data required for the EU comparable scoreboard do not allow us to construct summary index which would be meaningful. However, even very partial data, when organised in several groups, enable us to draw few interesting conclusions, which to a great extent conform, to conclusions of our analysis in the previous sections. We compare the available data with the country based EU average values.

Table 30. Innovation scoreboard 2001

No.	Indicator	Year	Cyprus	Czech R.	Estonia	Hungary	Poland	Slovenia	EU
Human resources									
1.1	S&E graduates/20-29 pop, promiles	1999		4.0	3.8	5.5	5.9	13.1	9.32
1.2.	% ec.actve pop with 3rd level education	1999	22.60%	11.30%	40.80%	15.60%	14.80%	15.90%	23.25%
1.3	Life-long learning								9.65
1.4	% emp. h-tech manufactur.	1999	1.85%	10.63%	5.71%	8.49%	7.54%	10.18%	6.29%
1.5	% emp h-tech services								3.27
Knowledge creation									
2.1	Public exp. R&D / GDP	1999	0.18	0.47	0.48	0.37	0.44	0.64	0.62
2.2	BERD / GDP	1999	0.03	0.82	0.12	0.26	0.30	0.75	1.14
2.3	EPO h-tech pats /pop								19.14
2.3b	USPTO h-tech pat/pop	1998	0	0	0	2.08	0	1.52	11.65
Transmission and application of knowledge									
3.1	% SMEs innov in-house						4.1	16.9	41.01
3.2	% SMEs innov co-op								15.42
3.3	% innov exp /total sales						4.1	3.9	3.41
Innovation finance, output and markets									
4.1	% vent capital / GDP	1999		0.021		0.016	0.045		0.09
4.2	% new capital /GDP	1999					0.24	0.15	1.53
4.3	% new-to-mark products								5.40
4.4	Home Internet access								33.40
4.5	% ICT markets / GDP	1999		8.49		6.42	4.9	4.31	5.86
4.6	% 93-97 high-tech share								9.50

Notess : a) In 1.2, we replaced % of workking age population with 3rd level education by the % of economically active population (employed and unemployed only) with 3rd level of education.
b) Due to very small figures the use of data under 4.6. for CCs does not make much sense. This indicator has not been also applied in the orginal Trendchart scoreboard for small EU economies.
c) We were unable to collect comparable data for 1.3 (adult learning).

Sources : as in Tables 1-29 except for 4.1. PriceWaterhouse Cooper, Global Private Equity 2000, for 4.2. www.fibv.com, and EC 2001 for the EU average.

Table 31. Innovation scoreboard – definitions

N°	Short description of indicator
1.	**Human resources**
1.1	New Science & Engineering graduates as a ‰ of the 20 - 29 year old population (ISCC5D classes 5a and above in ISC 42, 44, 46, 48, 52, 54, 58)
1.2	Percent of working age population (25-64) with a tertiary education (ISCC5D 5 to 7 inclusive)
1.3	Percent working age population in education or training (life-long learning)
1.4	Percent of total employment in medium-high and hi-tech[3] manufacturing (NACC5 24, 30-35)
1.5	Percent of total employment in high-tech[4] services (NACC5 64, 72-73)
2.	**Knowledge creation**
2.1	Public R&D funding as % of GDP (public funding relates to governments and higher education institutions)
2.2	Business expenditures on R&D as a percentage of GDP (business sector relates to manufacturing and services)
2.3	Number of EPO patent applications in high tech classes per million population (pharmaceuticals, biotechnology, information technology and aerospace)
2.3a	Number of USPTO patent applications in high tech classes per million population (same categories as in 2.3)
3.	**Transmission and application of knowledge**
3.1	Percent of manufacturing SMEs that innovate in-house or in combination with other
3.2	Percent of manufacturing SMEs involved in co-operative innovation
3.3	Total innovation expenditures in the manufacturing sector as a percent of total turnover
4.	**Innovation finance, output and markets**
4.1	Venture capital investment in technology firms as a percent of GDP
4.2	New capital raised on stock markets as a percent of GDP
4.3	Sales share of products ‘new to the market’ in the manufacturing sector
4.4	Home Internet access
4.5	Share of ICT markets as a percent of GDP (total expenditure on ICT as a % of GDP)
4.6	Change in share of TRIAD value-added in hi-tech sectors (1993-97)

Source: EC 2001

5.1. Conclusions

First, CC5 are lagging the least in terms of human resources (1.1 to 1.5) and than knowledge creation (2.1 to 2.3). Their biggest gaps are in transmission and application of knowledge (3.1. to 3.3), i.e. in issues related to the overall interconnectivity within national systems of innovation. Lagging of variables related to innovation finance, structure of output and markets (4.1. to 4.6) are

difficult to generalise and situation in this respect seems to be very uneven, ie. country specific. This may suggest that countries that are similar in terms of human resources, or knowledge generation, or diffusion may record very different growth rates due to non-technological factors like finance.

Second, share of employed in high tech manufacturing is relatively high when compared to EU average. ICT sector intensity is very high in Hungary and in Czech Republic, yet it is low and varying in the other CCs. A high share of intra-industry trade with the EU suggests that foreign investors have managed to tap labour pool in the region. Hungary, in particular, has become the prominent production location for car industry and electronics. The key issue is if this initial favourable situation can be transformed into the dynamic potential. Indicators of knowledge creation show that the potential for dynamism is severely restricted by weak demand for R&D by domestic business sector and is confined to one or two economies. This especially applies to high tech activities (see patenting data). Though nominally a significant share of employment and export in CC5 is in high tech industries, the detailed country data would show that they are specialised for the time being in low value added segments, which do not require high R&D intensity. However, the industry structure is skewed towards engineering in CC5 economies, which suggest that the knowledge creation via R&D will remain significant and important for future technology upgrading.

Third, very small number of innovative small firms and innovative activity confined on few large firms suggest that there are serious problems of linkages within national innovation systems. Innovative small firms are characterised by higher innovation intensity (high share of innovation expenditures in sales) than the EU average. However, there is a big gulf between this layer of firms and the majority of small firms. This raises the issues of 'systemness' or inter-connectivity within national innovation systems as crucial for innovation policy. Fragmented national innovation systems with significant gaps between domestic and foreign firms, between large and small firms, between high technology and traditional small firms, and between new and old sector will require a long-term innovation policy and co-ordination with other economic policies, in particular with FDI policy.

Fourth, there are serious weaknesses in the ability of CC5 to generate venture capital that would expand the number of innovative small firms. The issue of deepening of financial system and of gearing it towards innovation has become one of the key questions of innovation policy in CC5.

Fifth, high ICT intensity of some CC5 (Czech R and Hungary) and lags of other CC5 are still difficult to interpret. They may represent either the source of the emerging long-term growth differences or only different patterns of use and production of ICT (standalone ICT versus ICT integrated into traditional sectors).

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