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INTEGRATION AND CONDITIONAL CONVERGENCE IN THE ENLARGED EU AREA

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Ville Kaitila*

Abstract

This working paper analyses conditional convergence in Europe and also tries to assess the impact that arises from integration. Using a pooled mean-group estimation method, we first analyse the conditional convergence of GDP per labour force in the area covering the 15 member states of the European Union (EU-15) in 1960-2002. Conditional convergence is well-documented for the EU-15. Higher investment, lower public consumption and lower inflation have contributed positively to GDP growth. Deeper European integration is shown to have accelerated growth when inflation is not included in the specification, but not otherwise. The evidence on the effect of integration on growth is therefore mixed. We then apply the same method to estimate the growth of GDP per labour force in the new EU member states – the eight Central and Eastern European countries (CEECs) – for the period 1993-2002. These countries are shown to have converged conditionally towards the average level of GDP per labour force in the EU-15. Higher investment and lower public consumption have also supported growth in the CEECs.

JEL classification: F15, F43

Key words: European Union, economic integration, economic growth, conditional convergence

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Introduction

Integration has decreased barriers to trade and cross-border investment in Europe. This result has, among other things, made business and product standards and administrative practices more similar. As a result, trade and foreign direct investment (FDI) have increased between the countries participating in integration. FDI has often been trade-supporting with intra-industry trade especially increasing. FDI inflows also help to modernise technology and business practices in less advanced economies.

Consequently, European integration should push the continent towards fewer differences in productivity as well as in wage and price levels. By and large, convergence in GDP per capita has indeed taken place within the area of the 15 member states of the European Union (EU-15) since 1960. Still, convergence has not been uniform and periodic divergence has also occurred.[1]

Using pooled mean-group estimation we first analyse conditional β-convergence of GDP per labour force in constant 1995 PPP-adjusted US dollars – the measurement we henceforth use – in the EU-15 area in 1960-2002. Then we apply the same method to estimate the conditional convergence of the new EU member states – the eight Central and Eastern European countries (CEECs)[2] – towards the average of the EU-15 countries in 1993-2002. We focus on the effects arising from investment, EU membership and deeper integration, foreign trade, inflation and public consumption.

Conditional (β-)convergence refers to a situation where there is a negative relationship between the initial level of GDP per labour force and its average growth rate after we control for additional variables such as investment. In other words, poorer countries have a tendency to grow faster than richer ones and will eventually tend to catch up with them.

Our results indicate that conditional convergence has indeed occurred in the EU-15 area in 1960-2002. Higher investment, lower public consumption and lower inflation have contributed positively to GDP growth. Deeper European integration is shown to have accelerated growth when inflation is not included in the specification, but not otherwise. The evidence on the effect of integration on growth is therefore mixed.

Furthermore, the CEECs are shown to have converged conditionally towards the EU-15 countries' average level of GDP per labour force in the EU-15 in 1993-2002. Higher investment and lower public consumption have supported growth in the CEECs.

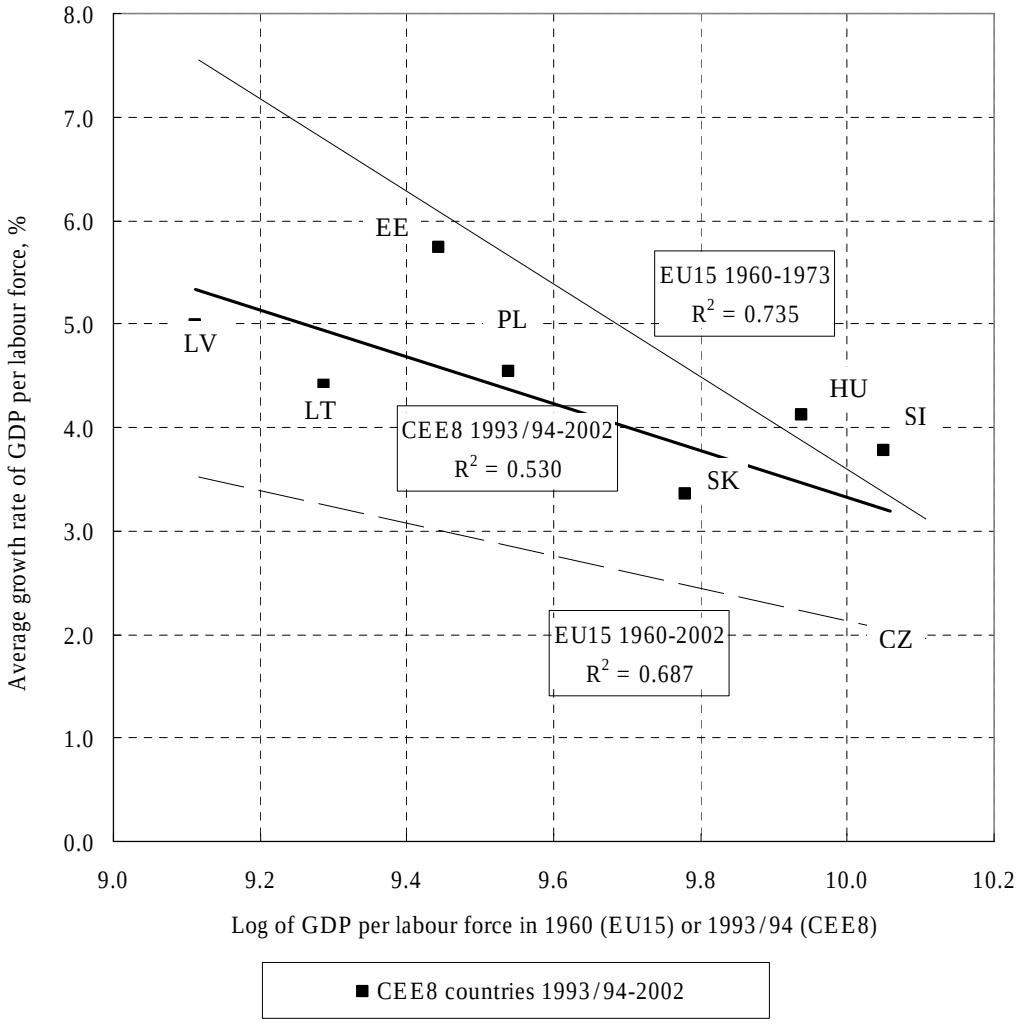
In absolute terms, the CEECs are presently at about the same level of GDP per labour force as the EU-15 countries were in the mid-1960s. The Baltic countries and Poland have lower productivity than the other CEECs. Figure 1 shows unconditional convergence in the enlarged EU area after 1960. For the EU-15 countries, we show GDP per labour force in 1960 and its average growth rate in the 1960-73 period of fast growth and the total time period 1960-2002. For clarity, only the linear trend has been shown, not the position of individual countries. For the CEECs we show

