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INTEGRATION AND CONDITIONAL CONVERGENCE IN THE ENLARGED EU AREA

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ABSTRACT: Using pooled mean-group estimation we first analyse conditional convergence in the EU15 area in 1960-2002. Conditional convergence is well documented for the EU15 countries and deeper European integration is mostly shown to have fastened convergence. Also higher investment, lower public consumption and lower inflation have increased GDP growth. Then we apply the same method in order to estimate the conditional convergence of the new EU member countries of Central and Eastern Europe towards the average of the EU15 countries since 1993. The CEE8 countries are shown to have converged conditionally towards the EU15 countries' average level of GDP per labour force.

KEY WORDS: EU, enlargement, economic integration, economic growth, conditional convergence

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TIIVISTELMÄ: Tässä tutkimuksessa analysoidaan ensin, kuinka ehdollinen konvergenssi on edistynyt EU15-alueella vuosina 1960-2002. Ehdollista konvergenssia osoitetaan tapahtuneen, ja syvempi integraatio on enimmäkseen edistänyt sitä. Myös korkeampi investointiaste sekä pienempi julkinen kulutus ja alempi inflaatio ovat nopeuttaneet talouskasvua. Sitten käytämme samaa menetelmää (PMG, pooled mean group) analysoidaksemme kahdeksan Keski- ja Itä-Euroopan uuden EU-maan konvergenssia kohti EU15-maiden keskimääräistä BKT per työvoima -tasoa vuosina 1993-2002. KIE8-maiden osoitetaan konvergoituneen ehdollisesti kohti EU15-maiden keskiarvoa tässä suhteessa.

AVAINSANAT: EU, itälaajeneminen, taloudellinen integraatio, talouskasvu, ehdollinen konvergenssi

1 Introduction

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

Consequently, European integration should push the continent towards smaller differences in wage and price levels and in productivity. By and large, convergence in GDP per capita has taken place within the EU15 area since 1960.[1] Still, convergence has not been uniform and also periodical divergence has occurred.

Using pooled mean-group estimation we will first analyse conditional convergence in the EU15 area in 1960-2002. Then we will apply the same method to estimate the conditional convergence of the new EU countries[2] of Central and Eastern Europe (CEE8) towards the average of the EU15 countries in 1993-2002. We will focus on the effects from EU membership and deeper integration, foreign trade, and some economic policy measures (inflation and public consumption).

Our results indicate that conditional convergence has indeed taken place in the EU15 area. Also the CEE8 countries are shown to have converged conditionally towards the EU15 countries' average level of GDP per labour force.

In absolute terms the CEE8 countries are presently at about the same level of GDP per labour force in constant 1995 PPP-adjusted US dollars – the measurement we will use – as the EU15 countries were in the mid-1960s with the exception of Slovenia, which is slightly higher in this respect. The Baltic countries and Poland have lower productivity than the other CEE8 countries.

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 the capital stock (investment). Put in other words, poorer countries will tend to grow faster than richer ones and will eventually catch up with them.

Figure 1 shows GDP per labour force in the EU15 countries in 1960 in real PPP terms and average growth rates in 1960-2002. For the CEE8 countries we show GDP per labour force in 1993 for all other CEE countries except for Lithuania for which 1994 is used. There is a negative relationship between the initial level of GDP per labour force and its growth rate. Consequently, β-convergence has indeed taken place in Europe. The R^2 for the EU15 countries is 0.687, while it is 0.530 for the CEE8 countries.

