EUROPEAN NETWORK OF ECONOMIC POLICY RESEARCH INSTITUTES
WORKING PAPER NO. 25/JANUARY 2004

CONVERGENCE OF REAL GDP PER CAPITA IN THE EU15

HOW DO THE ACCESSION COUNTRIES FIT IN?

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ISBN 92-9079-467-4
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Abstract

The EU15 countries' real GDP per capita levels adjusted for purchasing power converged in 1960–2001. Convergence occurred in two spells, in 1960–73 and 1986–2001, with an interim period of stagnation. In this paper, we analyse both σ and β convergence and discuss the impact of EU membership, trade and investment. We also analyse how seven accession countries fit into the historical picture of the EU15 area. The CEE countries are well-positioned to catch up with the incumbent EU countries. After the mid-1990s, an increase in productivity and high investment rates have supported economic growth in the accession countries. Still, the experience of the EU15 countries shows that convergence cannot be taken for granted.

Key words: convergence, EU, accession countries, enlargement

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The author would like to thank Kari Alho for useful comments. This paper is a part of the research project 'Integration, Location and Growth within the Northern Dimension'. Financial support from the Academy of Finland is gratefully acknowledged. The paper was previously published as ETLA Discussion Paper No. 865, 15.08.2003.

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1. Introduction

In principle, poorer countries have some advantage over wealthier ones in economic growth. The former may be able to learn from the past experience of the latter and they can acquire new technology that will help them raise their productivity and material welfare faster than had been possible for the technologically 'cutting-edge' countries of the day. The latter have had to innovate new processes that may or may not prove to be the right ones many years later.

Poorer countries, however, are often short of capital and know-how. Foreign direct investment (FDI) from wealthier and more advanced countries may be an important source for the diffusion of technology. Further, learning and the extent of backward and forward linkages are also important factors if the positive effects from FDI are to materialise. As convergence proceeds, the formerly poor countries will need to take the next step and become innovators themselves, and in general we may expect the speed of convergence to eventually slow down.

Faster growth of course presumes that poorer nations are capable of learning and adopting new and more efficient technologies and production processes. Also, there has to exist a well-functioning (or at least a working) legal, administrative and physical infrastructure and a stable enough macroeconomic and political environment. We have seen this positive trend taking place in east and southeast Asia during the past couple of decades. Meanwhile, African nations have been unable to mount a positive spiral of growth.

In this study, we analyse both σ and β convergence (see below for descriptions) of income levels in Europe. Looking at real GDP per capita levels adjusted for purchasing power in 1960–2001 in the EU15 countries, where catching up has taken place, we seek to analyse the developments in light of EU integration, trade, fixed investment and foreign direct investment. We identify a clear break in convergence and its later resumption and discuss reasons for these. Given these developments, we then analyse development in the EU accession countries during the 1990s and up to 2001, and discuss their convergence prospects.

We consider the Central and Eastern European counties (CEECs) as normal European economies despite their ongoing transition. Looking back at the EU15 countries, many of them have also gone through what can be considered a kind of transition from more protected and less liberalised economies into the economies of the EU internal market that they are now, even though they have not been socialist economies. Consequently, analysing the development of the EU15 countries should give us a perspective on economic development in the accession countries.

The accession countries included in the analysis are four Central and Eastern European countries (CEEC4), the Czech Republic, Hungary, Poland and Slovakia, plus the three Baltic countries, Estonia, Latvia and Lithuania. Together we call these seven countries the CEEC7.

We do not analyse the initial transition phase of the early 1990s, which was plagued by severe structural changes, a decline in output and high inflation rates, but limit the analysis to the period after the accession countries' GDP started to grow.[1]

The catching-up countries of the EU, i.e. the cohesion countries such as Ireland, Greece, Portugal and Spain, have on average all converged but at different speeds and at partly different times. A question that arises is how the accession countries have fared during the 1990s relative to the experience of the current EU countries.

As a proxy for reform policies in the EU, we discuss the impact of membership and deeper integration. Here, some milestones are the forming of the customs union in 1968, the internal market (Single European Act) in 1987, the start of cohesion funds in 1988, the Maastricht Treaty in 1993 and the Economic and Monetary Union in 1999.[2]

The EU that the accession countries will join is very different from the EC that the catching-up EU countries joined in the 1970s and the 1980s. As the internal market and economic integration are much deeper now than they were before, membership is also likely to increase economic links more than it did earlier.

Membership itself gives a boost to reform policies even before actual membership takes place. This effect can be seen from the developments that have taken place in the accession countries since the mid-1990s. These countries have started to adjust their legislation and implement market-oriented liberalisation and privatisation reforms that can largely be credited to the future or ongoing membership negotiations and to the Europe Agreements between the EU and each accession country.

Looking back at the EU, reform policies have been important for the catching-up EU countries (Ireland, Greece, Portugal and Spain) as well. They were in many ways shielded from outside competition, and Greece, Portugal and Spain were undemocratic during parts of the 1960s and 1970s. There are therefore similarities between the catching-up countries and the accession countries.

The data that we have used for the OECD countries are from the OECD Economic Outlook. For the Baltic countries we have also had to use the World Development Indicators database of the World Bank. The trade data are from the Direction of Trade Statistics by the IMF.

2. Determinants of growth and some empirical results

In the standard neo-classical growth model in the tradition of Solow (1956), economic growth is driven by technical progress and the accumulation of two factors of production – labour and capital. Technical progress is assumed to be exogenous, but sustained growth in per capita terms does not occur without it. Both labour and capital are assumed to be paid a return that is equal to their marginal products. Labour is given by population, which is assumed to be growing at an exogenous rate. Consequently, labour too is exogenous. The capital stock is given by investment and the investment rate is typically assumed to be constant. Consequently, output, investment and the capital stock will all grow at the same long-run growth rate.

Labour and capital have a positive effect on production but their marginal products are diminishing. Convergence occurs because of diminishing and lower returns to investment in

[1] For an analysis of the initial transition period, see e.g. Fischer et al. (1998).

[2] Some transition periods have been enforced of course, which make these dates somewhat 'fuzzy'.

more developed and capital-abundant countries and sectors. Capital investment spreads to new, less-capital abundant countries and sectors, where returns to investment are higher or labour migrates to the more developed countries, where wages are higher. Nevertheless, capital accumulation cannot sustain growth in the long term, while growth in total factor productivity can.

Solow's growth model does not predict absolute convergence, but it does predict that per capita income in any given country converges on that country's steady-state value. Yet, if we control for the determinants of the steady state, we get 'conditional convergence' (Mankiw et al., 1992). According to the conditional convergence hypothesis, if countries have access to the same technology and their population growth rates are the same, but they have different propensities to save and their initial capital-to-labour ratios are also different, there is still convergence on the same growth rate of output and capital. Their per-capita income levels may differ, however.

Infrastructure and other capital goods, such as machinery, were outdated in the current accession countries in the early 1990s. To improve this situation, investment has been badly needed. Owing to the shortage of domestic financial assets, foreign investment in the form of FDI and EU funding, etc. have been and will remain very important for a long time to come. In many of these countries, FDI inflows account for a sizeable share of gross fixed capital formation. FDI is also a channel to import more advanced technology and know-how.

Population growth rates have been close to zero or negative in the CEE countries since the start of the transition. A high population growth rate has a negative effect on GDP per capita if the share of employed persons in the population declines. The demographical development may therefore support GDP per capita developments in the CEE countries in the short to medium term. In the longer term this may be a negative factor that decreases dynamism in the economies as their population grows older. This demographic weakness is also present in the incumbent EU countries. Also the quality of education received in the socialist era may not be quite compatible with the requirements of a market economy, which may hinder the adoption of new technology and thereby economic growth.

Growth and convergence can also be induced by trade, because of factor-price competition in the line of the Hecksher-Ohlin theory of international trade. Labour-abundant countries will specialise in the production and exports of labour-intensive goods and capital-abundant countries will specialise in the production and exports of capital-intensive goods.

This would lead to incumbent EU countries specialising more in capital-intensive production and the accession countries in labour-intensive production. The former are generally thought to have an advantage in capital and skill-intensive manufacturing, business and financial services while the accession countries are thought to have an advantage in labour-intensive sectors, tourism and transportation.

Although labour costs in the accession countries are significantly lower than in the incumbent EU countries, the former are not particularly abundant in labour in the way we may say less developed countries are. Furthermore, the accession countries also have a fairly educated and trained labour force. This feature, along with FDI inflows from the EU countries, produce a situation where these countries also compete in certain knowledge and capital-intensive

sectors. Still, there is room for specialisation in the lines of the incumbent EU countries' and accession countries' competitive advantage.[3]

The liberalisation of trade should increase growth through cheaper inputs, an increase in competition that leads to higher productivity and lower prices, and larger markets in the foreign countries. Free trade may also lead to an increase in FDI flows and thereby to technological diffusion. Baldwin & Seghezza (1996) argue that the countries that were members of the European Community during 1971–90 experienced higher total factor productivity growth rates than other European countries such as the EFTA countries. Furthermore, the original EEC6 countries that had been members the longest, had experienced the highest total productivity growth rates.

According to Ben-David & Rahman (1996), countries that trade extensively tend to converge more than countries that have less mutual trade. They examine two possible explanations. First, that trade-related income convergence is because of convergence in capital-labour ratios. And second, that there is a trade-related convergence in technologies. They argue that the latter explanation is supported by high convergence in total factor productivity between countries that have extensive trade relations. Ben-David & Kimhi (2000) provide evidence that especially increased exports from poorer countries to wealthier ones are related with an increase in the speed of income convergence between them. They also argue that after liberalisation, there is a significant increase in trade, which tends to level off and then remain at its new higher level at the end of liberalisation.

According to Ben-David (1993), the liberalisation of trade among the six original EEC countries led to income convergence. Further, the timing of trade reform among the EEC and the EFTA countries was found to coincide closely with convergence. Ben-David (1996) provides an analysis of several trade regimes and similar results of the positive effect of trade liberalisation.

Studies on real per-capita income convergence have discovered a two-percent-per-annum rule of convergence (see, for example, Sala-i-Martin, 1996). Quah (1996) criticises this result, which claims that convergence takes place at a more or less uniform rate of 2% per year regardless of the geographic region under analysis. Indeed, there are many regions in the world that seem to be caught in a vicious cycle that is difficult to break away from. Among the EU countries we also find convergence at quite different speeds.

Mankiw et al. (1992) argue that in the textbook Solow growth model, convergence takes place at a rate of 4%, which would imply that the economy moves halfway to its steady state in 17 years. On the other hand, if the textbook model is augmented by human capital, the convergence rate declines to 2% and the economy moves to its steady state in 35 years. Higher education makes it easier to adopt new technology. For example, Mankiw et al. (1992) and Bassanini & Scarpetta (2001) find evidence of the positive effects of schooling for growth.