[1] See for example Kaitila (2004).

[2] The eight CEECs comprise the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia. We do not include Cyprus or Malta in the analysis.

GDP per labour force in 1993 (1994 for Lithuania) and growth rates up to 2002. The position of individual CEECs is also shown. In all three cases there is a negative relationship between the initial level of GDP per labour force and its growth rate. Consequently, unconditional convergence has indeed taken place in Europe. The R^2 values are presented in the graph, which are relatively high.

Figure 1. Real GDP (PPP) per labour force of EU-15 countries in 1960 with average growth rates in 1960-73 and 1960-2002, and the CEECs' GDP (PPP) per labour force in 1993-94 with average growth rates up to 2002



Notes: Real GDP (PPP) per labour force has been growing since at least 1993 in the CEECs (1994 in Lithuania). Belgium and Luxembourg are combined.

Comparing the EU-15 countries during the whole available time period 1960-2002 and the CEECs since 1993-94, we find that the latter have grown faster than the former given their initial levels of GDP per labour force: the linear trend is positioned higher in the case of the CEECs.

Why is there such a difference in the trends? The main reason is simply 'catching up', as GDP per labour force in the CEECs was and remains considerably lower than in the EU-15. Despite faster growth, it is not self-evident that poorer countries will grow faster than wealthier ones. For example, the Czech Republic has by and large failed to do so.

The EU has given the accession countries of Central and Eastern Europe a clear direction of reform in legislation, politics, economics and administration. The speed of structural change and the large inflows of FDI, which have introduced more modern technology and business practices, have fostered an environment that has promoted investment and growth. In this sense, the CEECs that joined the EU in 2004 have been in a better position than the countries of the Commonwealth of Independent States to their east, which are not candidates for EU membership (see also Crafts & Kaiser, 2004). The EU-15 also forms a very large and wealthy destination for exports from the CEECs.

On the other hand, Figure 1 also shows the growth performance of the EU-15 countries during 1960-73. It is notable that at that time the EU-15 countries were growing faster than the CEECs have done since 1993-94 (the linear trend is higher in the case of the former). Consequently, the performance of the CEECs has not been spectacular from a historical European point of view. During the past couple of decades, growth rates have declined in the EU-15, which explains why the linear trend for the CEECs is higher than for the EU-15 countries in 1960-2002 despite the brisk performance of the latter before the first oil crisis.

1. Trade, integration and growth: Earlier results

Before going into the model we estimate, it is useful to discuss some earlier results concerning the impact of trade on growth, given that economic integration increases trade and European integration has an important role in our analysis.

According to Ben-David & Rahman (1996), countries that trade extensively tend to converge more than countries that do not have the same intensity of trade. Ben-David & Kimhi (2000) provide evidence that increased exports, especially from poorer countries to wealthier ones, are related to an increase in the rate of income convergence between them. They also argue that prior to trade policy liberalisation in Europe there was very little change in trade-to-GDP ratios. After liberalisation, a significant increase in trade occurred, which tended to level off and remain at the new higher level at the end of liberalisation.

Edwards (1998) finds evidence of a positive effect from openness on total factor productivity (TFP) growth. But he uses nine different openness indicators that are for the most part only available for a part of the 1980s. The indices used are measurements of tariffs, quotas, etc. TFP growth is assumed to arise from two sources: domestic (innovation) and international (the ability to adopt and use foreign innovations). The former is a function of the level of human capital while the latter is assumed to be a function of a catching-up period that is longer the poorer the country is. More open and less developed countries rely more on the international channel for TFP growth than other countries. Yet the ability to adopt foreign innovations also depends on the quality of human capital.

According to Rodríguez & Rodrik (1999), empirical studies that conclude that a more liberal trade regime induces faster GDP growth are problematic, in that the indicators used to measure openness are poor measures of trade barriers or they are highly correlated with other sources of poor economic performance, notably macroeconomic imbalances.

Nevertheless, Wacziarg & Welch (2003) argue that dates showing the liberalisation of the trade regime can be used to estimate the within-country growth response. In the countries that have liberalised their trade regimes after 1950, GDP growth rates have risen by an average of 1.5 percentage points compared with the pre-liberalisation period. The investment-to-GDP ratio also increased by 1.5 to 2 percentage points. Furthermore, liberalisation raised the trade-to-GDP ratio by an average of 5 percentage points after controlling for a time trend.

Concerning European integration, Ben-David (1993) argues that the liberalisation of trade between the six original European Economic Community (EEC) countries led to income convergence. The timing of trade reform between the EEC and European Free Trade area (EFTA)

countries was also found to coincide closely with convergence.[3] The analysis does not take into account the countries' trade-to-GDP ratios, which are likely to have an impact on convergence. Using Ben-David's (1996) method, Gaulier (2003) argues that trade intensity does not in itself lead to σ-convergence. Still, he does find evidence that trade and β-convergence are robustly linked.