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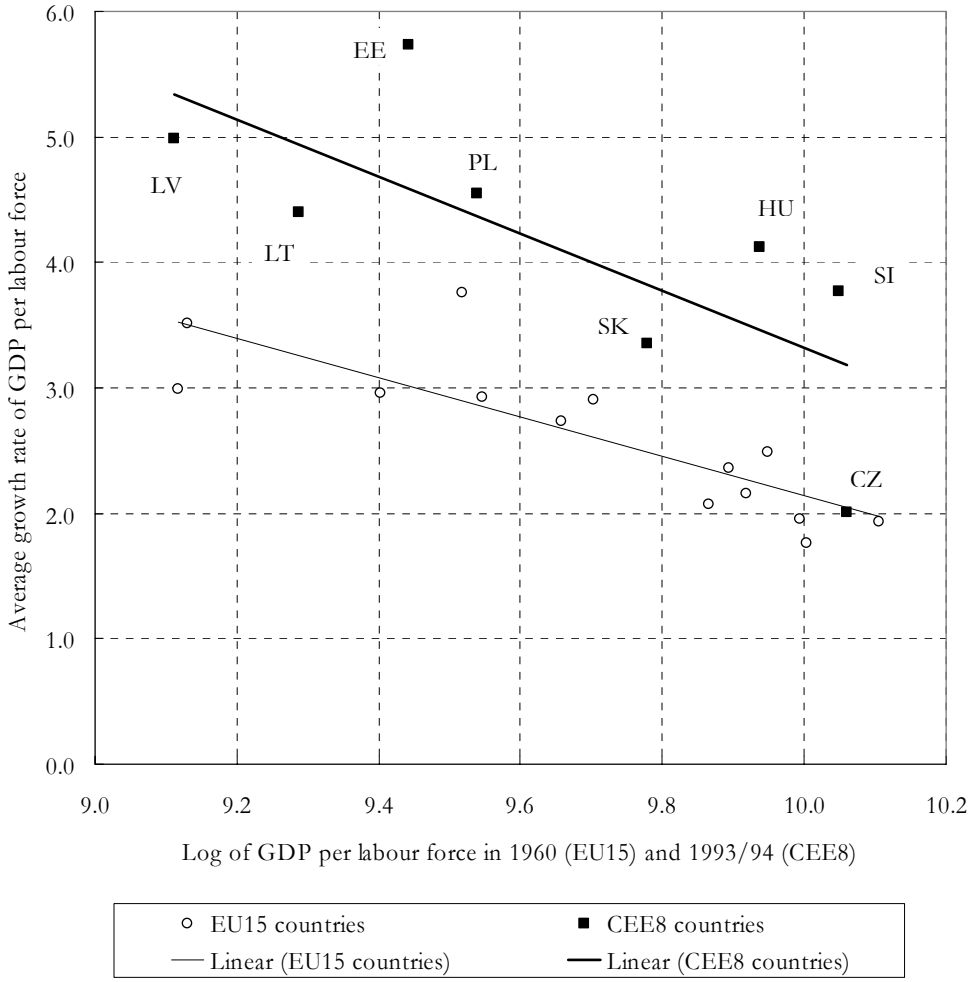
1 See e.g. Kaitila (2004).

2 The Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia. We will not include Cyprus and Malta in the analysis.

Figure 1 **EU15 countries' real GDP (PPP) per labour force in 1960 and average growth rates in 1960-2002 along with the CEE8 countries' GDP (PPP) per labour force in 1993 (1994 in Lithuania) and average growth rates up to 2002**



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

There should be no *a priori* reason to expect that either the growth performance or the logic behind the growth in the CEE countries should differ from that of the EU15 countries after the structural transition into a market economy is completed. Still, at least for the available time period, we find that the CEE8 countries have grown faster than the EU15 countries given their initial levels of GDP per labour force. The linear trend is not only located higher for the CEE8 countries, it is also slightly steeper in Figure 1.

Why is there such a difference in the trends? One obvious reason is that the CEE countries now have a much wealthier anchor, i.e. EU15, neighbouring them, something the EU15 countries did not have. The anchor has provided the CEE countries with a clear direction (judicial, political, economic and administrative).

The rapidity of structural change in administration and legislation along with the large inflows of foreign direct investment, which have introduced more modern technology and business practices, have fostered an environment which has made it possible for the CEE8 countries to grow faster than the EU15 countries have done after controlling for the initial levels of their GDP per labour force. In this sense, the CEE countries that joined the EU in 2004 have been in a much better position than the CIS countries to their east that are not EU candidate countries (see also e.g. Crafts and Kaiser, 2004).