Wagner & Hlouskova (2002) base their analysis on the historical convergence of the EU countries and then project it on the accession countries. They estimate the time it takes for the accession countries to catch up with the EU15 countries. With the exception of the wealthier Slovenia and the Czech Republic, they estimate it to be three or four decades.

[3] For an analysis of the skill and capital intensity of the accession countries' revealed comparative advantage in the internal market in 1993–98, see Kaitila (2001).

Barro (1991) analyses a cross-section of 98 countries for the time period 1960–85 and finds that the growth rate of real per capita GDP is positively related to initial human capital and negatively related to the initial level of real per capita GDP. Indeed, in neo-classical growth models, a country's growth rate is inversely related to its initial income per capita level.

Meanwhile, De Long (1996) argues in his comment to Baumol (1996) that when analysing a group of 22 rich countries by the standards of 1870, we find that by 1979 they had as wide a spread in relative incomes as they did in 1870. Indeed, many of the wealthy countries of the late 19th century fell badly behind in development during the 20th century.

Bernard & Jones (1996) find convergence in aggregate productivity for a group of 14 industrialised countries in 1970–87, but conclude that it is becaise of convergence in the service sector. Manufacturing on the other hand showed little or no convergence. This effect is interesting especially because trade and FDI occur predominantly in manufacturing and these are often assumed to cause technological spillovers and convergence.

3. GDP per capita in EU15 and CEE7 countries

Figure 1 shows real GDP per capita adjusted for purchasing power in the current EU member countries in 1960–2001 and the CEE7 countries from the 1990s until 2001. The differences have decreased in relative terms, but in many cases they have not changed and in some cases they have increased in absolute terms. (See also Figure 2 for trends relative to the EU15 average.)

Not taking into account Luxembourg and Ireland (the two highest GDP per capita levels in 2001), the difference between the lowest and highest GDP per capita levels (in 1995 prices) was $7,050 in 1960 but already $10,160 in 2001. This difference grew until 1986 but has stayed relatively stable since then. We later see why.

If we look at the catching-up countries, Spain's GDP per capita was $3,379 below the EU15 average in 1960 and $3,610 below it in 2001. For Portugal the figures are $4,700 and $5,637 and for Greece $4,103 and $6,688, respectively. In absolute terms, they have therefore fallen behind since 1960.

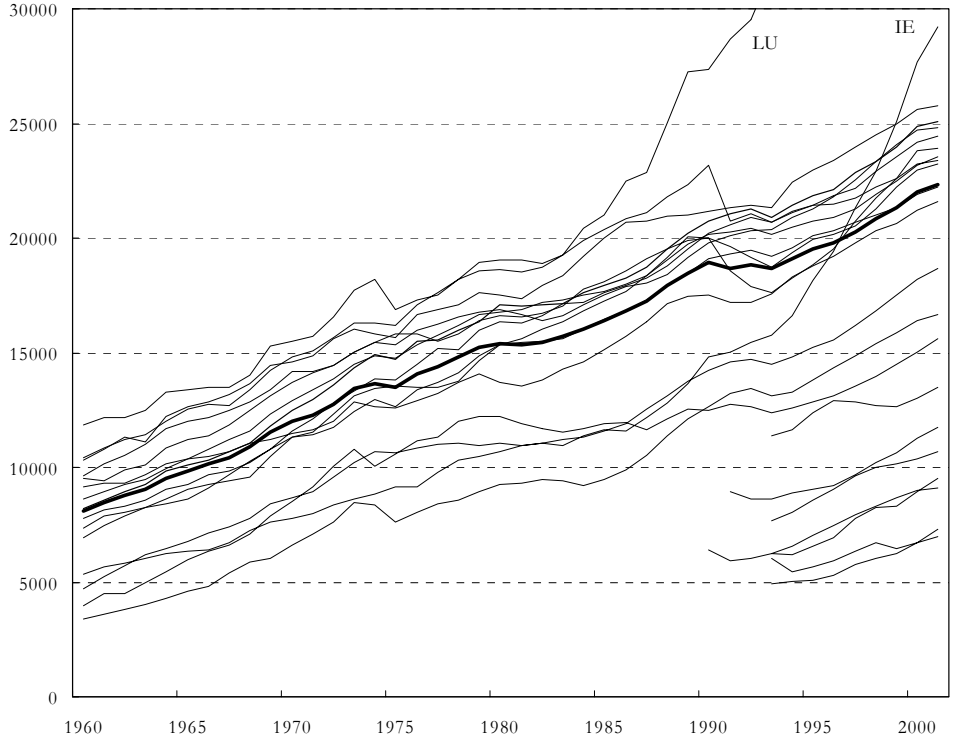
The CEE7 countries are now at about the same levels of GDP per capita in real purchasing power terms as the catching-up countries were during the first oil crisis some 30 years ago although there is now more dispersion between the GDP per capita levels of the former than there was between those of the catching-up countries in the early 1970s. The differences would be even larger had we included Slovenia into the analysis.

Figures 2 and 3 show the same data but relative to the average GDP per capita in the EU15 countries. In a way this is more relevant than the above comparison of absolute levels. Wealth is very much a relative question after absolute poverty has been left behind.

The first of the four figures shows the incumbent EU countries. There has been convergence towards the EU15 level with the exception of Luxembourg, where GDP per capita has grown considerably faster than in the other countries after the early 1980s.

The second figure shows the 'non-catching-up' EU countries (Austria, Denmark, Finland, Sweden and the United Kingdom) for which we can also see convergence taking place even though for some of the countries this has meant a decline in their relative GDP per capita levels (especially Denmark and Sweden).

Figure 1. Real GDP per capita adjusted for purchasing power (in 1995 prices) in the EU15 countries in 1960–2001 and the CEEC7 countries in the 1990s and until 2001. The line in bold is the average EU15 GDP per capita



Note: Luxembourg (LU) is not included for the 1993–2001 period in order to show the other countries better. Its GDP per capita surpassed 44,000 in 2001. Ireland (IE) has also been identified.

The third figure shows the 'catching-up' EU countries (Ireland, Greece, Portugal and Spain) and here, too, there is long-run convergence towards the EU15 income level. Ireland is a well-known exception to this rule in the sense that it has diverged strongly during the past few years.

The fourth figure shows the seven accession countries. There is a little divergence in the case of the Czech Republic, but otherwise the countries have converged towards the EU15 GDP per capita level during 1993–2001.

Figure 2. GDP per capita convergence towards the EU15 level (= 100) in the original six EEC countries (above) and the 'non-catching up' EU countries (below)

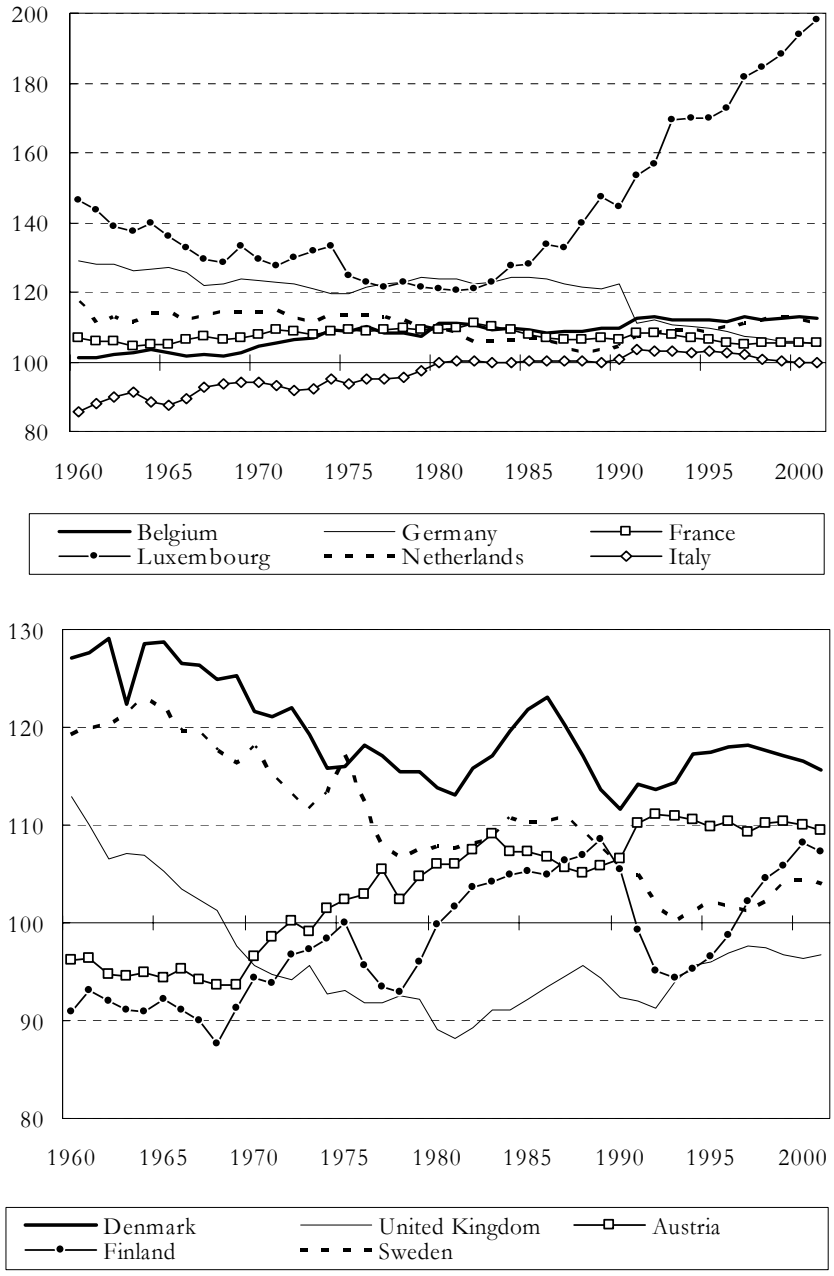
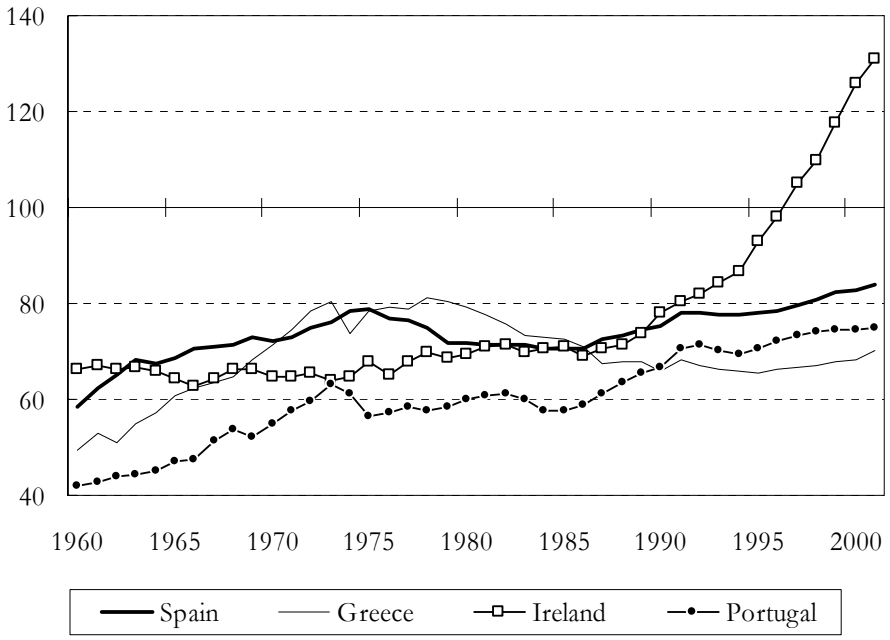
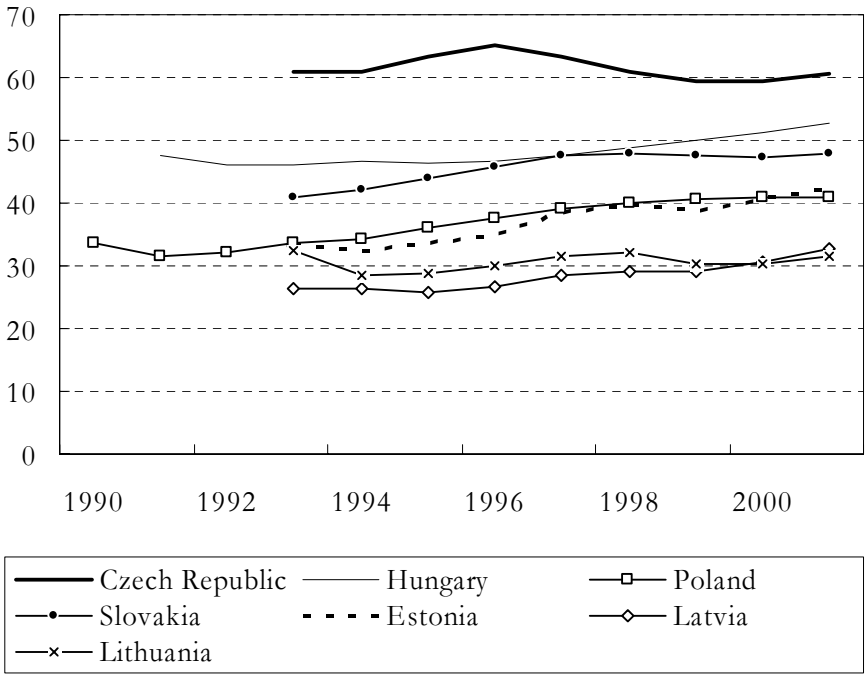