Henrekson et al. (1996) analyse the growth effects of European integration. They conclude that European Community (EC) or EFTA membership may have had a positive effect of up to 1 percentage point in the growth rate of the member countries. They do not find any difference between membership in the EC or the EFTA. They argue that technology transfer is the main channel through which membership has affected growth, but that membership has had no effect on investment.

Baldwin & Seghezza (1996) argue that countries that were members of the European Community during 1971-90 experienced faster TFP growth than other European countries, such as those that were part of the EFTA. Furthermore, the founding members of the EEC had experienced the highest growth rates. Baldwin & Seghezza also argue that European integration affects growth through physical capital formation (integration-induced, investment-led growth) and knowledge creation (integration-induced, technology-led growth). They further argue that the convergence of Ireland, Spain and Portugal is proof of the former, while it is very difficult to measure the latter.

Wagner & Hlouskova (2002) base their analysis on the historical convergence of the EU countries and then project it on the accession countries by analysing data going up to 1998. They argue that the neo-classical growth model "does not yet adequately describe the growth process" in the CEECs.

2. The model

In the standard neo-classical growth model, economic growth is driven by technological progress and the accumulation of two factors of production, namely labour and capital. Technological progress is assumed to be exogenous, but sustained growth in per-capita incomes cannot occur without it. Labour is determined by population, which is assumed to be growing at an exogenous rate. The investment rate is typically assumed to be constant, determined by a constant saving rate. Consequently, output, investment and the capital stock will all grow by the same long-run growth rate.

Convergence occurs because of capital investment flows to less capital-abundant countries and sectors – where returns on investment are higher – thereby raising productivity. Another possibility is that labour migrates to more developed countries, where wages are higher. Per capita income in a given country converges to that country's steady-state value. Also, if countries are similar in every respect other than their initial capital stocks, poorer countries will grow faster than wealthier ones.

If we control for the determinants of the steady state, the results are 'conditional convergence' (see for example Mankiw et al., 1992), i.e. a relation between the growth rate and the initial conditions after controlling for some other variables. 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 different, there is still convergence towards the same growth rate of output and capital, but at a different steady-state income level.

We construct a neo-classical aggregate growth model following Bassanini & Scarpetta (2001). They analyse economic growth and the role of technological progress, policy and institutions in 21 OECD countries in 1971-98 in the tradition of Solow (1956) and Mankiw et al. (1992).

[3] See also Ben-David (1996) for an analysis of several trade regimes and similar results of a positive effect from trade liberalisation within "trading-country groups".

Bassanini & Scarpetta find that the accumulation of physical and human capital was the main growth engines of GDP per capita (for population aged 15-64) in the OECD countries in 1971-98. Furthermore, research and development, a sound macroeconomic environment, openness to trade and well-developed financial markets contributed to rising living standards.

We start with a Cobb-Douglas production function with country indices *i* and time *t*:

$$Y_{it} = K_{it}^{\alpha} \left(A_{it} L_{it} \right)^{1-\alpha}, \tag{1}$$

where *Y* is output, *K* is physical capital, *A* is the level of labour-augmented technology, *L* is labour and $0 < \alpha < 1$ is the constant partial elasticity of output with respect to physical capital.

Now we define $k_{it} = K_{it} / A_{it} L_{it}$ as the stock of physical capital per unit of effective labour and $y_{it} = Y_{it} / A_{it} L_{it}$ as output per unit of effective labour in country *i*. We can then derive the following differential equation:

$$\frac{dk_{it}}{dt} = s_i \, y_{it} - \left(g_i + n_i + d \right) k_{it}, \tag{2}$$

where *s* is the investment-to-GDP ratio, *g* is the exogenous improvement rate of technology *A*, *n* is the exogenous growth rate of the labour force and *d* is the (constant) depreciation rate of physical capital.

The production function can be rewritten in the intensive form:

$$y_{it} = k_{it}^{\alpha}. \tag{3}$$

The steady-state value of capital intensity k_{it}^{*} can be solved from (2) and (3), so that:

$$\log k_i^{*} = \frac{1}{1-\alpha} \log s_i - \frac{1}{1-\alpha} \log \left(g_i + n_i + d \right). \tag{4}$$

Then we substitute the steady state k_i^{*} into (3) to obtain:

$$\log \, y_i^{*} = \log(A_{i0}) + g_i t + \frac{\alpha}{1-\alpha} \log s_i - \frac{\alpha}{1-\alpha} \log \left(g_i + n_i + d \right), \tag{5}$$

which gives us the steady-state level of output per worker. Next, we subtract the lagged dependent variable from both sides and modify the equation to derive an empirical specification.

Assume that $A = A(V)$, where *V* represents other, policy-related and institutional variables, which we include at this stage. These are public spending, inflation, export openness and dummy variables reflecting EU integration among other things. We also add country-specific short-term dynamics in first-differences as cyclical components of output growth (see the next section for the method used). This yields us the function we estimate below:

$$\begin{aligned} \Delta \log \, y_{it} = a_{i,0} - \varphi \log \, y_{i,t-1} + a_1 \log s_{it} - a_2 n_{it} + \sum_{j=3}^{m} a_j \log V_{ijt} \\ + b_{i1} \Delta \log s_{it} + b_{i2} \Delta n_{it} + \sum_{j=3}^{m} b_{ij} \Delta \log V_{ijt} + \varepsilon_{it}, \end{aligned} \tag{6}$$

where the coefficient *b* captures short-term dynamics and ε is a country-specific error term. The time trend present in equation (5) did not become statistically significant in our estimates, so it is not included in equation (6).