The EU15 countries also form a very large and wealthy destination for exports. Again the EU15 countries did not have such an outside destination close to them. The United States was and remains wealthier and represents the technological edge in many fields, but it is geographically distant. Only a relatively small part of European countries' foreign trade has taken place across the Atlantic. This is in stark contrast with the importance of EU15 in CEE8 countries' foreign trade.

Also, the internal market is much deeper now than it was before (or when it did not even exist) and this helps in the catching-up process, too. These factors explain at least partly the faster growth in productivity in the CEE8 countries during 1993-2002 than what the EU15 countries experienced in 1960-2002 given their initial levels of GDP per labour force.

2 Trade, Integration and Growth: Earlier Results

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

According to Ben-David and Rahman (1996), countries that trade extensively tend to converge more than countries that do not have the same intensity of trade. Ben-David and Kimhi (2000) provide evidence that increased exports especially from poorer countries to wealthier ones are related with 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, there occurred a significant increase in trade, 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 growth. He uses nine different openness indicators which are, however, mostly available only for a part of the 1980s. The indices used are measurements of tariffs, quotas, etc. Total factor productivity growth is assumed to arise from two sources: domestic (innovation) and international (ability to adopt and use foreign innovations). The former is a function of the level of human capital, the latter is a function of a catching-up term that is the larger the poorer the country is. More open and less developed countries rely more on this latter international channel for total factor productivity growth than other countries. Also the ability to adopt foreign innovations depends on the quality of human capital however.

According to Rodríguez and 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 that they are highly correlated with other sources of poor economic performance, notably macroeconomic imbalances.

However, Wacziarg and 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 to the pre-liberalisation period. Also the investment-to-GDP ratio 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 the impact of economic integration in Europe, Ben-David (1993) argues that the liberalisation of trade between the six original EEC countries led to income convergence. Also the timing of trade reform between the EEC and EFTA countries was found to coincide closely with convergence. 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." 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 EC/EFTA membership may have had a positive effect of up to one percentage point to the growth rate of the member countries. They do not find any difference between membership in EC or 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 and Seghezza (1996) argue that the countries that were members of the European Community during 1971-90 experienced faster total factor productivity growth than other European countries such as the EFTA countries. Furthermore, the founding members of the EEC had also experienced the highest growth rates. Baldwin and Seghezza further argue that European integration affects growth via 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 and Hlouskova (2002) base their analysis on the historical convergence of the EU countries and then project it on the accession countries with data up to 1998. They argue that the neo-classical growth model "does not yet adequately describe the growth process" in the CEE countries.

3 The Model

We will construct a neo-classical aggregate growth model following Bassanini and Scarpetta (2001) who analyse economic growth and the role of technological progress, policy and institutions in 21 OECD countries in 1971-1998 using a neo-classical Solow growth model in the tradition of Mankiw *et al.* (1992).

In the standard neo-classical growth model in the tradition of Solow (1956) and others, economic growth is driven by technological progress and the accumulation of two factors of production, namely labour and capital. Technical progress is assumed to be exogenous, but sustained growth in per-capita income 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. We use a Cobb-Douglas production function:

$$Y = K^{\alpha}\left(AL\right)^{1-\alpha}, \tag{1}$$

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 partial elasticity of output with respect to physical capital.

Convergence occurs because of higher returns to investment in less developed and less capital-abundant countries and sectors relative to more developed ones. Capital investment flows to the new, less-capital-intensive countries and sectors, where returns to investment are higher, thereby raising productivity there. Another possibility is that labour migrates to the more developed countries, where wages are higher.

The basic neo-classical growth model predicts that per-capita income in a given country converges to that country's steady-state value. Also, if countries are similar in every respect except their initial capital stocks, poorer countries will grow faster than wealthier ones and catch up with these.

If we control for the determinants of the steady state, we get "conditional convergence" (see e.g. Mankiw *et al.* 1992), i.e. a relation between growth rate and 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 to the same growth rate of output and capital, but at a different steady-state income level.