Figure 3. GDP per capita convergence towards the EU15 level (= 100) in the 'catching-up' EU countries (above) and the CEEC7 countries (below)





4. Convergence of GDP per capita levels

We discuss two concepts of convergence in this paper: σ and β-convergence. According to Rey & Montouri (1998), β-convergence has been more popular with macroeconomists, while σ-convergence has been used more in regional science and economic geography literature.

σ-convergence means that the dispersion of real per capita income tends to decline over time, while β-convergence means that there is a negative relationship between the initial level of GDP per capita and its average growth rate. The latter means that poorer regions and countries tend to grow faster than richer ones and will eventually catch up with them. β-convergence does not necessarily imply σ-convergence if each country's income level is persistently subject to random disturbances that affect country-specific growth rates (Barro & Sala-i-Martin, 1990).

Dispersion of per capita income: σ-convergence

σ-convergence takes place when the dispersion of real per capita income declines over time. We measure this dispersion using the standard deviation of the indices shown above in Figures 2 and 3 with average GDP per capita in the EU15 area set at 100. This gives the same result as measuring the coefficient of variation, which is given by

$$100 \times \frac{standard\ deviation}{mean\ value\ of\ set}.$$

We see from Figure 4 that σ-convergence has taken place in the EU15 area in two spells separated by an interim period of stagnation. The first period of convergence took place between 1960 and the first oil crisis in 1973. This was a time when only the six founding members made up the European Community. Of the present EU member countries, the United Kingdom, Denmark, Sweden, Austria, Portugal and Finland were EFTA countries.[4] Even though economic integration also occurred outside the Community, this was a time of increasing international trade within Western Europe, which contributed to convergence. Integration within the European Community advanced in 1968 with the customs union.

Exports from the EU15 area is shown in Figure 9. In the beginning, indeed starting from 1958, the share of intra-EU15 exports grew very rapidly. This growth has largely to do with the forming of the EEC by the six original member countries. This ratio continued to grow until 1973, which means that growth in the share of intra-EU15 exports ended at the same time as convergence came to a halt.

After 1973, the share of intra-EU15 trade in these countries' exports did not grow before 1985. Again, this stagnation in exports coincided with a time when there was no convergence (1973–86). The UK, Denmark and Ireland had joined the Community in 1973 and they were followed by Greece in 1981. The stagnation in convergence lasted until 1986, when Spain and Portugal became members of the Community. During this time, i.e. between the first oil crisis and the mid-1980s, unemployment also grew considerably in Western Europe.

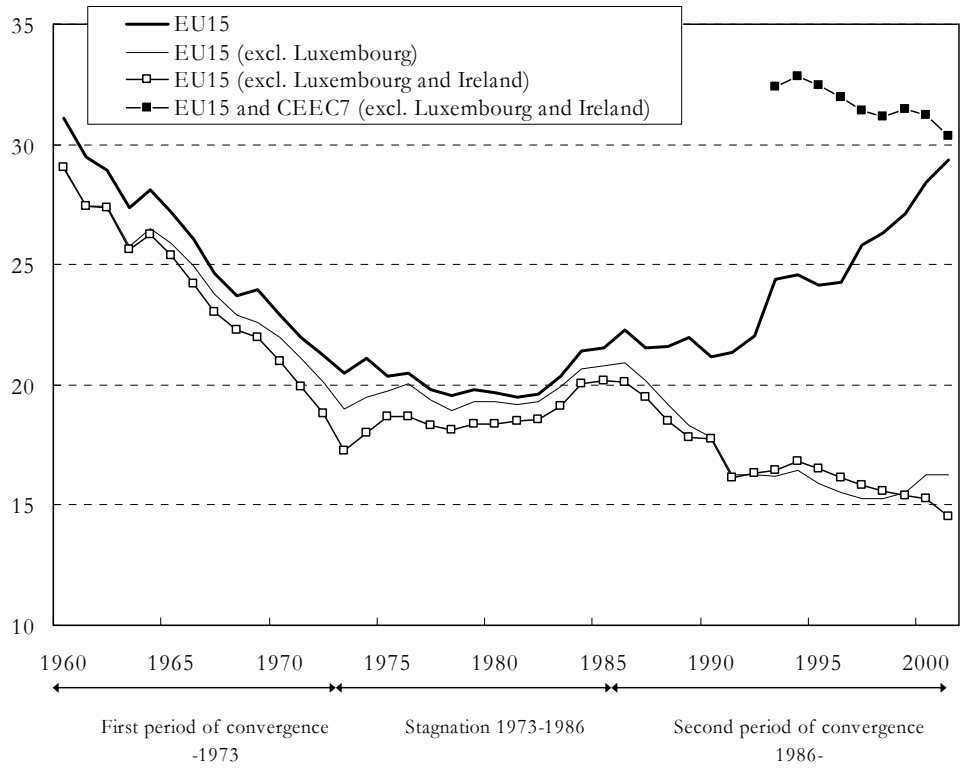
Another explanation for the end of convergence after the first oil crisis may be the dramatic decline in investment rates. Total investment as a percentage of GDP declined in the EU15 area after the first oil crisis (see Figure 13). The decline only came to an end in around 1985 after which it has somewhat recovered. Both the decline and the recovery were particularly

[4] Finland was an associate member of EFTA in 1961–86 and full member in 1986–94.

steep in the catching-up countries (Ireland, Greece, Portugal and Spain). The non-catching up EU countries (Austria, Denmark, Finland, Sweden and the United Kingdom) have constantly had a below-average investment rate. The CEE7 countries' investment rate rose very rapidly after 1993 but then declined in 2001–02. Still, it is considerably higher than in the EU countries on average and also a little higher than in the catching-up EU countries. High investment rates will support economic growth in the CEE7 countries.

A second period of convergence in GDP per capita took place after 1986. Luxembourg's relative GDP per capita started to increase considerably after 1981 and therefore Figure 4 shows standard deviation both with and without Luxembourg. The latter curve starts to descend after 1986. There is also a curve without both Luxembourg and Ireland. Ireland caught up with the EU15 GDP per capita level in 1997 and by 2001 it was already 31% above it. Ireland has therefore become a diverging force and its exclusion from the figure seems to make a difference.[5] There is also a line with the EU15 (excluding Luxembourg and Ireland) and the CEE7 countries, which shows a declining trend and σ-convergence to have taken place within this enlarged EU area after the mid-1990s.

Figure 4. Standard deviation of real GDP per capita (PPP) levels of the EU15 countries as calculated from the relative income indices with EU15=100 in 1960–2001



This second period of convergence can be further divided into two parts, a phase of fairly rapid convergence in 1986–91 and a phase of slower convergence in 1992–2001. By excluding Ireland from the analysis we see that convergence has proceeded throughout the

[5] This kind of an analysis, however, will lose its point if we start to remove countries one by one. Perhaps these two exceptions can be made due to their exceptional character and the two countries' small size.

1990s. In this sense, it is interesting to note that the share of the EU15 countries in total trade increased until 1992, which coincides well with the period of rapid convergence that lasted until 1991. After that, the share of the EU15 countries stabilised and convergence in GDP per capita levels also slowed down. Meanwhile, exports to the EU15 countries as a share of GDP have continued to grow almost continually with the exception of 1985–92, when there was a decline. This measure does not seem to correlate with convergence.

The Economic and Monetary Union was formed in 1999. Frankel & Rose (2000) for example, indicate that the formation of a monetary union will increase intra-union trade. If this will indeed happen within the euro area, convergence may well continue. In 1998, the share of the intra-EU12 (the euro area) trade in these countries' total exports was 57.5%. It increased to 58.3% in 1999 but then declined to 56.1% in 2001. Intra-EU12 exports as a share of GDP have, however, increased from 14.0% in 1998 to 15.7% in 2001. The time span is still a little too short to make strong conclusions.