Despite our efforts we were unable to find evidence of human capital affecting growth in 1960-2002 in the EU-15 area. This may be because the EU-15 countries' income levels are relatively

similar. Consequently, education was left out of the specification. The variable we tested was the average number of years of education in the working-age population in different years.

Not all studies have found evidence of a positive impact from human capital on growth. For example, Barro (1991), Mankiw et al. (1992), Bassanini & Scarpetta (2001) and Miller & Upadhyay (2002) have, but Hamilton & Monteagudo (1998) and Benhabib & Spiegel (1994) have not. Yet after the latter changed their model so that they used the average level of human capital during the whole period (and not its growth rate), they did obtain the result that human capital affects growth positively. Islam (1995) derives very different results, both positive and negative, as to the significance of human capital depending on the estimation method that he uses.

3. Estimation method and data

We use pooled cross-country time-series data for the 14 EU countries[4] in 1960-2002 and the eight CEECs in 1993-2002. The method used (pooled mean-group, as later discussed) explains both cross-country differences in growth in the short term as well as the growth performance of each country over time. The technique allows for short-term adjustments and convergence speeds to vary across countries. It imposes restrictions only on long-run coefficients.[5]

Country-specific effects could be controlled for by using a dynamic fixed-effect estimator, which would assume homogeneity in both the dynamics and the long-run equilibrium relationship. Consequently, the set of slope coefficients would be identical, but differences in intercepts would persist. But imposing identical slope coefficients and allowing only intercepts to vary across countries may be problematic if the speed of convergence between the countries were to differ.

An alternative would be to use a mean-group approach, which would be equivalent to estimating separate regressions for each country and calculating their mean. It would assume heterogeneity in both the dynamics and the long-run equilibrium relationship. This estimator, however, is likely to be inefficient if the number of countries in the sample is small.

An intermediate choice is a pooled mean-group (PMG) estimator, which allows for heterogeneity in the short-term coefficients, but assumes homogeneity in the long term (see Pesaran et al., 1999). Consequently, the intercepts, the speed of convergence parameter φ in (6), the short-run adjustment coefficients b and error variances may differ across countries, but homogeneity is imposed on the long-run coefficients a, which are identical for all the countries in the sample. Following Bassanini & Scarpetta (2001), we adopt PMG.

We use fixed effects and generalised least squares (GLS) with cross-section residual variances as weights allowing for cross-section heteroskedasticity. We use annual data instead of the average growth rate over a period of time as is done in many other studies. In order to control for cyclical components in the year-to-year variations in output, we include first differences of the steady-state determinants as short-run regressors.

White heteroskedasticity-consistent standard errors and covariance will allow variances within a cross-section to differ across time. Using fixed effects for the intercept specification and cross-section weights for weighting also implies that each pool will have an unrestricted intercept and that each pool equation is weighted by an estimate of the cross-section residual standard deviation.

[4] Here Belgium and Luxembourg are combined.

[5] Other estimation methods that we could have used include using the original income level as the dependent variable and average growth rate over time as the independent variable, or analysing the data in five-year blocks, for example, in order to avoid cyclical short-term volatility.

We use real GDP figures adjusted for purchasing power. Often GDP is divided by either the total population or the number of persons aged 15-64 in the population (as in for example Mankiw et al., 1992 and Bassanini & Scarpetta, 2001). Instead, we divide GDP by the labour force as this is closer to the spirit of the production function than the per-capita measures.[6]

We want to analyse as long a time period as possible in order to investigate possible effects arising from EU membership and integration on growth. This objective, however, limits the selection of other variables. A time period that starts from the early 1970s would allow for more variables, but then we would have 9 of the 14 EU countries in the Union during the whole period of the analysis. The fact that we have four non-OECD economies also limits the use of OECD data.[7]

In addition to the lagged dependent variable, the right-hand side of the estimated equation includes the ratio of total investment to GDP and the growth rate of the labour force. We expect the former to have a positive sign and the latter a negative sign. These two are supplemented by additional variables. The ratio of public consumption to GDP is a fiscal-policy variable with an expected negative sign. There are also two inflation variables: consumer price inflation and its three-year centred standard deviation. The latter is a measurement of the volatility of (uncertainty over) inflation. We expect both to have a negative sign. We use total exports of goods and services as a percentage of GDP to measure openness and expect it to have a positive sign.

4. The dummy variables of integration

We include dummy variables that should capture some of the effect from integration. These variables are dummies for when the country is a member of the European Union, its customs union (1968), the internal market (1987), a signatory of the Maastricht Treaty (1993) and the economic and monetary union (1999). See Table 1 for the dummies. These dummies have an expected positive sign, i.e. we expect that deeper integration will increase convergence.

Table 1. Dummy variables used in the analysis

Country	EU	Customs Union	Internal Market	Maastricht Treaty	EMU
Belgium-Luxembourg	1960	1968	1987	1993	1999
France	1960	1968	1987	1993	1999
Germany	1960	1968	1987	1993	1999
Italy	1960	1968	1987	1993	1999
Netherlands	1960	1968	1987	1993	1999
United Kingdom	1973	1973	1987	1993	Not member
Denmark	1973	1973	1987	1993	Not member
Ireland	1973	1973	1987	1993	1999
Greece	1981	1981	1987	1993	2001
Portugal	1986	1986	1987	1993	1999
Spain	1986	1986	1987	1993	1999
Austria	1995	1995	1995	1995	1999
Finland	1995	1995	1995	1995	1999
Sweden	1995	1995	1995	1995	Not member

Note: The first year the integration dummies receive the value of 1, which they continue to receive after this year

[6] Miller & Upadhyay (2002) find more evidence of convergence of total factor productivity than of real GDP per labour force.