Bassanini and Scarpetta (2001) find that the accumulation of physical and human capital were the main growth engines of GDP per capita (population aged 15-64) in the OECD in 1971-1998. Furthermore, R&D, a sound macroeconomic environment, trade openness and well-developed financial markets contributed to rising living standards.

The liberalisation of trade in the EU should contribute to increased growth via 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 technological diffusion.

Let us first introduce country indices i and time t in equation (1) into all other variables except α. Then 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 population growth rate, 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), which implies 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 get

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

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 get 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, openness and dummy variables reflecting EU integration among other things. We add country-specific short-term dynamics in first-differences as cyclical components of output growth (see next section for the method used). This yields us the function we will estimate:

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

where the coefficients b capture 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 the specification (6).

Despite our efforts we were unable to find evidence of human capital affecting growth in 1960-2002 in the EU15 area. This may be because the EU15 countries' income levels are relatively similar. Consequently, schooling was left out of the specification. The variable we tested was the average number of years of schooling 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 and Scarpetta (2001), and Miller and Upadhyay (2002) have, but Hamilton and Monteagudo (1998) and Benhabib and Spiegel (1994) have not. However, after the latter changed their model so that they used the average level of human capital during the whole period, not its growth rate, they did get the result that human capital affects growth positively. Islam (1995) gets very different results, both

positive and negative, as to the significance of human capital depending on the estimation method that he uses.

4 The Estimation Method and the Data

We use pooled cross-country time-series data for the fourteen EU countries[3] in 1960-2002 and the eight new EU member countries (CEE8) in 1993-2002. The method used (PMG, see below) explains both cross-country differences in growth in the short term as well as the growth performance in 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.[4]

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. However, imposing identical slope coefficients and allowing only intercepts to vary across countries might 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 n separate regressions and calculating their mean. It would assume heterogeneity in both the dynamics and the long-run equilibrium relationship. This estimator is likely to be inefficient if the number of countries in the sample is small, however.

An intermediate choice is a pooled mean-group (PMG) estimator that 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 and Scarpetta (2001), we will adopt PMG.

We use fixed effects and GLS with cross-section residual variances as weights allowing for cross-section heteroskedasticity. Following Bassanini and Scarpetta, we will assume that the policy and institutional variables only affect the equilibrium level of output, but not the steady-state growth rate. 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 in the estimations.

White heteroskedasticity-consistent standard errors and covariance will allow variances within a cross-section to differ across time. Also using fixed effects for the intercept specification and cross-section weights for weighting implies that

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[3] With Belgium and Luxembourg combined.

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

each pool will have an unrestricted intercept and that each pool equation is weighted by an estimate of the cross-section residual standard deviation.

We will use real GDP figures adjusted for purchasing power. Often GDP is divided by either the total population or the number of 15-64 year olds in the population (as in e.g. Mankiw *et al.*, 1992, and Bassanini and Scarpetta, 2001). Instead, we will divide GDP by the labour force as this is closer to the spirit of the production function than the per-capita measures are.[5]

We want to analyse as long a time period as possible in order to investigate possible effects from EU membership and integration on growth. This limits the selection of other variables, however. A time period that starts from the early 1970s would allow for more variables, but then we would have nine of the fourteen EU countries in the Union during the whole period of analysis. Also the fact that we have four non-OECD economies limits the use of OECD data.[6]

In addition to the lagged dependent variable, the right-hand side of the estimated equation includes total investment per 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 with additional variables. Public consumption (% of GDP) is a fiscal policy variable with an expected negative sign. There are also two inflation variables: consumer price inflation (%) and its 3-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.

5 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-), of the Maastricht Treaty (1993-), and the Economic and Monetary Union (1999-). See Table 1 for the dummies. The above dummies have an expected positive sign, i.e. we expect that deeper integration will increase convergence.

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 transition period of several years. For example, the forming of the EEC in 1958 initiated annual cuts in tariffs and quotas for non-agricultural goods between the six original member countries. Quotas were removed in steps between 1959 and 1962, while it took until 1968 before all tariffs had been removed (see e.g. Ben-David, 1993).