Initial GDP levels and growth rates: β-convergence

Considerable convergence has occurred from the lower GDP per capita levels towards the average in 1960–2001, or from a minimum of 42% of the average in Portugal in 1960 to 70% of the average in Greece in 2001. A wealthy exception is Luxembourg, which has diverged very fast after 1981 and its GDP per capita is now almost twice as high as the average in the EU15 countries.

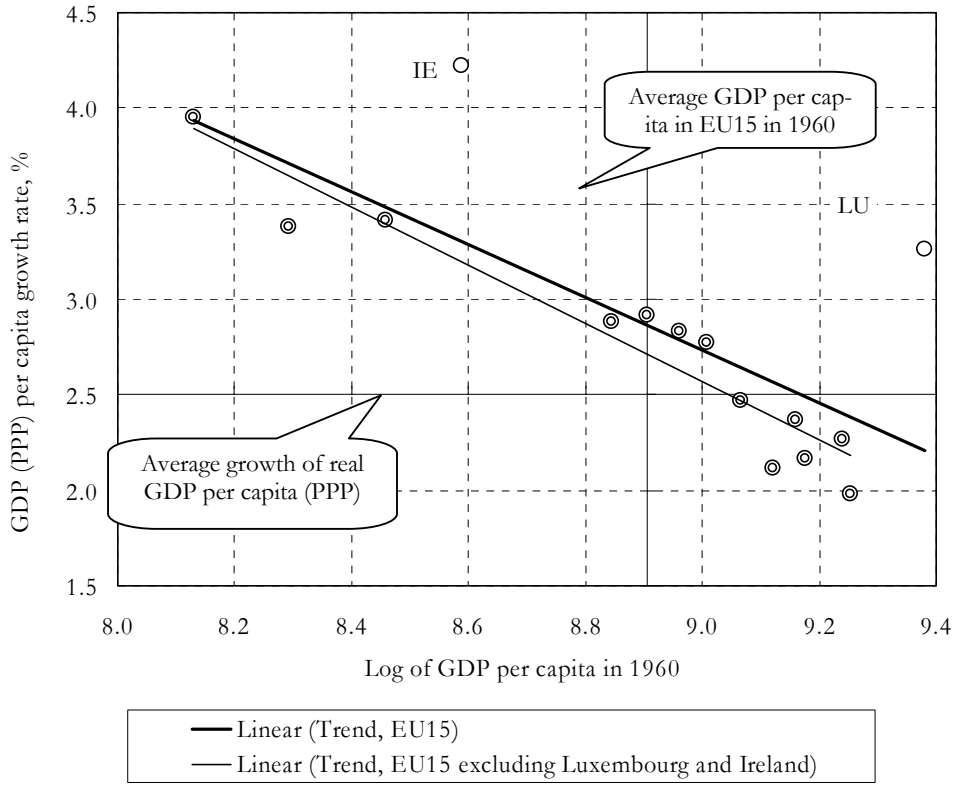
There has been a trend for poorer countries to catch up with wealthier ones. There has also been a trend of convergence within the wealthier countries though the former trend has been clearly stronger. Six countries, Denmark, France, Germany (also without the reunification), the Netherlands, Sweden and the United Kingdom have been losing their relative positions.

Figure 5 depicts the logs of the EU15 countries' GDP per capita levels in 1960 and their average growth rates until 2001. Most of the countries are not identified because the point is just to show general trends. There is a clear negative correlation between the two variables, which means that β-convergence has taken place. We show two outliers, Ireland and Luxembourg, which have experienced considerably faster growth rates than the countries on average given their initial GDP per capita levels in 1960.

Linear trends have been drawn both for all the EU15 countries and these countries excluding Luxembourg and Ireland. The first linear trend is $y = 15.2 - 1.383x$ with $R^2 = 0.590$. Excluding Luxembourg and Ireland we get a linear trend of $y = 16.3 - 1.525x$ with $R^2 = 0.917$. The latter fit is very good. It should be noted that the kind of convergence implied by Figure 5 is not automatic. There have been periods of stagnation or even divergence.

Figure 6 is the same as Figure 5 but with the CEE7 countries added. We have taken as the initial GDP level their troughs, i.e. the CEE7 countries' lowest real GDP (PPP) per capita in the early 1990s. Consequently, the time period analysed varies. There is no *a priori* reason to expect that either the growth performance or the logic of growth in the accession countries will differ from that of the incumbent EU countries after the structural transition has been completed.

Figure 5. EU15 countries' real GDP per capita (PPP) levels in 1960 and average GDP growth rates in 1960–2001

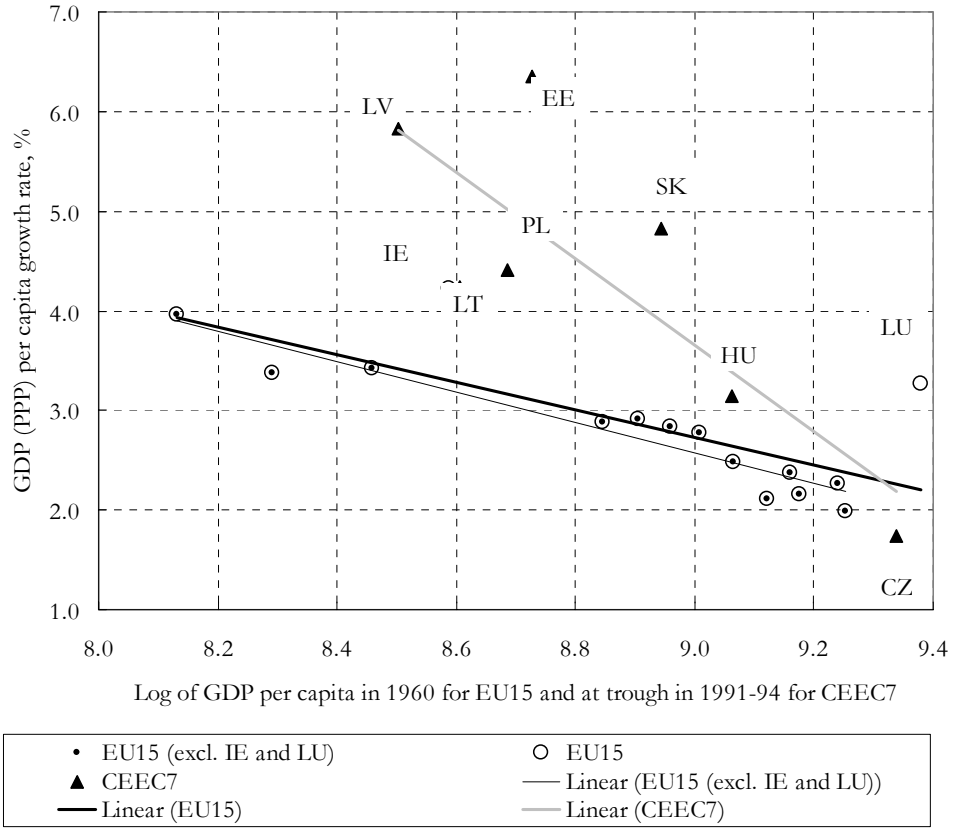


A negative trend between the initial GDP per capita levels and average GDP growth rates is visible but it is not as clear as in the case of the EU countries. Estonia, Lithuania and Slovakia are the main outliers.

The scarcity of the available data is a constraining element here and it can be expected that the fit will improve in the future as more data become available. Indeed, already the CEE4 countries show some possibility of this taking place.

The trend with all the CEE7 countries has an R2 of 0.655, while that of the CEE4 countries (not shown in the graph) is 0.748. The linear trend for the CEE7 countries is $y = 42.6 - 4.329x$. The slope is much larger than that for the EU15 countries, which reflects the CEE7 countries' higher average growth rates and more rapid convergence than what the EU countries have experienced in the past. The Czech Republic is a notable exception. We discuss possible reasons for this below.

Figure 6. CEE7 countries' GDP per capita levels in their respective troughs in 1991–94 and their average GDP growth rates until the year 2001 combined with Figure 5 of the EU15 countries



Note: The trough is the minimum of real GDP (PPP) per capita experienced in the CEEC4 and the Baltic countries in the early 1990s. The trough has been measured at 1991 for Poland, 1993 for the Czech Republic, Hungary, Slovakia and Latvia, and at 1994 for Estonia and Lithuania. Average growth rates have been calculated for the period between the trough and 2001.

Unconditional convergence

Next, we analyse convergence towards the average GDP per capita level of the EU15 countries using pooled least squares. We have estimated the speed of unconditional convergence with

$$\log y_{it} - \log y_{i,t-1} = \alpha + \beta \log y_{i,t-1} + \varepsilon_{it},$$

where $\log y_{it}$ is the natural logarithm of GDP per capita in country *i* at time *t*, α is a constant and ε is the error term.[6] Table 1 shows the results according to which convergence has taken place within the EU15 area at a rate of 2.6% a year during 1960–2001.

[6] See, for example, Miller & Upadhyay (2002).

Table 1. Results from the estimation of unconditional convergence in the EU15 area in 1960–2001

EU15				
Dependent Variable: $(\log y_{it} - \log y_{i,t-1})$				
Method: Pooled Least Squares				
Sample(adjusted): 1961 2001				
Included observations: 41 after adjusting endpoints				
Number of cross-sections used: 14				
Total panel (balanced) observations: 574				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.27994	0.02516	11.1246	0.0000
$\log y_{i,t-1}$	-0.02647	0.00264	-10.0202	0.0000
R-squared	0.14932	Mean dependent var		0.02800
Adjusted R-squared	0.14783	S.D. dependent var		0.02635
S.E. of regression	0.02433	Sum squared resid		0.33855
Log likelihood	1319.58	F-statistic		100.404
Durbin-Watson stat	1.38250	Prob (F-statistic)		0.00000

Note: Belgium and Luxembourg are combined into one.

Table 2. Results from the estimation of unconditional convergence in the CEE7 countries in 1995–2001

CEEC7				
Dependent Variable: $(\log y_{it} - \log y_{i,t-1})$				
Method: Pooled Least Squares				
Sample: 1995 2001				
Included observations: 7				
Number of cross-sections used: 7				
Total panel (balanced) observations: 49				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.34931	0.12713	2.7476	0.0085
$\log y_{i,t-1}$	-0.03406	0.01411	-2.4135	0.0198
R-squared	0.11027	Mean dependent var		0.04262
Adjusted R-squared	0.09134	S.D. dependent var		0.02817
S.E. of regression	0.02685	Sum squared resid		0.03388
F-statistic	5.82481	Durbin-Watson stat		1.54780
Prob (F-statistic)	0.01975			

Table 2 shows the equivalent results for the CEE7 countries with a rate of unconditional convergence of 3.4% a year. We have chosen 1995 as the first year, because using 1994 did not render statistically significant results. This shows the problem of incorporating the initial years of transition into the analysis.