[7] The data for the EU-15 countries are mostly from the Economic Outlook database by the OECD. This database is also available for the Czech Republic, Hungary, Poland and Slovakia. For the Baltic countries and Slovenia we have mainly used the World Development Indicators database by the World Bank. The data for the exports of goods and services to GDP ratio are from the International Financial Statistics by the IMF.

A clear problem with our EU dummies is that in reality integration takes place over a longer period of time with tariffs, quotas and other trade restrictions decreasing over a period of transition that lasts several years. For example, the formation of the EEC in 1958 initiated annual cuts in tariffs and quotas for non-agricultural goods among the six original member countries. Quotas were removed in steps between 1959 and 1962, while it took until 1968 before all the tariffs had been removed (see e.g. Ben-David, 1993).

The internal market removed restrictions from the free movement of goods, persons, services and capital. The first main treaty revision, the Single European Act, only was signed in 1987. This started a movement towards further integration. Still, the internal market officially started in 1993, although it was not 'perfect' even in 2002. Further, we do not have dummies for free trade between the EU and EFTA countries. As such, dummy variables can hardly depict the complexity of the integration process in its whole.

Before estimating the actual model, we explore to what extent the dummy variables alone succeed in explaining growth, investment and trade. Table 2 shows the results for unconditional convergence with the inclusion of the integration dummies, but without the other variables referred to in section 4 (e.g. investment or public consumption).

Table 2. Explaining the growth rate of GDP per labour force in the EU-15 with the integration dummies

Dependent variable: Change in the log of GDP per labour force				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Log of GDP per labour force (-1)	-0.0633***	0.0045	-14.1320	0.0000
Dummies				
- EU member	-0.0056*	0.0033	-1.7233	0.0854
- Member of the customs union	0.0072**	0.0028	2.5235	0.0119
- Member of the internal market	0.0103***	0.0023	4.4255	0.0000
- Sign. of the Maastricht Treaty	0.0046**	0.0023	1.9934	0.0467
- Member of EMU	0.0012	0.0024	0.4884	0.6254
Weighted statistics				
R-squared	0.4055	**Mean dependent var.**		0.0302
Adjusted R-squared	0.3857	**S.D. dependent var.**		0.0306
S.E. of regression	0.0240	**Sum squared resid.**		0.3278
Log likelihood	1444.4470	**F-statistic**		20.3938
Durbin-Watson stat.	1.6153	**Prob. (F-statistic)**		0.0000
	F-Statistics		**Normalised restriction (=0)**	
	Value	**Prob.**	**Value**	**Std. error**
Wald test for integration dummies	25.0689***	0.0000	0.0177	0.0035

Notes: * = significant at 10%; ** = significant at 5%; *** = significant at 1%. The time trend was not statistically significant and therefore it was omitted.

The results indicate that conditional convergence has taken place in the EU-15 area when the integration dummies are controlled for. Also, four out of the five integration dummies are statistically significant. We also performed a Wald coefficient-restriction test for the five

integration dummies.[8] The null hypothesis is that integration has had no impact on growth. The Wald test is thus rejected and we conclude that integration has had a statistically significant and positive impact on the growth of GDP per labour force.

Integration may affect economic growth and convergence through different channels. Next, we analyse two possible channels using the same method: investment and exports. Integration is expected to have a positive effect on both per se, and through these channels it should also affect economic growth.

Table 3 shows the results for investment. The dependent variable is the log of the total-investment-to-GDP ratio. The explicatory variables are the lagged change in the log of GDP per labour force and the lagged dependent variable, in addition to the integration dummies. The coefficients for the growth rate of GDP per labour force and the investment-to-GDP ratio are positive and very significant. The time trend is slightly negative and statistically significant. The Wald test is rejected and we conclude that integration has had a statistically significant and positive impact on investment.

Table 3. Explaining investment with the integration dummies (EU-15)

Dependent variable: Log of total investment per GDP				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Change in the log of GDP per labour force (-1)	0.5676***	0.0969	5.8551	0.0000
Investment-to GDP ratio (-1)	0.8536***	0.0171	49.7881	0.0000
Time trend	-0.0009***	0.0003	-2.7910	0.0054
Dummies				
- EU member	0.0104	0.0074	1.4051	0.1605
- Member of the customs union (1968)	-0.0082	0.0061	-1.3476	0.1783
- Member of the internal market (1987)	0.0260***	0.0056	4.6265	0.0000
- Signatory of the Maastricht Treaty (1993)	-0.0024	0.0049	-0.4801	0.6314
- Member of the EMU	0.0053	0.0053	0.9962	0.3196
Weighted statistics				
R-squared	0.9946	**Mean dependent var.**		-1.8311
Adjusted R-squared	0.9944	**S.D. dependent var.**		0.6457
S.E. of regression	0.0482	**Sum squared resid.**		1.2820
Log likelihood	1002.2240	**F-statistic**		4872.4840
Durbin-Watson stat.	1.6730	**Prob. (F-statistic)**		0.0000
	F-Statistics		**Normalised restriction (=0)**	
	Value	**Prob.**	**Value**	**Std. error**
Wald test for integration dummies	8.6119***	0.0035	0.0311	0.0106

Notes: *** = significant at 1%.

[8] The dummies are for membership of the EU, customs union, internal market, the EMU and a signatory of the Maastricht Treaty. The null hypothesis is then c(EU)+c(CU)+c(IM)+c(MT)+c(EMU)=0, i.e. whether the five coefficients are jointly equal to zero.

Exports are likely to increase as a result of integration, and increased trade may also contribute positively to economic growth. Table 4 shows the results with the log of exports-to-GDP ratio as the dependent variable and the integration dummies as explanatory variables together with the lagged dependent variable. All but membership in the EU and the EMU are significant at least at the 1% level of significance. The internal market, however, had a negative impact on the exports-to-GDP ratio. The Wald test was rejected and we conclude that integration has had a statistically significant and positive impact on exports. The time trend was significant and positive.