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[5] Miller and Upadhyay (2002) find more evidence of convergence of total factor productivity than of real GDP per labour force, however.

[6] The data for the EU15 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.

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

Table 1 **The first year the integration dummies get a value 1. The dummies get the value 1 also after this year.**

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
Britain	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

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.

Table 2 shows the results for unconditional convergence with the inclusion of the above dummy variables, but without the other variables referred to in Section 4 (e.g. investment or public consumption). The results indicate that convergence has taken place in the EU15 area. Also three of the five the integration dummies are statistically significant. If we sum up the coefficients of the statistically significant integration dummies we get 0.0119, which would indicate that integration has increased the speed of convergence by about one percentage point.

Integration may affect economic growth and convergence via 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 via these channels it should also affect economic growth.

Table 3 shows the results for investment. The dependent variable is the log of 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 GDP growth rate and the investment-to-GDP ratio are positive and very significant. The sum of the statistically significant integration dummies is also positive, about one per cent.

Table 2 Explaining the growth rate of GDP per labour force 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, lagged one year	-0.0420***	0.0074	-5.6934	0.0000
- EU member	-0.0058*	0.0034	-1.7041	0.0889
- Member of Customs Union	0.0088***	0.0027	3.2237	0.0013
- Member of Internal Market	0.0089***	0.0022	4.0236	0.0001
- Member of Maastricht Treaty	0.0031	0.0027	1.1241	0.2614
- Member of EMU	-0.0001	0.0025	-0.0454	0.9638
- Unified Germany	-0.0226**	0.0119	-1.8982	0.0582
- 1960-72	0.0141***	0.0030	4.6436	0.0000
Weighted Statistics				
R-squared	0.4211	**Mean dependent var**		0.0298
Adjusted R-squared	0.3996	**S.D. dependent var**		0.0302
S.E. of regression	0.0234	**Sum squared resid**		0.3096
Log likelihood	1457.1130	**F-statistic**		19.6031
Durbin-Watson stat	1.7344	**Prob(F-statistic)**		0.0000

Note: * = significant at 10 per cent, ** = significant at 5 per cent, *** = significant at 1 per cent.

Table 3 Explaining investment-to-GDP ratio with the integration dummies

Dependent Variable: Log of total investment per GDP				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Change in the log of GDP per labour force, lagged one year	0.5166***	0.0941	5.4897	0.0000
Lagged dependent variable	0.8492***	0.0171	49.742	0.0000
- EU member	0.0114	0.0073	1.5658	0.1180
- Customs Union (1968-)	-0.0037	0.0057	-0.6593	0.5100
- Internal Market (1987-)	0.0190***	0.0042	4.4824	0.0000
- Maastricht Treaty (1993-)	-0.0094*	0.0048	-1.9593	0.0506
- EMU member	0.0014	0.0050	0.2739	0.7843
- Unified Germany	0.0050	0.0094	0.5343	0.5933
- 1960-72	0.0227***	0.0050	4.5443	0.0000
Weighted Statistics				
R-squared	0.9948	**Mean dependent var**		-1.8392
Adjusted R-squared	0.9946	**S.D. dependent var**		0.6546
S.E. of regression	0.0479	**Sum squared resid**		1.2659
Log likelihood	1007.4690	**F-statistic**		4832.9940
Durbin-Watson stat	1.66190	**Prob(F-statistic)**		0.0000

Note: * = significant at 10 per cent, ** = significant at 5 per cent, *** = significant at 1 per cent.

Exports are likely to increase as a result of integration and may 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 EU and EMU are significant at least at the 5 per cent level of significance. Internal market had a negative, although relatively small, impact on the exports-to-GDP ratio here. The sum of the coefficients of the statistically significant integration

dummies is about 0.08, which can be interpreted as an eight per cent increase in the exports-to-GDP ratio due to EU integration.