The results from the estimation of unconditional convergence presented in Tables 1 and 2 and the results presented in Figure 6 show that the CEE7 countries have grown faster after their

GDP decline ended than the EU15 countries have grown after 1960, perhaps with the notable exceptions of both Ireland and Luxembourg.

5. Factors that may contribute to convergence

Growth accounting

On the basis of the production function, the factors contributing to growth are productivity, employment and the capital stock. In the 1994–2001 period, the annual increase in labour productivity was 2.6% in the Czech Republic, 3.0% in Hungary, 5.3% in Poland and 4.0% in Slovakia. These are considerably higher figures than in the EU15 area and also help to explain the accession countries' high growth rates. In the euro area, average annual productivity growth was just 1.0% in 1994–2001 and 1.8% in 1970–2001.

Doyle et al. (2001) have estimated that in 1991–99, total factor productivity (TFP) contributed 122% of GDP growth in Hungary, 82% in Slovenia, 51% in the Czech Republic, 44% in Poland and 9% in Slovakia. Consequently, TFP growth has been quite a significant factor in some countries, but its share in GDP growth has varied considerably.

GDP growth can also result from an increase in the factors of production. Nevertheless, in 1993–2001 the number of persons employed declined by a total of 2.2% in the Czech Republic, 5.6% in Hungary, 4.6% in Poland, 14.5% in Estonia and 9.9% in Lithuania (in 1996–2001). It grew by 0.6% in Slovakia (in 1994–2001) and 1.4% in Latvia (in 1996–2001). Consequently, employment has mostly declined.

Gross fixed-capital formation is discussed further below. Investment rates have on average been higher in the CEE7 countries than in the EU15 countries during the 1994–2001 period. This has supported growth in the accession countries. Also the inflow of foreign direct investment has been an important source of modern technology and has increased foreign trade considerably. For example, almost all of Hungary's exports originate from firms with FDI. The superficial evidence suggests that faster growth in the accession countries is because of high investment rates and an increase in productivity, owing to modernisation in production technology and business management.

EU membership and convergence

Next we discuss in more detail the convergence that has taken place within the EU15 area and the possible impact of these countries' EU membership. The figures and tables also present some data for the CEE7 countries.

Between 1960 and 2001, the EC/EU has been enlarged four times, in 1973, 1981, 1986 and 1995.[7] The first and third of these enlargements coincide with breaks in convergence as we have identified earlier. The breaks are asymmetric because the first break coincides with a discontinuation in convergence and the second coincides with a resumption in convergence. The picture that emerges is therefore not one where simple enlargement, i.e. the extension of EC/EU membership is enough for convergence to take place. Other forces affect the development and may overrun the possibly positive impact of 'administrated' integration.

[7] A fifth enlargement would be the reunification of Germany, which decreased Germany's GDP per capita and therefore also had a minor effect on the average GDP per capita in the EU countries.

We have now calculated an index for the countries' GDP per capita levels relative to that in the original EU6 area, which is fixed at 100. It made more sense here to compare GDP per capita with the EU6 countries. By comparing the starting point in 1960, the year of membership and the end point in 2001, we can analyse the slope of the relative GDP per capita. This analysis has been done in Figure 7 and in Table 3.[8]

The countries have again been classified into four groups: the '*non-catching-up' EU countries* are Denmark (membership in 1973), the United Kingdom (1973), Austria (1995), Finland (1995) and Sweden (1995); the '*catching-up' EU countries* are Ireland (1973), Greece (1981), Portugal (1986) and Spain (1986); the *CEE4 countries* are the Czech Republic, Hungary, Poland and Slovakia; and the *Baltic countries* are Estonia, Latvia and Lithuania.

If we look at the non-catching up EU countries in the upper part of Figure 7, we see that on average there has been clear convergence towards the GDP per capita in the EU15 countries. Denmark, Sweden and the United Kingdom have been losing in relative terms, while Austria and Finland have gained. The catching-up countries have all gained since 1960. The relative development in the post-membership period has been particularly good in Ireland, Portugal and Spain. In relative terms, Greece performed better before its membership than after it.[9]

Overall, the developments are varied but, with the exception of Austria and Greece, post-membership development has been more favourable than pre-membership development in the countries' relative GDP per capita levels.

In the bottom-right corner we can see the relative levels of the CEE4 countries and the Baltic countries in 2001. The CEE4 countries are approximately at the same relative level as the catching-up countries were in 1960, while the Baltic countries are, on average, below them.

Next we have calculated the average change in the slope (presented in Figure 7) of each country's GDP per capita Y_i relative to the average GDP per capita in the original EU6 countries Y_{EU6} using the following simple formula:

$$\frac{1}{t}\left[{Y_{i,t}}/{Y_{EU6,t}} - {Y_{i,0}}/{Y_{EU6,0}} \right] * 100 ,$$

where the subscript 0 denotes the first year we have data for (in the case of the EU15 countries this is 1960), and the subscript t denotes the last year (i.e. 2001). Consequently, $1/t = 1/41$ for the EU15 countries for the whole time period 1960–2001, but varies between 1/7 and 1/10 for the CEE7 countries depending on when their GDP started to grow again in the beginning of the 1990s. As we use the EU6 countries, the point of reference is unaffected by faster growth in the catching-up countries as it was when we used the EU15 countries as reference.

Table 3 shows the slopes of the lines in Figure 7 for the countries that joined the EU between 1973 and 1995. The membership years differ depending on the country and therefore the number of years available for the calculations before and after membership differs. The first

[8] 'Convergence slope' is perhaps a slightly misleading term because some of the countries have in fact not converged between 1960 and 2001 (Luxembourg) or have caught up with the average and overshot it (Ireland).

[9] These results differ from those by Ellison (2001) as, according to him, the 'catching-up' countries (save Ireland) converged more rapidly towards the European average per capita GDP before their EU membership than after it. He uses real GDP data in per capita terms. He is also quite pessimistic about the CEE countries' prospects for real convergence towards the EU average.

numerical column presents the average slope in 1960–2001. The next two columns present the slopes in the pre-membership period and in the post-membership period, respectively.

Using the above formula, the average change[10] in the non-catching up countries is almost zero, +0.02 percentage points per year for the whole period. This disguises both positive and negative developments as has already been noted. Still, for all the non-catching up countries (except Austria) the slope in the post-membership years has been higher than before membership. Even for Austria, the difference between pre-membership and post-membership is very small.

The average improvement in the catching-up countries has of course been much better than in the non-catching up countries. The former have converged on average by 0.88 percentage points per year. This trend includes the fact that Ireland has caught up with and overshot the average of the EU6 countries. The post-membership performance of Ireland, Portugal and Spain is clearly superior to their performance before their membership. Greece has fallen behind after its membership.

The convergence of the CEE7 countries has been calculated from their relative troughs in the early 1990s until the year 2001. The arithmetic average of convergence in the CEE4 countries has been 0.77 percentage points per year and in the Baltic countries 0.96 percentage points per year. These are about the same as the average in the catching-up countries in 1960–2001. The best relative performance has taken place in Estonia, followed by Poland, Slovakia, Hungary and Latvia, while the Czech Republic has performed the least well.

Figure 8 returns to the four catching-up countries that are the best existing references within the European Union for the accession countries. We depict the convergence of these four countries before and after membership, with the first year of membership set at 1 on the horizontal axis. For Spain, Greece and Ireland, a few turning points have been marked.

Spain converged until 1975, when it became a democracy. Then a period of divergence started that came to an end in 1986 when Spain became a member of the European Community. After that, convergence has taken place at an average rate of 1.1 percentage points per year. Portugal is somewhat similar to Spain in this respect. It converged until 1973, followed by a period of stagnation, which came to an end as the country joined the European Community in 1986. After that, convergence has taken place at an average annual rate of 1.2 percentage points per year. The Iberian peninsula seems to have received a boost from membership. This boost did not, however, happen in Ireland or Greece. Ireland remained relatively stagnant in relative terms until 1986 but then started to gain very rapidly relative to the EU6 countries, i.e. around the time when Spain and Portugal started to converge too. The speed has been much faster in Ireland. The year 1986 coincides with an increase in intra-EU trade. The internal market was formed in 1987, so we also find a factor from administrated integration that coincides with these developments. Another factor was the implementation of cohesion funds for these four countries in 1988.

[10] Arithmetic average.

Figure 7. GDP per capita in selected EU countries in 1960, in the first year of their EC/EU membership, and in 2001 with 100 = GDP per capita in the EU6 countries. The GDP per capita in the CEE4 and the Baltic countries in 2001 are also shown.