Table 4. Explaining exports with the integration dummies (EU-15)

Dependent variable: Log of exports-to-GDP ratio				
Variable	**Coefficient**	**Standard error**	**t-Statistic**	**Prob.**
Log of exports-to-GDP ratio (-1)	0.8567***	0.0214	40.0025	0.0000
Time trend	0.0019***	0.0006	3.4115	0.0007
Dummies				
- EU member	-0.0101	0.0098	-1.0257	0.3055
- Member of the customs union	0.0453***	0.0091	4.9966	0.0000
- Member of the internal market	-0.0354***	0.0097	-3.6366	0.0003
- Sign. of the Maastricht Treaty	0.0323***	0.0085	3.8046	0.0002
- Member of the EMU	0.0059	0.0106	0.5575	0.5774
Weighted statistics				
R-squared	0.9847	**Mean dependent var.**		-1.6622
Adjusted R-squared	0.9842	**S.D. dependent var.**		0.5663
S.E. of regression	0.0713	**Sum squared resid.**		2.8819
Log likelihood	770.3363	**F-statistic**		1823.5800
Durbin-Watson stat.	1.7962	**Prob. (F-statistic)**		0.0000
	F-Statistics		**Normalised restriction (=0)**	
	Value	**Prob.**	**Value**	**Std. error**
Wald test for integration dummies	4.8888**	0.0274	0.0380	0.0172

Note: *** = significant at 1%.

It should be noted that the dependent variable is the total exports of goods and services, not just exports to other EU countries. Also we do not take into consideration other forms of integration such as the EFTA or global tariff-cutting in the context of the General Agreement on Tariffs and Trade or periods of transition in the liberalisation of trade.

Along with the integration dummies, other dummy variables included are 'unified Germany' given for Germany in 1991-2002 and 'time period 1960-72', i.e. before the first oil crisis when productivity growth in Europe was considerably higher than after the oil crisis. We expect the former to have a negative sign and the latter a positive sign.

5. Estimation results: Conditional convergence in the EU-15

Returning to our full model, our estimation results for growth and conditional convergence in the EU-15 countries in 1960-2002 are shown in Table 5. The signs of the coefficients are mostly as expected. The coefficient of the lagged dependent variable is always significant and negative indicating conditional convergence. The investment rate (including both private and public) is always significant and positive and the growth rate of the labour force is always significant and negative. We did not separate public investment from private investment because of lack of data.

Table 5. Estimation results for conditional convergence of the EU-15 countries

Dependent variable: Change in the log of GDP per labour force								
Variable	**Specification**							
	Basic specifica-tion	With public spending	With inflation	With public spending, inflation	With openness indicator	With openness indicator, w/o EU dummies	With public spending, inflation, openness	With public spending, inflation, openness, w/o EU dummies
Basic explanatory variables								
- Log of GDP per labour force (-1)	0.0304***	0.0158***	0.0341***	0.0196***	0.0279***	0.0221***	0.0250***	-.0271***
	(-4.2336)	(-2.7555)	(-7.6625)	(-3.4718)	(-3.7493)	(-4.1199)	(-4.3331)	(-5.2440)
- Log of total investment per GDP	0.0225***	0.0274***	0.0212***	0.0250***	0.0225***	0.0219***	0.0269***	0.0268***
	(3.1241)	(4.1751)	(3.2337)	(3.9381)	(3.2176)	(3.1739)	(4.1769)	(4.1550)
- % growth rate of labour force	-0.0068***	-0.0070***	-0.0063***	-0.0062***	-0.0068***	0.0068***	-0.0064***	-0.0060***
	(-9.9834)	(-9.0281)	(-12.3722)	(-10.8083)	(-10.0844)	(-9.7235)	(-10.6705)	(-8.9706)
Other explanatory variables								
- Log of public consumption (% of GDP)	..	-0.0256***	..	-0.0278***	..	..	-0.0307***	-0.0274***
		(-4.4919)		(-4.7356)			(-4.6420)	(-4.3462)
- Consumer price inflation (%)	..	..	-0.1663***	-0.1367***	..	..	-0.1350***	-0.1149***
			(-6.2080)	(-5.3405)			(-5.6327)	(-5.2508)
- Standard deviation in CPI, 3-year centred	..	..	0.0479	-0.0006	..	..	0.0413	0.0843
			(0.4609)	(-0.0065)			(0.4468)	(0.9620)
- Log of exports (% of GDP)	..	..	..	..	0.0066	0.0073	0.0097	0.0092
					(1.2525)	(1.4362)	(1.6353)	(1.6232)
Dummy variables								
- EU member	-0.0053*	insign.	insign.	insign.	insign.	..	insign.	..
	(-1.7423)							
- Member of the customs union (1968)	0.0093***	0.0055***	0.0065***	0.0068***	0.0046**	..	0.0044**	..
	(3.7214)	(2.9469)	(3.0435)	(3.2580)	(2.4258)		(2.1456)	
- Member of the internal market (1987)	0.0041**	insign.	-0.0060***	-0.0070***	0.0040**	..	insign.	..
	(2.0819)		(-2.8705)	(-3.5588)	(2.3220)			
- Signatory of the Maastricht Treaty (1993)	insign.	insign.	insign.	insign.	-0.0030*	..	0.0064***	..
					(-1.8542)		(-3.7980)	
- Member of the EMU	insign.	insign.	insign.	insign.	insign.	..	insign.	..
- Unified Germany	-0.0058*	insign.	insign.	insign.	insign.	insign.	insign.	-0.0069**
	(-1.7646)							(-2.1539)
- 1960-72	0.0101***	0.0067***	insign.	insign.	0.0117***	0.0114***	insign.	insign.
	(3.4010)	(2.6940)			(4.0589)	(4.5067)		
Weighted statistics								
R-squared	0.6035	0.6605	0.6520	0.7132	0.6399	0.6371	0.7352	0.7269
Adjusted R-squared	0.5664	0.6201	0.5988	0.6590	0.5954	0.5946	0.6750	0.6657
Durbin-Watson stat	1.8616	1.8821	1.8274	1.9156	1.8487	1.8452	1.8738	1.8725
F-statistic	16.2739	16.3320	12.2520	13.1713	14.3861	15.0082	12.2296	11.8648
Prob. (F-statistic)	0.0000	0.0000	0.0000	0.00000	0.0000	0.0000	0.0000	0.0000