Table 4 Explaining exports with the integration dummies for the EU15 countries

Dependent Variable: Log of exports-to-GDP ratio				
Variable	**Coefficient**	**Standard error**	**t-Statistic**	**Prob.**
- Lagged dependent variable	0.8988***	0.0168	53.4154	0.0000
- EU member	-0.0161	0.0099	-1.6306	0.1035
- Member of Customs Union	0.0567***	0.0086	6.6031	0.0000
- Member of Internal Market	-0.0183**	0.0079	-2.3144	0.0210
- Member of Maastricht Treaty	0.0422***	0.0080	5.2700	0.0000
- Member of EMU	0.0046	0.0104	0.4433	0.6578
Weighted Statistics				
R-squared	0.9847	**Mean dependent var**		-1.6663
Adjusted R-squared	0.9842	**S.D. dependent var**		0.5732
S.E. of regression	0.0720	**Sum squared resid**		2.9475
Log likelihood	764.8374	**F-statistic**		1926.3740
Durbin-Watson stat	1.8241	**Prob(F-statistic)**		0.0000

Note: ** = significant at 5 per cent, *** = significant at 1 per cent.

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 EFTA or global tariff-cutting in the context of GATT, or periods of transition in the liberalisation of trade.

6 Estimation Results: Conditional Convergence in the EU15 Area

Our estimation results for growth and conditional convergence in the EU15 countries in 1960-2002 are shown in Table 5. The signs of the coefficients are mostly as expected. The lagged dependent variable always gets a negative and significant coefficient indicating conditional convergence. The investment rate (including both private and public investment) is always significant and positive and the growth rate of the labour force is always significant and negative.

When included in the specifications, public consumption is significant and has a negative impact on growth. Also Barro (1991) 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. We did not separate public investment from private investment because of lack of data.

In our estimations, higher inflation rates prove to be bad for growth while their volatility has been insignificant in the EU15 area. For example Fischer (1993) in his study of developing countries 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 effect from openness was positive but did not become significant even when the integration dummies were dropped from the estimations.

Table 5 Estimation results for conditional convergence of the EU15 countries

Dependent Variable: Change in the log of GDP per labour force								
Variable	**Specification**							
	Basic specification	**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, lagged one year	-0.0304*** (-4.2336)	-0.0158*** (-2.7555)	-0.0341*** (-7.6625)	-0.0196*** (-3.4718)	-0.0279*** (-3.7493)	-0.0221*** (-4.1199)	-0.0250*** (-4.3331)	-0.0271*** (-5.2440)
- Log of total investment per GDP	0.0225*** (3.1241)	0.0274*** (4.1751)	0.0212*** (3.2337)	0.0250*** (3.9381)	0.0225*** (3.2176)	0.0219*** (3.1739)	0.0269*** (4.1769)	0.0268*** (4.1550)
- % growth rate of labour force	-0.0068*** (-9.9834)	-0.0070*** (-9.0281)	-0.0063*** (-12.3722)	-0.0062*** (-10.8083)	-0.0068*** (-10.0844)	-0.0068*** (-9.7235)	-0.0064*** (-10.6705)	-0.0060*** (-8.9706)
Additional explanatory variables								
- Log of public consumption (% of GDP)	..	-0.0256*** (-4.4919)	..	-0.0278*** (-4.7356)	..	..	-0.0307*** (-4.6420)	-0.0274*** (-4.3462)
- Consumer price inflation, %	..	..	-0.1663*** (-6.2080)	-0.1367*** (-5.3405)	..	..	-0.1350*** (-5.6327)	-0.1149*** (-5.2508)
- Standard deviation in CPI, 3-year centred	..	..	0.0479 (0.4609)	-0.0006 (-0.0065)	..	..	0.0413 (0.4468)	0.0843 (0.9620)
- Log of exports (% of GDP)	..	..	..	..	0.0066 (1.2525)	0.0073 (1.4362)	0.0097 (1.6353)	0.0092 (1.6232)
Dummy variables								
- EU member	-0.0053* (-1.7423)	insign.	insign.	insign.	insign.	..	insign.	..
- Customs Union (1968-)	0.0093*** (3.7214)	0.0055*** (2.9469)	0.0065*** (3.0435)	0.0068*** (3.2580)	0.0046** (2.4258)	..	0.0044** (2.1456)	..
- Internal Market (1987-)	0.0041** (2.0819)	insign.	-0.0060*** (-2.8705)	-0.0070*** (-3.5588)	0.0040** (2.3220)	..	insign.	..
- Maastricht Treaty (1993-)	insign.	insign.	insign.	insign.	-0.0030* (-1.8542)	..	-0.0064*** (-3.7980)	..
- EMU	insign.	insign.	insign.	insign.	insign.	..	insign.	..
- Unified Germany	-0.0058* (-1.7646)	insign.	insign.	insign.	insign.	insign.	insign.	-0.0069** (-2.1539)
- 1960-72	0.0101*** (3.4010)	0.0067*** (2.6940)	insign.	insign.	0.0117*** (4.0589)	0.0114*** (4.5067)	insign.	insign.
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