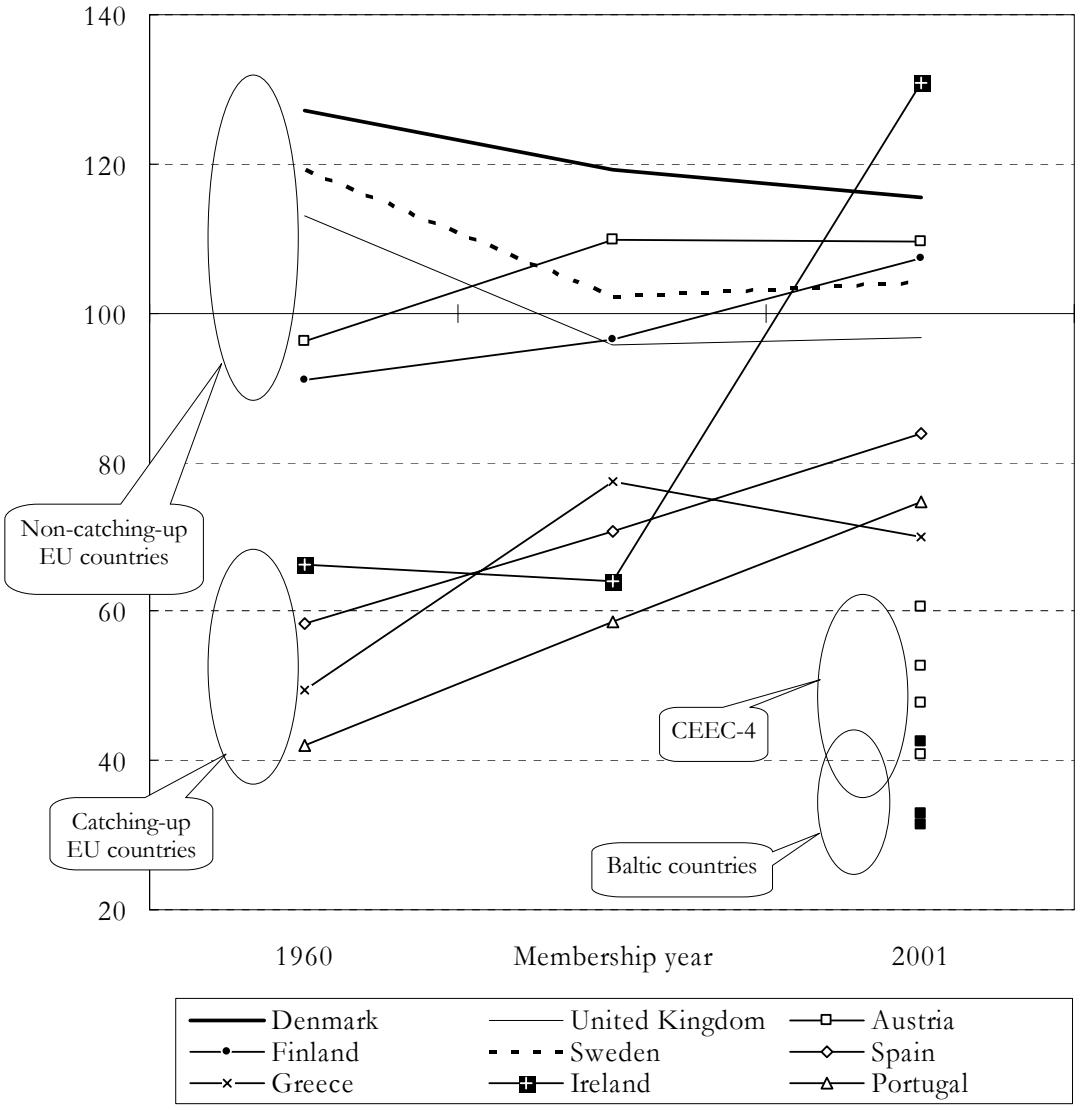


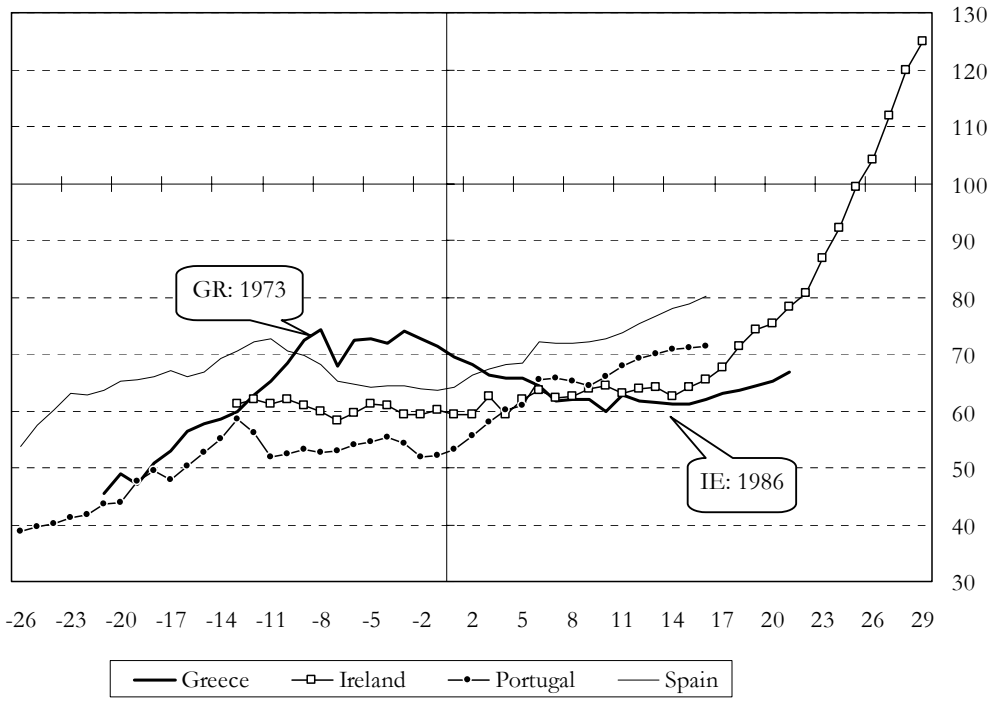
Table 3. Slopes towards EU6 real GDP per capita (PPP) levels

Country	Slopes in 1960-2001	Pre-member-ship slopes	Post-member-ship slopes	CEE coun-tries' slopes in the 1990s
'Non-catching up' EU coun-tries	0.02	-0.36	0.65	..
Denmark (membership in 1973)	-0.17	-0.41	0.00	..
United Kingdom (1973)	-0.29	-1.46	0.13	..
Austria (1995)	0.39	0.41	0.36	..
Finland (1995)	0.45	0.14	2.07	..
Sweden (1995)	-0.26	-0.47	0.69	..
'Catching-up' EU countries	0.88	0.54	1.12	..
Ireland (1973)	1.56	-0.08	2.35	..
Greece (1981)	0.52	1.29	-0.13	..
Portugal (1986)	0.80	0.54	1.21	..
Spain (1986)	0.64	0.40	1.06	..
CEE4 countries	..	..	..	0.77
Poland	..	..	..	0.98
Slovakia	..	..	..	0.96
Hungary	..	..	..	0.95
Czech Republic	..	..	..	0.19
Baltic countries	..	..	..	0.96
Estonia	..	..	..	1.52
Latvia	..	..	..	0.87
Lithuania	..	..	..	0.49

Note: The country group data are arithmetic averages of the slopes of the countries belonging to that particular group. Slopes for the CEE countries and the Baltic countries have been calculated from the troughs of their relative GDP. The years used are 1991–2001 for Poland; 1993–2001 for the Czech Republic, Hungary, Slovakia and Latvia; and finally, 1994–2001 for Estonia and Lithuania.

Greece was not affected by the year 1986. Greece converged until 1973, then stagnated until 1978, after which it started to decline in relative terms. The decline seems to have come to an end in 1995. Foreign goods trade is much less important for Greece than it is for Spain or Portugal, not to mention Ireland.

Figure 8. Convergence towards GDP per capita of the EU6 (= 100) until the year 2001; first year of membership = 1



Trade and convergence

European integration has lowered trade costs and barriers in Western Europe in the post-WWII period. Above we cited different studies that have demonstrated the positive effect of increased trade on convergence. Figure 9 shows the development of exports in the EU15 area during the latter part of the 20th century. The graph also shows the two periods of convergence: the first period until 1973 and the second period starting in 1986.

Exports to the EU15 area as percentage of GDP have increased almost continuously since 1960, although a small decline did occur in the early 1990s. The EU15 countries' share in total exports grew until the first oil crisis, but then levelled off at around 60%. It started to grow again in 1986 but has declined again to 60-63% at the turn of the millennium. This latter trend coincides with the development in convergence.

Figure 10 shows exports to the EU15 area relative to GDP for the catching-up countries. Ireland stands out as a clear exception. It is, of course, the smallest of these countries and as such we may expect its economy to be more open than those of the other countries. Greece is a small economy too, but it is very closed in its goods exports and has become increasingly so during the 1990s. Greece does export a lot of services in the form of tourism for example, but these are not included in the data.

Spain and Portugal started to converge around 1986. Even though the developments are not as dramatic as in the case of Ireland, their exports to the EU15 area are now clearly more important than they were before integration. Portugal and Spain also have important service exports that are not visible in the graph.

Figure 9. Exports of the EU15 countries in 1960–2001

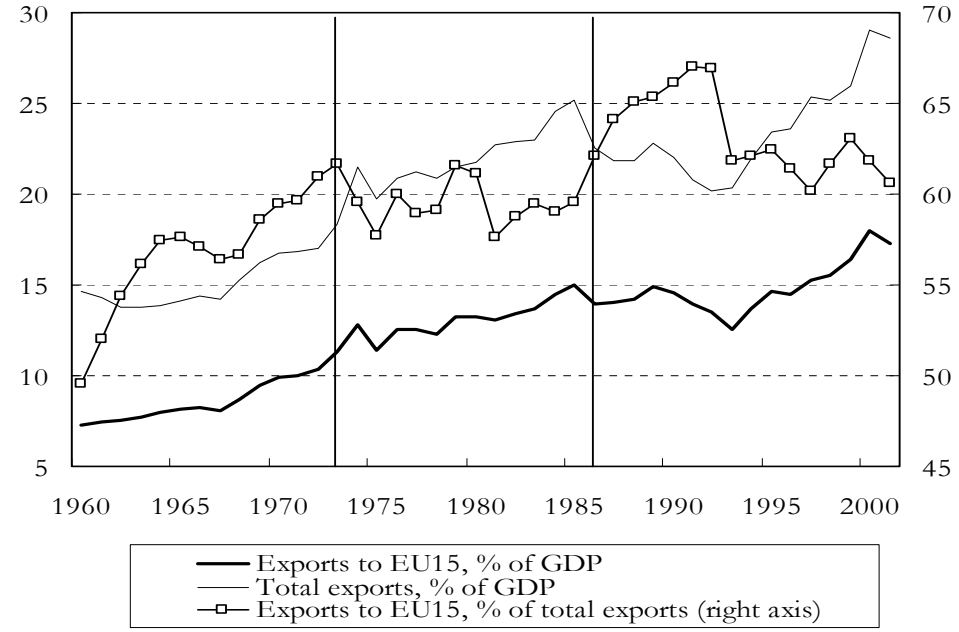
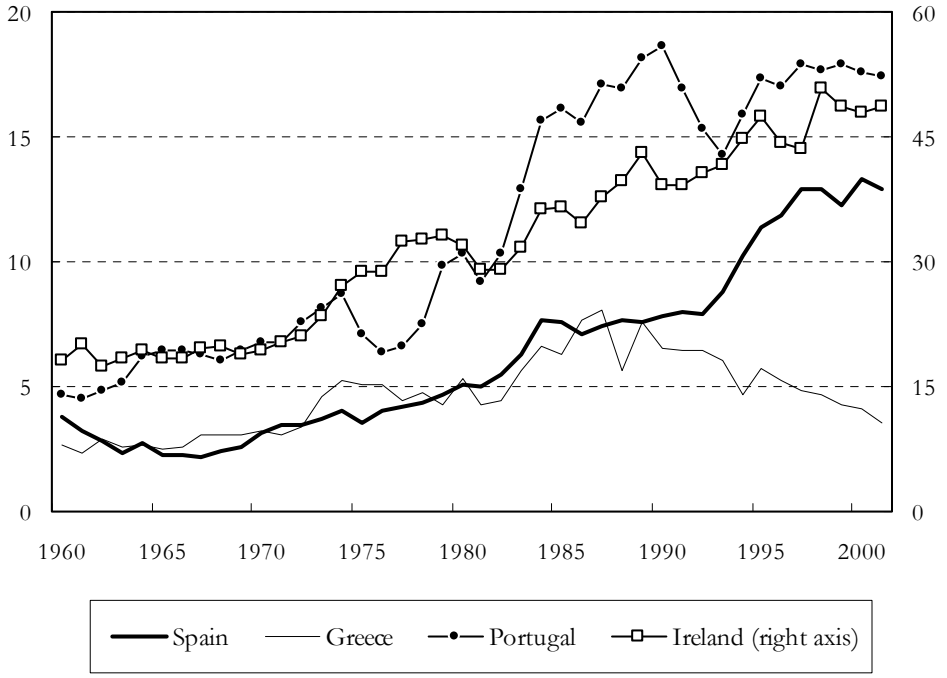


Figure 10. Exports to the EU15 area, % of GDP



Let us next review how the CEE7 countries' trade with the EU has evolved since 1990. This is shown in Figure 11. By comparing it with Figure 9, we see that the share of EU15 countries in total exports is higher for the CEE7 countries than the share of intra-EU15 exports is in the total exports of the EU15 countries. The same is true if we compare exports with the EU15 as

a percentage of GDP. This latter result is partly because of the smaller size and therefore the larger openness of the economies in the CEE7 countries.