Notes: t-statistics in parenthesis; * = significant at 10%; ** = significant at 5%; *** = significant at 1%; insign. = statistically not significant; .. = not included in the specification.

When included in the specifications, public consumption is significant and it has a negative impact on growth. Barro (1991) also found that public consumption has a negative effect on growth. He did not, however, find this negative effect arising from public investment, which was neutral from the point of view of growth. Public consumption may introduce distortions, such as high tax rates, without providing stimuli for growth and investment.

Higher inflation rates proved to be bad for growth while, in this respect, their volatility has been insignificant in the EU-15 area. For example, in his study of developing countries, Fischer (1993) shows that inflation is harmful for growth as it reduces investment and productivity growth. A stable macroeconomic framework is a necessary but still not a sufficient condition for sustainable economic growth. The coefficient for trade was positive but it did not become significant even when the integration dummies were dropped from the estimations.

The dummy variables for integration were also as usually expected. Membership of the customs union proved to be the most important factor in this respect, contributing positively to growth. On the other hand, the formation of the internal market had an ambiguous effect. In summary, this does not amount to very substantial evidence on behalf of the benefits of EU integration from the point of view of conditional convergence. Indeed, we have already expressed some criticism of the structure of the integration dummies used here.

As expected, the reunification of Germany had a negative effect on growth in two specifications. In addition, the dummy for the years before the first oil crisis is positive in four specifications. Otherwise these dummies were insignificant. The EU and EMU dummies did not become positive or significant in the estimations. We also tried to use a dummy variable for the recipients of cohesion funds, i.e. Greece, Ireland, Portugal and Spain in 1988-2002, but its coefficient was not statistically significant. Ederveen et al. (2002) provide evidence that on average, structural funds are ineffective in view of boosting growth, after controlling for openness, institutional quality, corruption and indicators of good governance. Nevertheless, if the institutional setting is good, structural funds do enhance growth. This is important given that corruption is a major problem in many of the new member countries and they are beneficiaries of structural funds.

The dummy variables comprise (see also Table 1): EU (=1 if EU member), the customs union (1968 onward if an EU member), the internal market (1987 onward if an EU member), the Maastricht Treaty (1993 onward if an EU member), the EMU (=1 if an EMU member), unified Germany (1991 onwards for Germany) and 1960-72 (for all countries).

We further do Wald coefficient-restriction tests for the five integration dummies[9] to test whether they are significant when taken together (Table 6).

Table 6. Wald coefficient-restriction tests for the five integration dummies taken together (EU-15)

Specification	F-Statistic		Normalised restriction (= 0)	
	Value	Probability	Value	Std. error
Basic specification	8.7575***	0.0032	0.01029	0.00348
With public spending	4.8844**	0.0275	0.00697	0.00315
With inflation	0.0417	0.8383	0.00070	0.00345
With public spending, inflation	0.4817	0.4880	0.00218	0.00314
With openness indicator	3.4167*	0.0651	0.00637	0.00345
With public spending, inflation, openness	1.7867	0.1820	0.00483	0.00361

Notes: * = significant at 10%; ** = significant at 5%; *** = significant at 1%.

[9] The dummies are for membership of the customs union, the internal market, the EMU and a signatory of the Maastricht Treaty. The null hypothesis is c(EU)+c(CU)+c(IM)+c(MT)+c(EMU)=0, i.e. whether the five coefficients are jointly equal to zero. The dummies for unified Germany and pre-1973 have been included in the specifications as in Table 5.

The null hypothesis is that integration has had no impact on growth. The results are mixed. When inflation is not included in the specification, the results indicate that the null hypothesis is rejected and that integration has had a statistically significant effect on growth. But whenever inflation is included, the null hypothesis is not rejected and integration has not been statistically significant.

6. Estimation results: Convergence of the CEECs

Next we use PMG to estimate the speed of convergence of the CEECs towards the average GDP per labour force in the EU-15 countries in 1993-2002. The results are shown in Table 7. On the right-hand side, we have a catching-up variable that is given by the ratio of GDP per labour force in each CEEC to the average GDP per labour force in the EU-15 countries.

Table 7. Estimation results for the growth rate of GDP per labour force in the CEECs

Dependent variable: Change in the log of GDP per labour force			
Variable	**Specification**		
	Basic specification	With public spending	With inflation
Explanatory variables			
- Log of GDP per labour force (-1), EU-15 = 100	-0.1758***	-0.6252***	-0.1742**
	(-6.3027)	(-14.6080)	(-2.4910)
- Log of total investment per GDP	0.0507***	0.1619***	-0.0534***
	(2.9517)	(5.3390)	(-3.0429)
- % growth rate of the labour force	-0.0030*	-0.0031*	-0.0038
	(-1.9613)	(-2.3519)	(-1.3439)
- Log of public consumption (% of GDP)	..	-0.2848***	..
		(-9.7811)	
- Consumer price inflation (%)	..	..	-0.1205
			(-1.5984)
- Standard deviation in CPI, three-year centred	..	..	-0.3274
			(-1.5284)
- Dummy for Europe Agreements	0.0119***	0.0208***	insign.
	(5.5169)	(8.2035)	
Weighted statistics			
R-squared	0.9172	0.9948	0.9516
Adjusted R-squared	0.8551	0.9711	0.8394
Durbin-Watson stat.	2.3975	2.3854	2.5140
F-statistic	14.7704	42.1399	8.4836
Prob. (F-statistic)	0.0000	0.0000	0.0000

Notes: t-statistics in parenthesis; * = significant at 10%; ** = significant at 5%; *** = significant at 1%; insign. = statistically not significant; .. = not included in the specification.