Note: t-statistics in parenthesis; * = significant at 10 per cent, ** = significant at 5 per cent, *** = significant at 1 per cent; insign. = statistically not significant.

Dummy variables: EU (=1 if EU member), Customs union (1968 onward if EU member), Internal market (1987 onward if EU member), Maastricht (1993 onward if EU member), EMU (=1 if EMU member), Unified Germany (1991 onward for Germany), 1960-72 (for all countries).

The dummy variables for integration were also usually as expected. Membership in the customs union proved to be the most important in this respect contributing positively to growth. On the other hand, the forming of the internal

market had an ambiguous effect. This does not amount to very substantial evidence of the benefits of EU integration for 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 convergence in two specifications. Also the dummy for the pre-first-oil-shock years is positive in four specifications. Otherwise these dummies were insignificant.

The EU and EMU dummies did not become positive and significant in the estimation. 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 the dummy did not turn out to be 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. If the institutional setting is good structural funds do enhance growth, however. This is important given that corruption is a major problem in many of the new member countries and they are beneficiaries of structural funds.

7 Estimation Results: Convergence of the CEE8 Countries

Next we will use PMG estimation for the speed of convergence of the CEE8 countries towards the average GDP per labour force in the EU15 countries in 1993-2002. First, Table 6 shows estimation results for the *un*conditional convergence of the CEE8 countries towards the EU15 countries. As the lagged explanatory variable we have used GDP per labour force in each CEE8 country divided by the average GDP per labour force in the EU15 countries. The results indicate that unconditional convergence has indeed occurred.

Table 6 Unconditional convergence

Dependent Variable: Change in the log of GDP per labour force				
Variable	**Coefficient**	**Std. error**	**t-Statistic**	**Prob.**
Log of GDP per labour force, EU15 = 100, (lagged one year)	-0.0844***	0.0182	-4.6444	0.0000
Weighted Statistics				
R-squared	0.7197	**Mean dependent var**		0.0559
Adjusted R-squared	0.6841	**S.D. dependent var**		0.0450
S.E. of regression	0.0253	**Sum squared resid**		0.0402
Log likelihood	182.8995	**F-statistic**		20.2176
Durbin-Watson stat	1.5674	**Prob(F-statistic)**		0.0000

Note: *** = significant at 1 per cent.

Table 7 shows the estimation results for the conditional convergence of the CEE8 countries towards the average GDP per labour force in the EU15 countries in 1993-2002. On right-hand side, we use a variable that is a ratio of the GDP per labour force in the CEE8 country and the GDP per labour force in the EU15 countries with the latter set equal to 100.

The number of different specifications is smaller than above for the EU15 countries. 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, with public consumption and with inflation included, the results were more reasonable, and these results we report below.