Figure 11. CEE7 countries' trade in 1990–2001 (1992–2001 for the Baltic countries)

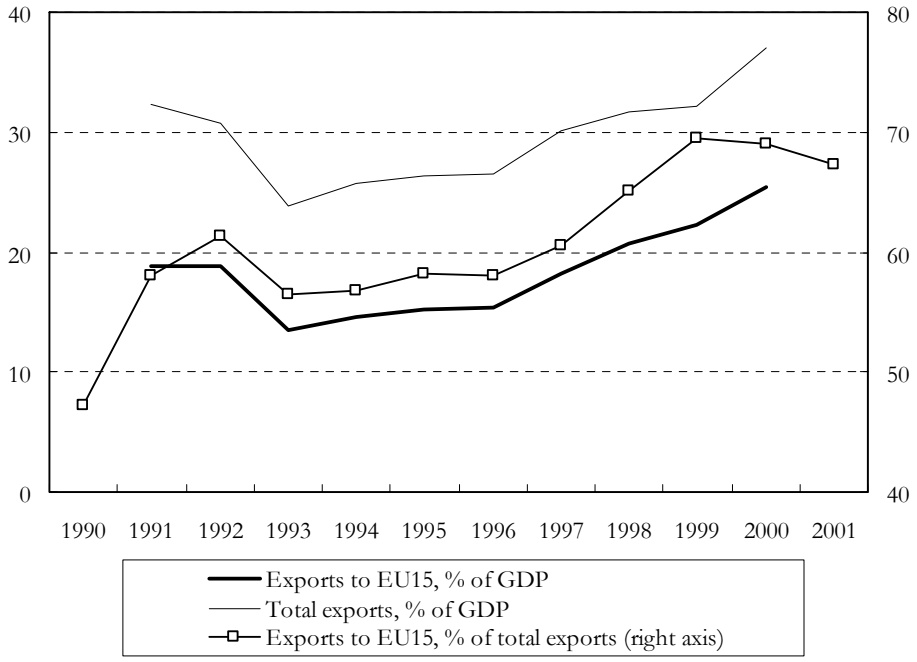
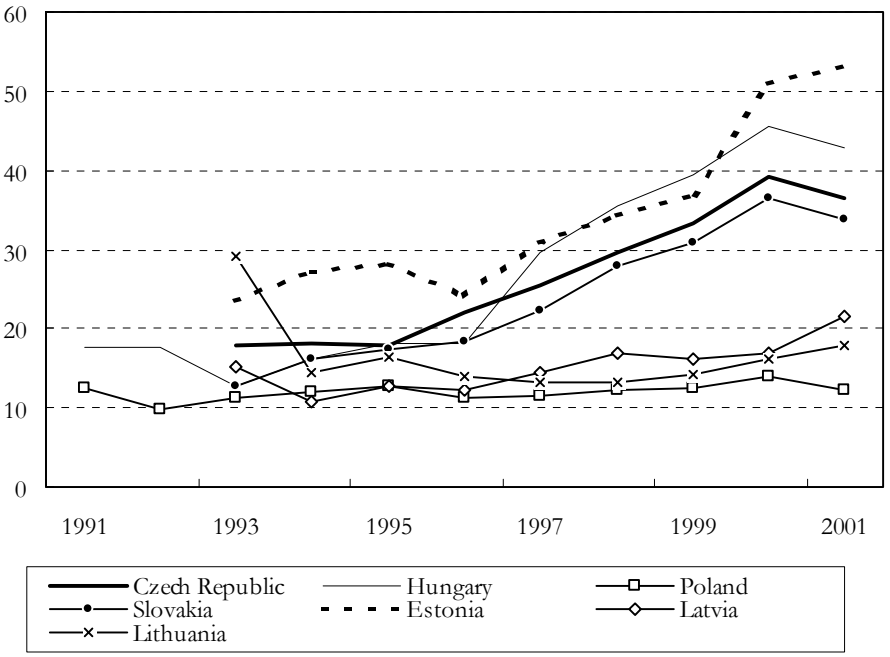


Figure 12 shows how the EU15 area has become more important for the CEE7 countries since 1991. There are two groups. Estonia, Hungary, the Czech Republic and Slovakia are clearly more open towards the EU15 area than Poland, Latvia and Lithuania.

Figure 12. Exports to the EU15 area, as a percentage of GDP



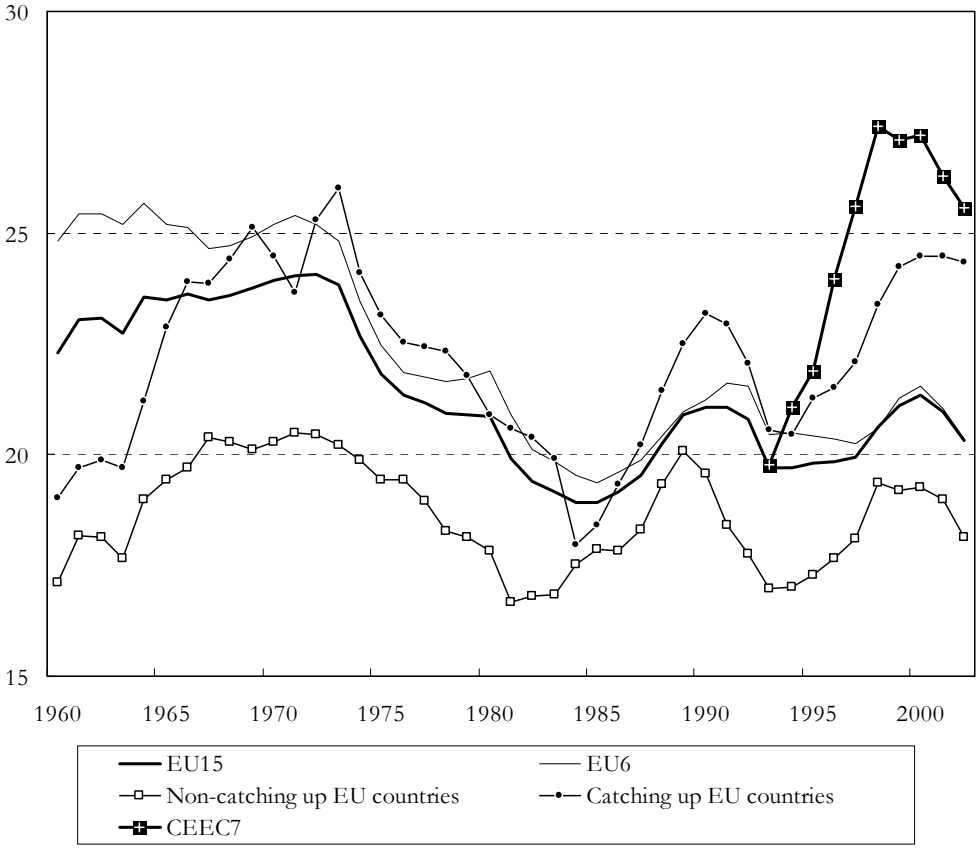
It is natural that Poland, as a larger economy, should be at a lower level than the others, but Latvia and Lithuania have remained relatively more closed towards the EU15 area. Indeed, the latter two are clearly poorer in GDP per capita (PPP) terms. Yet Latvia's GDP growth rate was high in 2000–02.

Convergence, investment and foreign direct investment

We have discussed EU membership and trade, but there does not seem to be any simple, explain-it-all correlation between these and convergence. Still, it is obvious that integration does have a positive effect on trade and foreign direct investment (FDI) flows. We discuss investment here.

First let us take a look at fixed investment. Figure 13 shows total fixed investment as a percentage of GDP in certain country groups. The non-catching up EU countries have continuously had lower investment rates than the other groups.

Figure 13. Total investment in the EU15 and the CEE7 countries, percentage of GDP



Note: Gross fixed capital formation in the Baltic countries. Estonia is only included in 1993–2001 and Latvia and Lithuania in 1995–2001.