The number of different specifications is smaller than in Table 5. In more complicated specifications the data did not perform well: there were either too few observations or convergence did not occur and the Durbin-Watson statistics became very large. With the simplest specification (and with either public consumption or inflation included), the results were more reasonable and these results are reported below.

The coefficient for the catching-up term is negative and statistically significant, implying conditional convergence of the eight CEECs towards the average of the EU-15 countries. This means that labour productivity has increased faster in the former than in the latter after controlling for investment rates, the growth of the labour force and a dummy variable for the Europe Agreements.[10] These other explanatory variables also prove to be significant and of the expected sign, i.e. investment has had a positive effect on growth, an increase in the labour force has had a negative effect and the Europe Agreements have had a positive effect.

As for the two other specifications, public consumption has had a significant negative effect on growth; inflation and its volatility did not become statistically significant. They were both significant at 15%, however, and their signs were as expected. Removing the standard deviation of inflation had the effect that all other variables – including inflation – became very significant and of the expected sign.

Wagner & Hlouskova (2002) argued on the basis of data going up to 1998 that the neo-classical growth model did "not yet adequately describe the growth process" in the CEECs. Nevertheless, even with some obvious deficiencies, we may conclude on the basis of the results presented in Table 7 that it seems the growth model has begun to work for the CEECs. Still, owing to the limited number of years available, it does not work as well as for the EU-15 countries and the number of specifications that we were able to use was smaller.

Conclusions

The CEECs are less wealthy than the EU-15 countries. As predicted by the basic convergence theory, GDP growth rates have been higher in the former than in the latter after the end of the initial decline in their GDP in the early phase of economic transition. Prospective EU membership has accelerated much-needed changes in administration, legislation, etc., and it has also led to an increase in trade and inflows of foreign direct investment, which have introduced more modern technology and business practices.

In this paper, we first analysed the conditional convergence of GDP per labour force within the EU-15 area in 1960-2002 using a pooled mean-group estimator, which allows for heterogeneity in the short-term coefficients, but assumes homogeneity in the long-term ones. Then we made a similar analysis of the CEECs' conditional convergence towards the EU-15 average in 1993-2002.

The signs of the coefficients of the explicatory variables in our estimation results for the EU-15 countries are mostly as expected. Conditional convergence has taken place and growth in GDP per labour force has been affected positively by investment (including both private and public investment) and negatively by the growth rate of the labour force.

Public consumption is statistically significant and has had a negative impact on growth. Public consumption may introduce distortions, such as high tax rates, without providing stimuli for growth and investment. A higher inflation rate proved to be statistically significant and bad for growth, while the volatility of inflation has not been statistically significant. The effect from openness (the exports-to-GDP ratio) was positive but it did not become statistically significant even when integration dummies were omitted from the estimation. The integration dummies were shown to explain openness to a large degree.

The signs of the dummy variables for integration were also as usually expected. Membership in the customs union proved to be the most important factor in this respect, contributing positively to growth. On the other hand, the formation of the internal market has had an ambiguous effect. Wald tests for the combined effect of the integration dummies indicated that integration has

[10] For our purposes, the Europe Agreements entered into force in 1993 in Hungary and Poland, in 1995 in the Czech Republic and Slovakia, in 1997 in Slovenia and in 1998 in Estonia, Latvia and Lithuania. There were, however, some free trade arrangements already in force before these dates.

positively affected the growth rate of GDP per labour force as well as investment and total exports. Yet when inflation was included in the specifications, the Wald tests were not rejected and the integration dummies failed to have explicatory power. The evidence is therefore mixed in this regard. The way the integration dummies have been constructed here has failed to take into account transition periods from one phase of integration to the next.

We then used the same method to estimate the growth rate of GDP per labour force in the CEECs. The number of observations was relatively small and thus we refrained from performing the more complicated specifications. Still, conditional convergence towards the EU-15 was shown to have occurred. Investment has had a positive effect and public consumption has had a negative effect on growth. Inflation failed to become statistically significant although it was negative at the 15% level of significance. When inflation volatility was removed from the specification, the negative effect from inflation became statistically significant at the 5% level of significance.

The investment-to-GDP ratio in the new member states has been relatively high, although at least temporarily past its peak, which was reached in 1998. High investment rates will support growth in the CEECs. The demographic growth rates will not support growth in the long term; however, as birth rates have been quite low since transition began.

Total public expenditure is almost at the same level in the CEECs as in the EU-15 countries on average. Even though the CEECs have been lowering their tax rates, especially corporate tax rates, these countries have relatively large public sectors and are running quite large fiscal deficits. This may limit their growth potential in the future. The Baltic countries and Slovenia are better positioned in this respect.

The pooled mean-group estimation method that we used manages to explain relatively well the conditional convergence in GDP per labour force in the EU-15 area in 1960-2002. It also partially succeeds in extending the same analysis to the eight transition countries of Central and Eastern Europe that joined the EU in 2004. The more complicated specifications do not work to the same degree with the CEECs. Still, it is becoming possible to explain the convergence of the CEECs in terms of the neo-classical growth theory.

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