Table 7 Estimation results for conditional convergence of the CEE8 countries towards the average of EU15 countries

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, EU15 = 100, lagged one year	-0.1758*** (-6.3027)	-0.6252*** (-14.6080)	-0.1742** (-2.4910)
- Log of total investment per GDP	0.0507*** (2.9517)	0.1619*** (5.3390)	-0.0534*** (-3.0429)
- % growth rate of labour force	-0.0030* (-1.9613)	-0.0031* (-2.3519)	-0.0038 (-1.3439)
- Log of public consumption (% of GDP)	..	-0.2848*** (-9.7811)	..
- Consumer price inflation, %	..	..	-0.1205 (-1.5984)
- Standard deviation in CPI, 3-year centred	..	..	-0.3274 (-1.5284)
Dummy variables			
- Europe Agreements	0.0119*** (5.5169)	0.0208*** (8.2035)	insign.
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

Note: t-statistics in parenthesis; * = significant at 10 per cent, ** = significant at 5 per cent, *** = significant at 1 per cent; insign. = statistically not significant.

The lagged explanatory variable is negative and statistically significant implying conditional convergence of the CEE8 countries towards the average of the EU15 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.[7] These other explanatory variables also prove to be significant and of the expected sign, i.e. investment has had a positive effect on convergence, an increase in the labour force has had a negative effect and the dummy variable for the Europe Agreements has had a positive effect on convergence. Public consumption had a significant negative effect on growth. Inflation and its volatility did not become statistically significant

[7] 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.

but at least their signs were as expected. They were both significant at 15 per cent, however. Removing the standard deviation of inflation had the result that all the other variables became very significant and of the expected sign.

Wagner and 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 CEE countries. Even with some obvious deficiencies, we may conclude on the basis of the results presented in Table 5, however, that the growth model does seem to work for the CEE8 countries by now. Still, due to the limited number of years available, it does not work as well as for the EU15 countries and the number of specifications that we were able to use was smaller. However, the CEE8 are becoming "normal" market economies in the sense that growth theory does manage to reflect the developments there.

8 Conclusions

CEE8 countries are less wealthy than EU15 countries. As predicted by the basic neo-classical theory of convergence, 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 transition. The prospective EU membership has accelerated much-needed changes in administration, legislation and bureaucracy and it has also led to an increase in trade and foreign direct investment inflows which have introduced more modern technology and business practices.

We first analysed conditional convergence within the EU15 area in 1960-2002 and then made a similar analysis for the CEE8 countries in the 1993-2002 period using a pooled mean-group (PMG) estimator, which allows for heterogeneity in the short-term coefficients, but assumes homogeneity in the long-term ones.

The signs are mostly as expected in our estimation results for the EU15 countries. Conditional convergence has taken place, and it is explained by the investment rate (including both private and public investment), which is always significant and positive, and the growth rate of the labour force, which is always significant and negative.

Public consumption is statistically significant and has 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 inflation volatility was insignificant. The effect from openness (the exports-to-GDP ratio) was positive but did not become 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 usually as expected. Membership in the customs union proved to be the most important in this respect contributing positively to growth. On the other hand, the forming of the internal market had an ambiguous effect. This does not amount to very substantial evidence of the benefits from EU integration. The way the integration dummies have been constructed here fails to take into account transition periods from one phase of integration to the next.

We then used the same method and variables to evaluate the convergence performance of the CEE8 countries towards the average GDP per labour force in the EU15 area in 1993-2002. The number of observations was relatively small and it refrained us from performing the more complicated specifications. Still, conditional convergence was shown to have occurred. Investment had a positive and significant effect on convergence, and the growth rate of the labour force was negative and significant as expected. Public spending had a significant and negative impact on growth. Inflation failed to become statistically significant although it was negative at the 15 per cent level of significance.

The investment-to-GDP ratio in the new member countries has been relatively high, although at least temporarily past its peak that was reached in 1998. High investment rates will support growth in the CEE8 countries. The demographic growth rates will not support growth in the long term, however, as birth rates have been quite low since transition began.

Public spending is almost at the same level in the CEE8 countries as in the EU15 countries on average. Even though the CEE countries have been lowering their tax rates, especially for firms, especially the Central European countries 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 (PMG) estimation method that we used manages to explain relatively well conditional convergence in the EU15 area in 1960-2002. It also succeeds partially 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. Still, it is becoming possible to explain the convergence of the CEE8 countries in terms of the neoclassical growth theory.

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