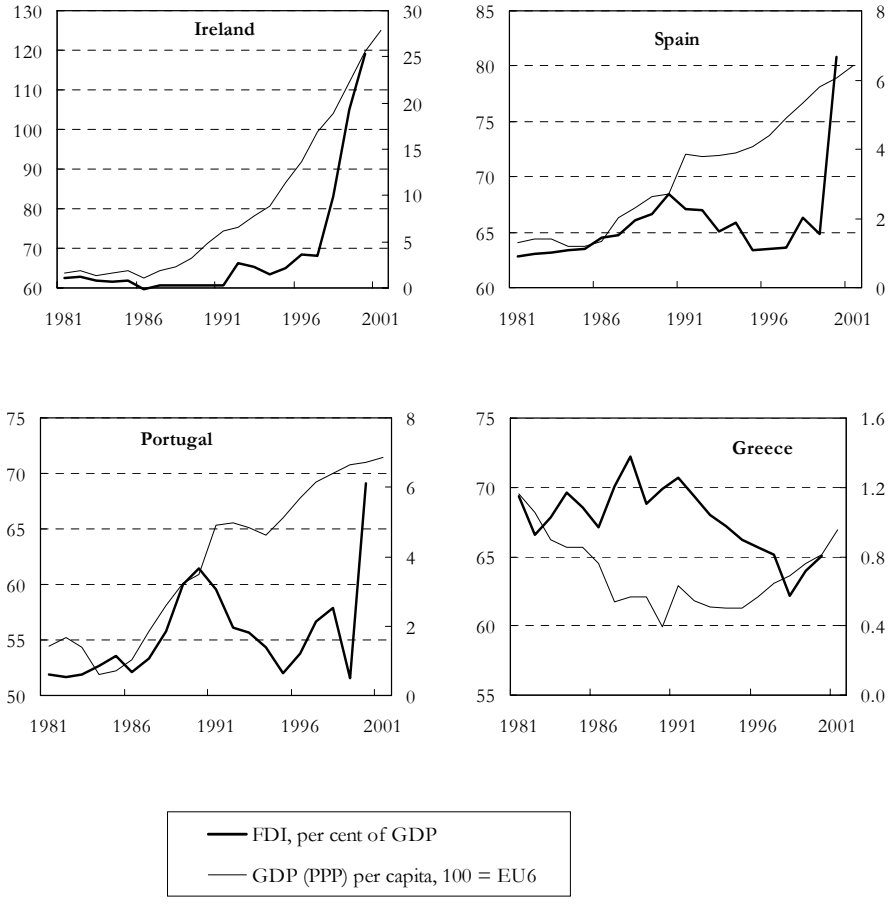
Generally speaking, the countries that have been poorer and grown more rapidly, i.e. the catching-up EU countries and the CEE7 countries, have had higher-than-average investment rates, especially after the mid-1980s. These figures do not include investment in research and

development, which has been considerable in certain countries.Investment is an important factor in growth and catching-up. But often domestic resources are not enough. One way of speeding up growth can be to encourage foreign direct investment. Expectations of the accession countries' membership has had a positive effect on FDI inflows to these countries. On the other hand, FDI flows have also considerably increased on a global scale during the 1990s compared with the previous decades.

Figure 14 shows the catching-up countries' GDP relative to the average GDP in the EU6 countries on the left axis and FDI inflows per GDP on the right axis. Ireland shows a strong positive relationship between the two lines, but there are also some hints of this for Spain and Portugal. For Greece the lines mostly go in different directions. FDI into Greece has been very low. On the other hand, Greece has not really converged either. Correlation coefficients for the two data sets are shown in Table 4.

We can see that for 1986, when convergence started or resumed in Ireland, Portugal and Spain, FDI inflows started to increase considerably in the latter two, though only until 1990. Ireland experienced a considerable increase in FDI inflows only five years later.

Figure 14. Convergence in GDP (PPP) per capita towards EU6 (left axis) and FDI inflows, percentage of GDP (right axis) in 1981–2001



Sources: OECD, UNCTAD and national central banks.

Figure 15. Convergence in GDP (PPP) per capita (left axis) and FDI inflows, percentage of GDP (right axis) in 1991–2001

Sources: OECD, UNCTAD and national central banks

Figure 15 shows GDP convergence in the CEE7 countries during the 1990s and the FDI inflows relative to their GDP. A lot of the FDI inflows to accession countries have been because of the privatisation of previously state-owned firms. After privatisation has been concluded, the countries have to attract more green-field investments, which may be harder to obtain. In many cases, they have already succeeded in this endeavour. The share of multinational firms has become extremely large in the exports of certain CEE countries. In 1999, their share in exports was 89% in Hungary, 61% in the Czech Republic, 60% in Poland and 30% in Slovakia. The share of multinational firms (MNFs) in investment was 82%, 53%, 63% and 22%, respectively.[11]

There is a considerable correlation between the relative GDP level and FDI inflows in Poland, Ireland and Lithuania, and also to some extent in Spain, Portugal, Slovakia and Latvia. The other countries do not show such correlation. This result is not to belittle the importance of FDI. In certain countries the inflows of FDI have been very large relative to gross fixed-capital formation. This can especially be seen in Ireland and the Baltic countries but also in the CEE4 countries. The importance of FDI in total gross fixed capital formation has been smaller in Portugal, Spain and Greece.

Table 4. Correlation coefficient between the FDI inflow data and convergence data in Figures 14 and 15

Country	Correlation coefficient	Country	Correlation coefficient
Ireland	0.865	Poland	0.970
Spain	0.496	Lithuania	0.669
Portugal	0.465	Slovakia	0.369
Greece	-0.130	Latvia	0.347
		Estonia	0.017
		Hungary	-0.381
		Czech Republic	-0.433

6. Conclusion

We have analysed convergence in GDP per capita levels adjusted for purchasing power in the EU15 area during 1960–2001. We discussed both β and σ-convergence, calculated the rate of unconditional convergence, and used graphs to see how EU membership, foreign trade and investment may have influenced convergence. We then used this framework to discuss the developments in the CEEC7 (Poland, the Czech Republic, Slovakia, Hungary, Estonia, Latvia and Lithuania) during the past ten years. We presume that the developments in the EU15 countries are a good indicator of the future economic development of the accession countries.

σ-convergence has taken place in the EU15 area in two spells separated by an interim period of stagnation. The first period of convergence took place between 1960 and the first oil crisis in 1973. Trade is often listed as a factor that increases convergence. The share of intra-EU15 exports in total exports grew very rapidly until 1973 and stabilised thereafter, which means that its growth ended at the same time as convergence came to a halt or vice versa. After

[11] Revue Elargissement, MINEFI – DREE/TRESOR, N°43, 14 April 2003.

1973, the share of the EU15 countries did not grow in these countries' exports before 1985. This stagnation in exports coincides with the period when no σ-convergence occurred (1973–86). At the same time there was also a dramatic decline in gross fixed-capital formation.

A second period of σ-convergence in GDP per capita has taken place after 1986. It can be further divided into two parts, a phase of fairly rapid convergence in 1986–91 and a phase of slower convergence in 1992–2001. Ireland and Luxembourg have been diverging very fast as of late and by excluding them from the analysis we see that convergence has proceeded throughout the 1990s. Meanwhile, the share of intra-EU15 exports in total trade increased until 1992, which coexists well with the period of rapid convergence that lasted until 1991. After that the share of the EU15 countries stabilised and also convergence in GDP per capita levels slowed down.

On average for the EU15 countries in 1960–2001, mutual trade seems to be a fairly good indicator of σ-convergence. It does not succeed so well in explaining the convergence of certain individual countries like Portugal or Greece. Exports to the EU15 countries as a share of GDP have continued to grow almost continuously with the exception of 1985–92, when there was a decline. This measure does not seem to correlate directly with convergence.

If we include the CEE7 countries, we again find an increase in σ convergence after the mid-1990s. Consequently, σ convergence has also taken place in this enlarged EU area. The share of the EU15 area in the accession countries' total exports is at about the same level as in the EU15 countries themselves. The exports-to-EU15-to-GDP ratio has now surpassed the respective level in the EU15 countries. High and increasing trade intensity indicates good prospects for convergence.

Let us then look at β-convergence. There has been considerable convergence in GDP per capita levels in the EU15 countries in 1960–2001. The catching-up EU countries, i.e. Greece, Ireland, Portugal and Spain, have on average all grown faster than the EU15 average but at different speeds and to a certain extent at different times. This convergence has not been automatic. Furthermore, wealthier EU countries have converged down towards the average EU GDP per capita levels. As the individual countries sum to the aggregate, there have to be some countries that lose in relative terms if there are countries that gain.

We find a clear linear trend between the logs of the EU15 countries' GDP per capita levels in 1960 and their average growth rates in 1960–2001; this fit becomes particularly good with an R^2 of 0.917 if we exclude Luxembourg and Ireland, which are outliers. This confirms that the countries with lower initial GDP levels have grown faster than those with higher initial GDP levels.

Of the seven applicant countries in our analysis, there is a little divergence in the case of the Czech Republic, but otherwise the countries have converged towards the average EU15 GDP per capita level in 1993–2001. The CEE7 countries are currently at about the same relative levels of GDP per capita as the catching-up countries were during the first oil crisis some 30 years ago, although there is more dispersion among the GDP per capita levels of the former than there was among those of the catching-up countries in the early 1970s.

For the CEE7 countries, taking as the initial GDP level their troughs, i.e. these countries' minimum real per capita GDP, in the early 1990s and comparing these with the countries' average growth rates we also find a negative trend, even though it is not (yet) as clear as in the case of the EU countries. Estonia, Lithuania and Slovakia are the main outliers. The scarcity of the available data is a constraining element here and we can expect that the fit will improve

in the future as more data become available. Indeed, the CEE4 countries already show some possibility of this happening. The trend with all the seven countries has an R^2 of 0.655, while that of the CEE4 countries is 0.748. The slope is much higher than for the EU15 countries, which reflects the CEE7 countries' higher average growth rates. The Czech Republic is a notable exception. We traced the more rapid convergence on higher investment rates and an increase in productivity owing to a technological transmission from the EU15 countries in the form of foreign direct investment.

In general, the EU15 countries have done better in relative terms after their EU membership than before it. The relative development in the post-membership period has been particularly good in Ireland, Portugal and Spain. Overall, post-membership development has been more favourable than pre-membership development in relative GDP per capita levels with the exception of Austria (very small weakening in growth rates) and Greece (considerable weakening) where pre-membership growth has been higher than post-membership growth.

After the accession countries started to grow, following the negative shock in the beginning of their transition in the early 1990s, the CEE7 countries have converged on average at about the same rate as the catching-up countries have done on average during 1960–2001. The best relative performance has taken place in Estonia, followed by Poland, Slovakia, Hungary and Latvia, while the Czech Republic has performed the least well. The convergence of the catching-up countries was not automatic after membership nor has it been continuous, and this will also most likely be the case for the accession countries. Structural and other reforms will support positive developments. On the basis of previous EU enlargements it does seem that membership typically improves growth prospects.

Foreign direct investment has had a major effect on the economies and foreign trade of the accession countries. On the basis of foreign direct investment inflows to the incumbent EU countries, it is difficult to conclude how much FDI may have effected GDP growth and convergence.

β-convergence, i.e. faster than average growth in initially poorer countries, depends on a number of factors. Convergence is not an automatic phenomenon and may occur at different speeds. Based on the evidence available for the EU15 countries during the past 40 years, however, it seems safe to say that convergence does typically take place within the EU. Consequently, it is most likely that the countries of Central and Eastern Europe will continue to converge on the income levels of the incumbent EU countries, although at different speeds and not necessarily continuously. Full convergence is likely to take several decades in the poorer countries. As convergence is not automatic, structural reforms remain an important factor in securing faster growth. Still, structural reforms are needed in many incumbent EU countries too.

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ENEPRI publications are partially funded by the European Commission under its Fifth Framework Programme - contract no. HPSE-CT-1999-00004.

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